Ab initio study of the CO-N2 complex: a new highly accurate intermolecular potential energy surface and rovibrational spectrum

A new, highly accurate ab initio ground-state intermolecular potential-energy surface (IPES) for the CO-N2 complex is presented. Thousands of interaction energies calculated with the CCSD(T) method and Dunning's aug-cc-pVQZ basis set extended with midbond functions were fitted to an analytical function. The global minimum of the potential is characterized by an almost T-shaped structure and has an energy of -118.2 cm\(^{-1}\). The symmetry-adapted Lanczos algorithm was used to compute rovibrational energies (up to J = 20) on the new IPES. The RMSE with respect to experiment was found to be on the order of 0.038 cm\(^{-1}\) which confirms the very high accuracy of the potential. This level of agreement is among the best reported in the literature for weakly bound systems and considerably improves on those of previously published potentials.

**General information**

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Nicolaus Copernicus University in Torun, Missouri University of Science and Technology, Queen's University Kingston, University of Santiago de Compostela
Authors: Cybulski, H. (Ekstern), Henriksen, C. (Intern), Dawes, R. (Ekstern), Wang, X. (Ekstern), Bora, N. (Ekstern), Avila, G. (Ekstern), Carrington, T. (Ekstern), Fernández, B. (Ekstern)
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- BFI (2016): BFI-level 2
- Scopus rating (2016): CiteScore 4.06 SJR 1.678 SNIP 1.117
- Web of Science (2016): Indexed yes
- BFI (2015): BFI-level 2
- Scopus rating (2015): SJR 1.771 SNIP 1.244 CiteScore 4.45
- Web of Science (2015): Indexed yes
- BFI (2014): BFI-level 2
- Scopus rating (2014): SJR 1.772 SNIP 1.253 CiteScore 4.29
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 2
- Scopus rating (2013): SJR 1.715 SNIP 1.216 CiteScore 4.05
- ISI indexed (2013): ISI indexed yes
- Web of Science (2013): Indexed yes
- BFI (2012): BFI-level 2
- Scopus rating (2012): SJR 1.916 SNIP 1.184 CiteScore 3.67
- ISI indexed (2012): ISI indexed yes
- Web of Science (2012): Indexed yes
- BFI (2011): BFI-level 2
- Scopus rating (2011): SJR 1.697 SNIP 1.203 CiteScore 3.6
- ISI indexed (2011): ISI indexed yes
- Web of Science (2011): Indexed yes
- BFI (2010): BFI-level 2
- Scopus rating (2010): SJR 1.802 SNIP 1.196
- Web of Science (2010): Indexed yes
- BFI (2009): BFI-level 2
- Scopus rating (2009): SJR 2.127 SNIP 1.369
- Web of Science (2009): Indexed yes
Designing interactively with elastic splines
We present an algorithm for designing interactively with $C^1$ elastic splines. The idea is to design the elastic spline using a $C^1$ cubic polynomial spline where each polynomial segment is so close to satisfying the Euler-Lagrange equation for elastic curves that the visual difference becomes negligible. Using a database of cubic Bézier curves we are able to interactively modify the cubic spline such that it remains visually close to an elastic spline.

General information
State: Accepted/In press
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Image Analysis & Computer Graphics
Authors: Brander, D. (Intern), Bærentzen, J. A. (Intern), Fisker, A. (Intern), Gravesen, J. (Intern)
Number of pages: 10
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Publication information
Journal: Computer-Aided Geometric Design
ISSN (Print): 0167-8396
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.55 SJR 0.753 SNIP 1.126
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.961 SNIP 1.618 CiteScore 1.71
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.404 SNIP 2.05 CiteScore 2.09
BFI (2013): BFI-level 2
Frame properties of systems arising via iterated actions of operators

Motivated by recent progress in dynamical sampling we prove that every frame which is norm-bounded below can be represented as a finite union of sequences. View the MathML source for some bounded operators $T_j$ and elements $\varphi_j$ in the underlying Hilbert space. The result is optimal, in the sense that it turns out to be problematic to replace the collection of generators $\varphi_1, \ldots, \varphi_J$ by a singleton: indeed, for linearly independent frames we prove that we can represent the frame in terms of just one system. View the MathML source but unfortunately this representation often forces the operator $T$ to be unbounded. Several examples illustrate the connection of the results to typical frames like Gabor frames and wavelet frames, as well as generic constructions in arbitrary separable Hilbert spaces.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Christensen, O. (Intern), Hasannasabjaldehbakhani, M. (Intern)
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Journal: Applied and Computational Harmonic Analysis
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BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.73 SJR 1.594 SNIP 1.781
Let $F$ be any field and $A_1, \ldots, A_m$ be finite subsets of $F$. We determine the maximum number of common zeroes a linearly independent family of $r$ polynomials of degree at most $d$ of $F[x_1, \ldots, x_m]$ can have in $A_1 \times \ldots \times A_m$. In the case when $F$ is a finite field, our results resolve the problem of determining the generalized Hamming weights of affine Cartesian codes. This is a generalization of the work of Heijnen and Pellikaan where these were determined for the generalized Reed–Muller codes. Finally, we determine the duals of affine Cartesian codes and compute their generalized Hamming weights as well.
Geometric singular perturbation analysis of systems with friction

This thesis is concerned with the application of geometric singular perturbation theory to mechanical systems with friction. The mathematical background on geometric singular perturbation theory, on the blow-up method, on non-smooth dynamical systems and on regularization is presented. Thereafter, two mechanical problems with two different formulations of the friction force are introduced and analysed. The first mechanical problem is a one-dimensional spring-block model describing earthquake faulting. The dynamics of earthquakes is naturally a multiple timescale problem: the timescale of earthquake ruptures is very short, when compared to the time interval between two consecutive ruptures. We identify a small parameter \( \varepsilon \) that describes the separation between the timescales, so that \( \varepsilon = 0 \) idealises the complete timescale separation. Earthquake faulting problems also have multiple spatial scales. The action of friction is generally explained as the loss and restoration of linkages between the surface asperities at the molecular scale. However, the consequences of friction are noticeable at much larger scales, like hundreds of kilometers. By using geometric singular perturbation theory and the blow-up method, we provide a detailed description of the periodicity of the earthquake episodes. In particular, we show that attracting limit cycles arise from a degenerate Hopf bifurcation, whose degeneracy is due to an underlying Hamiltonian structure that leads to large amplitude oscillations. We use a Poincaré compactification to study the system near infinity. At infinity, the critical manifold loses hyperbolicity with an exponential rate. We use an adaptation of the blow-up method to recover the hyperbolicity. This enables the identification of a new attracting manifold, that organises the dynamics at infinity for \( \varepsilon = 0 \). This in turn leads to the formulation of a conjecture on the behaviour of the limit cycles as the timescale separation increases for \( 0 < \varepsilon \). We illustrate our findings with numerics, and outline the proof of the conjecture. We also discuss how our results can be used to study a similar class of problems. The second mechanical problem is a friction oscillator subject to stiction. The vector field of this discontinuous model does not follow the Filippov convention, and the concept of Filippov solutions cannot be used. Furthermore, some Carathéodory solutions are unphysical. Therefore, we introduce the concept of stiction solutions: these are the Carathéodory solutions that are physically relevant, i.e. the ones that follow the stiction law. However, we find that some of the stiction solutions are forward non-unique in subregions of the slip onset. We call these solutions singular, in contrast to the regular stiction solutions that are forward unique. In order to further the understanding of the non-unique dynamics, we introduce a regularization of the model. This gives a singularly perturbed problem that captures the main features of the original discontinuous problem. We identify a repelling slow manifold that separates the forward slipping to forward sticking solutions, leading to a high sensitivity to the initial conditions. On this slow manifold we find canard trajectories, that have the physical interpretation of delaying the slip onset. We show numerically that the regularized problem has a family of periodic orbits interacting with the canards. We observe that this family is unstable of saddle type and that it connects, in the rigid body limit, the two regular, slip-stick branches of the discontinuous problem, that were otherwise disconnected.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Bossolini, E. (Intern), Brøns, M. (Intern), Kristiansen, K. U. (Intern)
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Main Research Area: Technical/natural sciences
Electronic versions: phd454_Bossolini_E.pdf

Relations
Projects:
Monge surfaces and planar geodesic foliations
A Monge surface is a surface obtained by sweeping a generating plane curve along a trajectory that is orthogonal to the moving plane containing the curve. Locally, they are characterized as being foliated by a family of planar geodesic lines of curvature. We call surfaces with the latter property PGF surfaces, and investigate the global properties of these two naturally defined objects. The only compact orientable PGF surfaces are tori; these are globally Monge surfaces, and they have a simple characterization in terms of the directrix. We show how to produce many examples of Monge tori and Klein bottles, as well as tori that do not have a closed directrix
On the Björling problem for Willmore surfaces

We solve the analogue of Björling's problem for Willmore surfaces via a harmonic map representation. For the umbilic-free case the problem and solution are as follows: given a real analytic curve $y_0$ in $S^3$, together with the prescription of the values of the surface normal and the dual Willmore surface along the curve, lifted to
the light cone in Minkowski 5-space $\mathbb{R}^5_1$, we prove, using isotropic harmonic maps, that there exists a unique pair of dual Willmore surfaces $y$ and $\hat{y}$ satisfying the given values along the curve. We give explicit formulae for the generalized Weierstrass data for the surface pair. For the three dimensional target, we use the solution to explicitly describe the Weierstrass data, in terms of geometric quantities, for all equivariant Willmore surfaces. For the case that the surface has umbilic points, we apply the more general half-isotropic harmonic maps introduced by Héléin to derive a solution: in this case the map $\hat{y}$ is not necessarily the dual surface, and the additional data of a derivative of $\hat{y}$ must be prescribed. This solution is generalized to higher codimensions.

General information
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Organisations: Department of Applied Mathematics and Computer Science , Mathematics , Tongji University
Authors: Brander, D. (Intern), Wang, P. (Ekstern)
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.45 SJR 3.036 SNIP 1.773
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 3.321 SNIP 2.175 CiteScore 1.38
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 3.369 SNIP 2.316 CiteScore 1.44
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 3.685 SNIP 2.23 CiteScore 1.35
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.554 SNIP 1.998 CiteScore 1.43
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 3.241 SNIP 1.772 CiteScore 1.44
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 3.019 SNIP 1.998
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.479 SNIP 1.87
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.817 SNIP 2.079
Scopus rating (2006): SJR 3.164 SNIP 1.341
Scopus rating (2005): SJR 2.413 SNIP 1.288
Scopus rating (2004): SJR 2.14 SNIP 1.761
Scopus rating (2003): SJR 2.108 SNIP 1.378
Scopus rating (2002): SJR 2.348 SNIP 1.33
Scopus rating (2001): SJR 2.786 SNIP 1.538
Scopus rating (2000): SJR 3.078 SNIP 1.597
Scopus rating (1999): SJR 3.449 SNIP 1.779
Original language: English
Electronic versions:
Topological bifurcations of coherent structures and dimension reduction of plasma convection models

Research in fusion energy seeks to develop a green, safe, and sustainable energy source. Nuclear fusion can be achieved by heating a hydrogen gas to temperatures of millions of kelvin. At fusion temperatures, some or all the electrons leave the atomic nucleus of the hydrogen atom. This results in an overall neutral gaseous state of negatively charged free electrons and positively charged ions. This state of matter is called plasma. To achieve and maintain fusion temperatures, the plasma must avoid direct contact with any solid material. Since the plasma consists of charged particles, it can be confined with an appropriate configuration of strong magnetic fields. Toroidal magnetic confinement devices, such as the tokamak, are the most promising designs for a fusion reactor. A tokamak can operate in two distinct modes of operation. These are the low confinement mode (L-mode) and the high confinement mode (H-mode). H-mode is the preferred operating mode for a fusion reactor. The transition from L-mode to H-mode is called the L–H transition. The confinement properties of a plasma are largely determined by the physics near the edge of the confinement region of the plasma. The edge transport of a magnetically confined plasma is predominantly caused by recurring bursts of coherent plasma structures. These structures are in L-mode called blob filaments (blobs) and in H-mode categorized into edge localized mode (ELM) filaments or inter-ELM filaments. To improve the plasma confinement, it is important to understand the evolution of these structures. We apply a dynamical systems approach to quantitatively describe the time evolution of these structures. Three state variables describe blobs in a plasma convection model. A critical point of a variable defines a feature point where that variable is significant. For a range of Rayleigh and Prandtl numbers, we analyze the bifurcations of the critical points of the three variables with time as the main bifurcation parameter. Plasma simulations can be computationally demanding. We apply a Galerkin method to approximate a plasma convection model with a reduced model. The time evolution of the energies of the pressure profile, the turbulent flow, and the zonal flow capture the dynamic behavior of the convection model. Rayleigh decomposition splits the variables of the model into averaged variables and fluctuation variables. We approximate the fluctuation variables by truncated Fourier series and project the equations onto the Fourier basis functions. This results in a computationally simpler model with the spatial dimension reduced by one. Bifurcation diagrams for the energies show consistency between the bifurcation structures of the full and the reduced model.

Finally, we utilize a data-driven modeling approach called SINDy to identify a reduced model from simulation data of a convection model. The reduced model reveals a predator-prey relationship between the zonal flow energy and the turbulent energy. The analytically derived bifurcation diagram for the reduced model has the same structure as the data-based bifurcation diagram for the full model.
Giulietti–Korchmáros maximal curve, Weierstrass points, Weierstrass semigroup
Robotic system and method for manufacturing of objects
The present disclosure relates to a method and a system for manufacturing a mould (17) for creation of complex objects, such as concrete objects, by controlling and moving two end effectors (1) of a robotic system, the two end effectors (1) having a flexible cutting element (3) attached to and extending between the two end effectors (1), the method comprising the steps of: defining at least one surface (8) representing the inner surface of the mould (17); dividing the surface (8) into a number of segments represented by planar curves (9, 11, 12) on the surface (8); for each planar curve, calculating at least one elastic curve representing the planar curve; for each calculated elastic curve, calculating a set of data corresponding to placement and direction of the two end effectors (1) for configuring the flexible cutting element to a shape corresponding to the calculated elastic curve; sequentially positioning the end effectors (1) according to each set of data.

Fast computation of the roots of polynomials over the ring of power series
We give an algorithm for computing all roots of polynomials over a univariate power series ring over an exact field K. More precisely, given a precision d, and a polynomial Q whose coefficients are power series in x, the algorithm computes a representation of all power series f(x) such that Q(f(x)) = 0 mod x^d. The algorithm works unconditionally, in particular also with multiple roots, where Newton iteration fails. Our main motivation comes from coding theory where instances of this problem arise and multiple roots must be handled. The cost bound for our algorithm matches the worst-case input and output size d deg(Q), up to logarithmic factors. This improves upon previous algorithms which were quadratic in at least one of d and deg(Q). Our algorithm is a refinement of a divide & conquer algorithm by Alekhnovich (2005), where the cost of recursive steps is better controlled via the computation of a factor of Q which has a smaller degree while preserving the roots.
Popov form computation for matrices of Ore polynomials

Let $F[[z, s, d]]$ be a ring of Ore polynomials over a field. We give a new deterministic algorithm for computing the Popov form $P$ of a non-singular matrix $A \in F[[z, s, d]]^{n \times n}$. Our main focus is to ensure controlled growth in the size of coefficients from $F$ in the case $F = k(z)$, and even $k = \mathbb{Q}$. Our algorithms are based on constructing from $A$ a linear system over $F$ and performing a structured fraction-free Gaussian elimination. The algorithm is output sensitive, with a cost that depends on the orthogonality defect of the input matrix: the sum of the row degrees in $A$ minus the sum of the row degrees in $P$. The resulting bit-complexity for the differential and shift polynomial case over $\mathbb{Q}(z)$ improves upon the previous best.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Waterloo
Authors: Khochtali, M. (Ekstern), Né Nielsen, J. R. (Intern), Storjohann, A. (Ekstern)
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DOIs: 10.1145/3087604.3087650
Source: Scopus
Source-ID: 85027692843
Publication: Research - peer-review › Article in proceedings – Annual report year: 2017

A complete characterization of Galois subfields of the generalized Giulietti–Korchmáros function field

We give a complete characterization of all Galois subfields of the generalized Giulietti–Korchmáros function fields $C_n/F_{q^{2n}}$ for $n \geq 5$. Calculating the genera of the corresponding fixed fields, we find new additions to the list of known genera of maximal function fields.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Bogazici University
Authors: Anbar, N. (Intern), Bassa, A. (Ekstern), Beelen, P. (Intern)
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Main Research Area: Technical/natural sciences

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Journal: Finite Fields and Their Applications
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Ratings: BFI (2018): BFI-level 2
Algorithms for Zero-Dimensional Ideals Using Linear Recurrent Sequences

Inspired by Faugère and Mou’s sparse FGLM algorithm, we show how using linear recurrent multi-dimensional sequences can allow one to perform operations such as the primary decomposition of an ideal, by computing of the annihilator of one or several such sequences.
A modular interpretation of various cubic towers
In this article we give a Drinfeld modular interpretation for various towers of function fields meeting Zink's bound.
A new tower with good p-rank meeting Zink's bound

In this article we investigate the asymptotic p-rank of a new tower of function fields defined over cubic finite fields. Its limit meets Zink's bound, but the new feature of this tower is that its asymptotic p-rank for small cubic finite fields is much smaller than that of other cubic towers for which the asymptotic p-rank is known. This is of independent interest, but also makes this new tower more interesting for theoretical applications in cryptography.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Anbar Meidl, N. (Intern), Beelen, P. (Intern), Nguyen, N. (Intern)
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Main Research Area: Technical/natural sciences

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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
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Scopus rating (2016): CiteScore 0.49 SJR 0.703 SNIP 0.913
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.758 SNIP 1.111 CiteScore 0.54
A Note on a Tower by Bassa, Garcia and Stichtenoth

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Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Anbar Meidl, N. (Intern), Beelen, P. (Intern)
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Volume: 57
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A Numerical Framework for Sobolev Metrics on the Space of Curves

Statistical shape analysis can be done in a Riemannian framework by endowing the set of shapes with a Riemannian metric. Sobolev metrics of order two and higher on shape spaces of parametrized or unparametrized curves have several desirable properties not present in lower order metrics, but their discretization is still largely missing. In this paper, we present algorithms to numerically solve the geodesic initial and boundary value problems for these metrics. The combination of these algorithms enables one to compute Karcher means in a Riemannian gradient-based optimization scheme and perform principal component analysis and clustering. Our framework is sufficiently general to be applicable to a wide class of metrics. We demonstrate the effectiveness of our approach by analyzing a collection of shapes representing HeLa cell nuclei.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Florida State University, Brunel University, University of Freiburg
Authors: Bauer, M. (Ekstern), Bruveris, M. (Ekstern), Harms, P. (Ekstern), Møller-Andersen, J. (Intern)
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Journal: SIAM Journal on Imaging Sciences
Volume: 10
Issue number: 1
ISSN (Print): 1936-4954
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.5 SJR 1.624 SNIP 1.789
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.812 SNIP 2.258 CiteScore 3.64
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.481 SNIP 2.478 CiteScore 3.28
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.863 SNIP 3.523 CiteScore 5.05
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.174 SNIP 3.985 CiteScore 4.26
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Bent and bent(4) spectra of Boolean functions over finite fields

For $c$ is an element of $F(2)^n$, a $c$-bent4 function $f$ from the finite field $F(2)^n$ to $F-2$ is a function with a flat spectrum with respect to the unitary transform $V-f(c)$, which is designed to describe the component functions of modified planar functions.

For $c = 0$ the transform $V-f(c)$ reduces to the conventional Walsh transform, and hence a 0-bent4 function is bent. In this article we generalize the concept of partially bent functions to the transforms $V-f(c)$. We show that every quadratic function is partially bent, and hence it is plateaued with respect to any of the transforms $V-f(c)$. In detail we analyse two quadratic monomials. The first has values as small as possible in its spectra with respect to all transforms $V-f(c)$, and the second has a flat spectrum for a large number of $c$. Moreover, we show that every quadratic function is $c$-bent4 for at least three distinct $c$. In the last part we analyse a cubic monomial. We show that it is $c$-bent(4) only for $c = 1$, the function is then called negabent, which shows that non-quadratic functions exhibit a different behaviour. (C) 2017 Elsevier Inc. All rights reserved.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Otto-von-Guericke Universität Magdeburg
Authors: Anbar Meidl, N. (Intern), Meidl, W. (Ekstern)
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.12 SJR 0.95 SNIP 1.31
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.003 SNIP 1.388 CiteScore 1.29
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.027 SNIP 1.579 CiteScore 1.17
Web of Science (2014): Indexed yes
In this paper, we present a way of extending the blowup method, in the formulation of Krupa and Szmolyan, to flat slow manifolds that lose hyperbolicity beyond any algebraic order. Although these manifolds have infinite co-dimensions, they do appear naturally in certain settings; for example, in (a) the regularization of piecewise smooth systems by tanh, (b) a particular aircraft landing dynamics model, and finally (c) in a model of earthquake faulting. We demonstrate the approach using a simple model system and the examples (a) and (b).

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Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Kristiansen, K. U. (Intern)
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**Publication information**

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Volume: 30
Issue number: 5
B-Spline Approximations of the Gaussian, their Gabor Frame Properties, and Approximately Dual Frames

We prove that Gabor systems generated by certain scaled B-splines can be considered as perturbations of the Gabor systems generated by the Gaussian, with a deviation within an arbitrary small tolerance whenever the order $N$ of the B-spline is sufficiently large. As a consequence we show that for any choice of translation/modulation parameters (Formula presented.) with (Formula presented.), the scaled version of (Formula presented.) generates Gabor frames for $N$ sufficiently large. Considering the Gabor frame decomposition generated by the Gaussian and a dual window, the results lead to estimates of the deviation from perfect reconstruction that arise when the Gaussian is replaced by a scaled B-spline, or when the dual window of the Gaussian is replaced by certain explicitly given and compactly supported linear combinations of the B-splines. In particular, this leads to a family of approximate dual windows of a very simple form, leading to $\varepsilon$-almost perfect reconstruction within any desired error tolerance whenever the product $ab$ is sufficiently...
small. In contrast, the known (exact) dual windows have a very complicated form. A similar analysis is sketched with the scaled B-splines replaced by certain truncations of the Gaussian. As a consequence of the approach we prove (mostly known) convergence results for the considered scaled B-splines to the Gaussian in the ($L^p$-spaces, as well in the time-domain as in the frequency domain.

**General information**

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Ulsan National Institute of Science and Technology, Yeungnam University
Authors: Christensen, O. (Intern), Kim, H. O. (Ekstern), Kim, R. Y. (Ekstern)
Pages: 1-22
Publication date: 2017
Main Research Area: Technical/natural sciences

**Publication information**

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Scopus rating (2016): CiteScore 1.09 SJR 0.755 SNIP 1.078
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Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
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BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.22 SNIP 1.464 CiteScore 1.23
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.042 SNIP 1.575 CiteScore 1.25
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.158 SNIP 2.482 CiteScore 2.7
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.431 SNIP 1.682
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.331 SNIP 1.991
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 0.948 SNIP 1.704
Scopus rating (2007): SJR 1.072 SNIP 1.781
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.797 SNIP 1.441
Scopus rating (2005): SJR 0.774 SNIP 1.457
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.251 SNIP 1.613
Scopus rating (2003): SJR 0.852 SNIP 1.009
Scopus rating (2002): SJR 1.032 SNIP 1.187
Scopus rating (2001): SJR 0.959 SNIP 1.859
Canards in stiction: on solutions of a friction oscillator by regularization

We study the solutions of a friction oscillator subject to stiction. This discontinuous model is non-Filippov, and the concept of Filippov solution cannot be used. Furthermore some Carathéodory solutions are unphysical. Therefore we introduce the concept of stiction solutions: these are the Carathéodory solutions that are physically relevant, i.e. the ones that follow the stiction law. However, we find that some of the stiction solutions are forward non-unique in subregions of the slip onset. We call these solutions singular, in contrast to the regular stiction solutions that are forward unique. In order to further the understanding of the non-unique dynamics, we introduce a regularization of the model. This gives a singularly perturbed problem that captures the main features of the original discontinuous problem. We identify a repelling slow manifold that separates the forward slipping to forward sticking solutions, leading to a high sensitivity to the initial conditions. On this slow manifold we find canard trajectories, that have the physical interpretation of delaying the slip onset. We show with numerics that the regularized problem has a family of periodic orbits interacting with the canards. We observe that this family has a saddle stability and that it connects, in the rigid body limit, the two regular, slip-stick branches of the discontinuous problem, that were otherwise disconnected.
Characterisations of Partition of Unities Generated by Entire Functions in $\mathbb{C}^d$

Collections of functions forming a partition of unity play an important role in analysis. In this paper we characterise for any $N \in \mathbb{N}$ the entire functions $P$ for which the partition of unity condition $\sum_{n \in \mathbb{Z}^d} P(x+n)\chi_{[0,N]^d}(x+n)=1$ holds for all $x \in \mathbb{R}^d$. The general characterisation leads to various easy ways of constructing such entire functions as well. We demonstrate the flexibility of the approach by showing that additional properties like continuity or differentiability of the functions $(P\chi_{[0,N]^d})(\cdot+n)$ can be controlled. In particular, this leads to easy ways of constructing entire functions $P$ such that the functions in the partition of unity belong to the Feichtinger algebra.
In this article we count the number of \([n, k]\) generalized Reed–Solomon (GRS) codes, including the codes coming from a non-degenerate conic plus nucleus. We compare our results with known formulae for the number of \([n, 3]\) MDS codes with \(n = 6, 7, 8, 9\).

### General information

**State:** Published  
**Organisations:** Department of Applied Mathematics and Computer Science, Mathematics, Flinders University, Indian Institute of Science Education and Research Pune  
**Authors:** Beelen, P. (Intern), Glynn, D. (Ekstern), Høholdt, T. (Intern), Kaipa, K. (Ekstern)  
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Scopus rating (2016): CiteScore 0.65 SJR 0.426 SNIP 0.835  
BFI (2015): BFI-level 1  
Scopus rating (2015): SJR 0.558 SNIP 1.053 CiteScore 0.72  
BFI (2014): BFI-level 1
Decoding Interleaved Gabidulin Codes using Alekhnovich's Algorithm

We prove that Alekhnovich's algorithm can be used for row reduction of skew polynomial matrices. This yields an $O((3\ell n(\omega + 1)/2)\log(n))$ decoding algorithm for $\ell$-Interleaved Gabidulin codes of length $n$, where $\omega$ is the matrix multiplication exponent.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Ulm
Authors: Puchinger, S. (Ekstern), Müelich, S. (Ekstern), Mödinger, D. (Ekstern), Rosenkilde, J. S. H. (Intern), Bossert, M. (Ekstern)
Pages: 175–180
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Main Research Area: Technical/natural sciences

Publication Information

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BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.32 SJR 0.269 SNIP 0.377
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.305 SNIP 0.397 CiteScore 0.35
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.211 SNIP 0.257 CiteScore 0.26
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.387 SNIP 0.482 CiteScore 0.43
ISI indexed (2013): ISI indexed no
BFI (2012): BFI-level 1
Decoding of interleaved Reed-Solomon codes using improved power decoding

We propose a new partial decoding algorithm for m-interleaved Reed-Solomon (IRS) codes that can decode, with high probability, a random error of relative weight $1 - Rm/m+1$ at all code rates $R$, in time polynomial in the code length $n$. For $m > 2$, this is an asymptotic improvement over the previous state-of-the-art for all rates, and the first improvement for $R > 1/3$ in the last 20 years. The method combines collaborative decoding of IRS codes with power decoding up to the Johnson radius.

**General information**

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Ulm
Authors: Puchinger, S. (Ekstern), Rosenkilde ne Nielsen, J. (Intern)
Pages: 356-60
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Series: 2017 IEEE International Symposium on Information Theory (isit)
ISSN: 2157-8117
Main Research Area: Technical/natural sciences
Conference: 2017 IEEE International Symposium on Information Theory, Aachen, Germany, 25/06/2017 - 25/06/2017

**Dynamical sampling and frame representations with bounded operators**

The purpose of this paper is to study frames for a Hilbert space $H$, having the form $(T^n\varphi)_{n=0}^\infty$ for some $\varphi \in H$ and an operator $T: H \to H$. We characterize the frames that have such a representation for a bounded operator $T$, and discuss the properties of this operator. In particular, we prove that the image chain of $T$ has finite length $N$ in the overcomplete case; furthermore $(T^n\varphi)_{n=0}^\infty$ has the very particular property that $(T^n\varphi)_{n=0}^{N-\ell}$ is a frame for $H$ for all $\ell \in \mathbb{N}$. We
also prove that frames of the form \((T^n\varphi)_{n=0}^{\infty}\) are sensitive to the ordering of the elements and to norm-perturbations of the generator \(\varphi\) and the operator \(T\). On the other hand positive stability results are obtained by considering perturbations of the generator \(\varphi\) belonging to an invariant subspace on which \(T\) is a contraction.

**General information**

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Mohaghegh Ardebili
Authors: Christensen, O. (Intern), Hasannasab, M. (Intern), Rashidi, E. (Ekstern)
Pages: 634-644
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Main Research Area: Technical/natural sciences

**Publication information**

Journal: Journal of Mathematical Analysis and Applications
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.11 SJR 1.023 SNIP 1.213
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.139 SNIP 1.296 CiteScore 1.13
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.315 SNIP 1.419 CiteScore 1.24
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.402 SNIP 1.42 CiteScore 1.25
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.306 SNIP 1.445 CiteScore 1.22
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.594 SNIP 1.482 CiteScore 1.3
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.419 SNIP 1.409
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.395 SNIP 1.52
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.322 SNIP 1.49
Scopus rating (2007): SJR 1.434 SNIP 1.651
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.21 SNIP 1.327
Scopus rating (2005): SJR 1.009 SNIP 1.149
Scopus rating (2004): SJR 0.968 SNIP 1.181
Scopus rating (2003): SJR 0.986 SNIP 1.321
Scopus rating (2002): SJR 0.727 SNIP 1.122
Scopus rating (2001): SJR 0.749 SNIP 1.201
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 1.044 SNIP 1.097
Scopus rating (1999): SJR 1.187 SNIP 1.129
Original language: English
Frames, Dual frames, Dynamical sampling, Operator theory, Operator representation of frames

**DOIs:**
Fractional and complex pseudo-splines and the construction of Parseval frames

Pseudo-splines of integer order \((m, \ell)\) were introduced by Daubechies, Han, Ron, and Shen as a family which allows interpolation between the classical B-splines and the Daubechies’ scaling functions. The purpose of this paper is to generalize the pseudo-splines to fractional and complex orders \((z, \ell)\) with \(\alpha = \text{Re}\ z \geq 1\). This allows increased flexibility in regard to smoothness: instead of working with a discrete family of functions from \(C^m, m \in \mathbb{N}_0\), one uses a continuous family of functions belonging to the Hölder spaces \(C^{\alpha-1}\). The presence of the imaginary part of \(z\) allows for direct utilization in complex transform techniques for signal and image analyses. We also show that in analogue to the integer case, the generalized pseudo-splines lead to constructions of Parseval wavelet frames via the unitary extension principle. The regularity and approximation order of this new class of generalized splines is also discussed.
Further Generalisations of Twisted Gabidulin Codes
We present a new family of maximum rank distance (MRD) codes. The new class contains codes that are neither equivalent to a generalised Gabidulin nor to a twisted Gabidulin code, the only two known general constructions of linear MRD codes.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University College Dublin, University of Ulm
Authors: Puchinger, S. (Ekstern), Rosenkilde, J. S. H. (Intern), Sheekey, J. (Ekstern)
Number of pages: 10
Publication date: 2017

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Conference: Tenth International Workshop on Coding and Cryptography 2017, Saint-Petersburg, Russian Federation, 18/09/2017 - 18/09/2017
Electronic versions: 2017_wcc_twistedgabidulin.pdf
Source: PublicationPreSubmission
Source-ID: 140540837
Publication: Research - peer-review › Article in proceedings – Annual report year: 2017

Gabor Frames in $\ell^2(\mathbb{Z})$ and Linear Dependence
We prove that an overcomplete Gabor frame in $(\mathbb{Z})$ generated by a finitely supported sequence is always linearly dependent. This is a particular case of a general result about linear dependence versus independence for Gabor systems in $(\mathbb{Z})$ with modulation parameter $1/M$ and translation parameter $N$ for some $(\mathbb{Z})$ and generated by a finite sequence $g$ in $(\mathbb{Z})$ with $K$ nonzero entries.

General information
State: Accepted/In press
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Christensen, O. (Intern), Hasannasab, M. (Intern)
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Main Research Area: Technical/natural sciences

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BFI (2015): BFI-level 2
Web of Science (2015): Indexed yes
Scopus rating (2015): SJR 1.103 SNIP 1.396 CiteScore 1.42
BFI (2014): BFI-level 2
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Scopus rating (2014): SJR 1.116 SNIP 1.406 CiteScore 1.21
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Web of Science (2013): Indexed yes
Scopus rating (2013): SJR 1.22 SNIP 1.464 CiteScore 1.23
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
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ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Gabor frames on locally compact abelian groups and related topics

This thesis consists of four papers. The first one introduces generalized translation invariant systems and considers their frame properties, the second and third paper give new results on the theory of Gabor frames, and the fourth is a review paper with proofs and new results on the Feichtinger algebra.

The generalized translation invariant (GTI) systems provide, for the first time, a framework which can describe frame properties of both discrete and continuous systems. The results yield the well-known characterizations of dual frame pairs and Parseval frames of Gabor-, wavelet-, curvelet- and shearlet-type and for (generalized) shift-invariant systems and their continuous formulations.

This thesis advances the theory of both separable and non-separable, discrete, semicontinuous and continuous Gabor systems. In particular, the well established structure theory for separable lattice Gabor frames is extended and generalized significantly to Gabor systems with time-frequency shifts along closed subgroups in the time-frequency plane. This includes density results, the Walnut representation, the Wexler-Raz biorthogonality relations, the Bessel duality and the duality principle between Gabor frames and Gabor Riesz bases.

The theory of GTI systems and Gabor frames in this thesis is developed and presented in the setting of locally compact abelian groups, however, even in the euclidean setting the results given here improve the existing theory.

Finally, the thesis contains a review paper with proofs of all the major results on the Banach space of functions known as the Feichtinger algebra. This includes many of its different characterizations and treatment of its many equivalent norms, its minimality among all time-frequency shift invariant Banach spaces and aspects of its dual space, operators on the space and the kernel theorem for the Feichtinger algebra. The work also includes new findings such as a characterization among all Banach spaces, a forgotten theorem by Reiter on Banach space isomorphisms of the Feichtinger algebra, and new useful inequalities.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Jakobsen, M. S. (Intern), Christensen, O. (Intern), Lemvig, J. (Intern)
Dual pairs of frames yield a procedure for obtaining perfect reconstruction of elements in the underlying Hilbert space in terms of superpositions of the frame elements. However, practical constraints often force us to apply sequences that do not exactly form dual frames. In this article, we consider the important case of generalized shift-invariant systems and provide various ways of estimating the deviation from perfect reconstruction that occur when the systems do not form dual frames. The deviation from being dual frames will be measured either in terms of a perturbation condition or in terms of the deviation from equality in the duality conditions.

Generalized shift-invariant systems and approximately dual frames

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Universidad Nacional de San Luis
Authors: Benavente, A. (Ekstern), Christensen, O. (Intern), Zakowicz, M. I. (Ekstern)
Pages: 177-189
Publication date: 2017
Main Research Area: Technical/natural sciences

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Journal: Annals of Functional Analysis
Volume: 8
Issue number: 2
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Scopus rating (2016): CiteScore 0.49 SNIP 0.701 SJR 0.384
Scopus rating (2015): CiteScore 0.62 SNIP 1.137 SJR 0.419
Scopus rating (2014): CiteScore 0.7 SNIP 1.009 SJR 0.581
Scopus rating (2013): CiteScore 0.88 SNIP 1.16 SJR 0.591
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Source-ID: 2351105195
Publication: Research - peer-review › Journal article – Annual report year: 2017

Idempotent and p-potent quadratic functions: distribution of nonlinearity and co-dimension

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Austrian Academy of Sciences, Sabanci University
Improved Power Decoding of One-Point Hermitian Codes

We propose a new partial decoding algorithm for one-point Hermitian codes that can decode up to the same number of errors as the Guruswami–Sudan decoder. Simulations suggest that it has a similar failure probability as the latter one. The algorithm is based on a recent generalization of the power decoding algorithm for Reed–Solomon codes and does not require an expensive root-finding step. In addition, it promises improvements for decoding interleaved Hermitian codes.

Invariant manifolds and the parameterization method in coupled energy harvesting piezoelectric oscillators

Energy harvesting systems based on oscillators aim to capture energy from mechanical oscillations and convert it into electrical energy. Widely extended are those based on piezoelectric materials, whose dynamics are Hamiltonian submitted to different sources of dissipation: damping and coupling. These dissipations bring the system to low energy regimes, which is not desired in long term as it diminishes the absorbed energy. To avoid or to minimize such situations, we propose that the coupling of two oscillators could benefit from theory of Arnold diffusion. Such phenomenon studies O(1) energy variations in Hamiltonian systems and hence could be very useful in energy harvesting applications. This article is a first step towards this goal. We consider two piezoelectric beams submitted to a small forcing and coupled through an electric circuit. By considering the coupling, damping and forcing as perturbations, we prove that the unperturbed system possesses a 4-dimensional Normally Hyperbolic Invariant Manifold with 5 and 4-dimensional stable and unstable manifolds, respectively. These are locally unique after the perturbation. By means of the parameterization method, we numerically compute parameterizations of the perturbed manifold, its stable and unstable manifolds and study its inner dynamics. We show evidence of homoclinic connections when the perturbation is switched on.
Damped oscillators, Energy harvesting systems, Parameterization method, Normally hyperbolic invariant manifolds, Homoclinic connections, Arnold diffusion
Matematikkommissionen - Afrapportering

Matematikkommissionen er nedsat som følge af ønsket om at styrke det faglige niveau i matematik i gymnasiet. Kommissionen skal bl.a. give forslag til udvikling af fagets indhold, didaktik, prøveformer og faglige overgange dels fra grundskole til gymnasiale uddannelser og dels videre til videregående uddannelser.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Københavns Åbne Gymnasium, Professionshøjskolen UCC, Sc. Knuds Gymnasium, KNord Handelsgymnasium, Københavns Universitet, Roskilde University, Aalborg University, University of Southern Denmark, TICRA
Authors: Grønbæk, N. (Forskerdatabase), Rasmussen, A. (Ekstern), Skott, C. K. (Ekstern), Bang-Jensen, J. (Ekstern), Jensen, K. B. S. (Forskerdatabase), Fajstrup, L. (Forskerdatabase), Schou, M. H. (Forskerdatabase), Christensen, M. (Ekstern), Lumholt, M. (Ekstern), Kjærup, R. M. (Ekstern), Jørgensen, S. (Forskerdatabase), Hansen, S. L. (Forskerdatabase), Markvorsen, S. (Intern)
Number of pages: 47
Publication date: 2017

Maximum number of common zeros of homogeneous polynomials over finite fields

About two decades ago, Tsfasman and Boguslavsky conjectured a formula for the the maximum number of common zeros that $r$ linearly independent homogeneous polynomials of degree $d$ in $m + 1$ variables with coefficients in a finite field with $q$ elements can have in the corresponding $m$-dimensional projective space over that finite field. Recently, it has been shown by Datta and Ghorpade that this conjecture is valid if $r$ is at most $m + 1$ and can be invalid otherwise. Moreover a new conjecture was proposed for many values of $r$ beyond $m + 1$. In this paper, we prove that this new conjecture holds true for several values of $r$. In particular, this settles the new conjecture completely when $d = 3$. Our result also includes the positive result of Datta and Ghorpade as a special case. Further, we also determine the maximum number of zeros in certain cases not covered by the earlier conjectures and results, namely, the case of $d = q − 1$ and of $d = q$.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Beelen, P. (Intern), Datta, M. (Intern), Ghorpade, S. R. (Intern)
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Main Research Area: Technical/natural sciences

Journal: Proceedings of the American Mathematical Society
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BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.68 SJR 1.105 SNIP 0.984
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.102 SNIP 1.068 CiteScore 0.68
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.28 SNIP 1.093 CiteScore 0.71
Modified planar functions and their components

Zhou ([20]) introduced modified planar functions in order to describe \((2^n, 2^n, 2^n, 1)\) relative difference sets \(R\) as a graph of a function on the finite field \(\mathbb{F}_{2^n}\) and pointed out that projections of \(R\) are difference sets that can be described by negabent or bent\(_4\) functions, which are Boolean functions given in multivariate form. One of the objectives of this paper is to contribute to the understanding of these component functions of modified planar functions. Moreover, we obtain a description of modified planar functions by their components which is similar to that of the classical planar functions in odd characteristic as a vectorial bent function. We finally point out that though these components behave somewhat different than the multivariate bent4 functions, they are bent or semibent functions shifted by a certain quadratic term, a property which they share with their multivariate counterpart.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Austrian Academy of Sciences
Authors: Anbar Meidl, N. (Intern), Meidl, W. M. (Ekstern)
Number of pages: 15
Pages: 1–15
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Cryptography and Communications
ISSN (Print): 1936-2447
Number of solutions of systems of homogeneous polynomial equations over finite fields

We consider the problem of determining the maximum number of common zeros in a projective space over a finite field for a system of linearly independent multivariate homogeneous polynomials defined over that field. There is an elaborate conjecture of Tsfasman and Boguslavsky that predicts the maximum value when the homogeneous polynomials have the same degree that is not too large in comparison to the size of the finite field. We show that this conjecture holds in the affirmative if the number of polynomials does not exceed the total number of variables. This extends the results of Serre (1991) and Boguslavsky (1997) for the case of one and two polynomials, respectively. Moreover, it complements our recent result that the conjecture is false, in general, if the number of polynomials exceeds the total number of variables.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Indian Institute of Technology, Bombay
Authors: Datta, M. (Intern), Ghorpade, S. R. (Ekstern)
Pages: 525-541
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Volume: 145
ISSN (Print): 0002-9939
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Web of Science (2018): Indexed yes
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On multivariate Wilson bases

A Wilson system is a collection of finite linear combinations of time frequency shifts of a square integrable function. In this paper we give an account of the construction of bimodular Wilson bases in higher dimensions from Gabor frames of redundancy two.

General information

State: Published
Organisations: Mathematics, Department of Applied Mathematics and Computer Science, University of Oregon, University of Maryland
Authors: Bownik, M. (Ekstern), Jakobsen, M. S. (Intern), Lemvig, J. (Intern), Okoudjou, K. A. (Ekstern)
Number of pages: 4
Pages: 192-5
Publication date: 2017

Host publication information
On permutation polynomials over finite fields: differences and iterations

The Carlitz rank of a permutation polynomial $f$ over a finite field $\mathbb{F}_q$ is a simple concept that was introduced in the last decade. Classifying permutations over $\mathbb{F}_q$ with respect to their Carlitz ranks has some advantages, for instance $f$ with a given Carlitz rank can be approximated by a rational linear transformation. In this note we present our recent results on the permutation behaviour of polynomials $f+g$, where $f$ is a permutation over $\mathbb{F}_q$ of a given Carlitz rank, and $g \in \mathbb{F}_q[x]$ is of prescribed degree. We describe the relation of this problem to the well-known Chowla-Zassenhaus conjecture. We also study iterations of permutation polynomials by using the approximation property that is mentioned above.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Sarajevo, University of Warwick, Universidade Federal do Rio de Janeiro, Leiden University, Sabanci University
Authors: Anbar Meidl, N. (Intern), Odzak, A. (Ekstern), Patel, V. (Ekstern), Quoos, L. (Ekstern), Somoza, A. (Ekstern), Topuzoglu, A. (Ekstern)
Number of pages: 13
Publication date: 2017

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Title of host publication: Women in Numbers
Main Research Area: Technical/natural sciences
Electronic versions:
WINN.pdf

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conference paper submitted to Women in Numbers Europe
Source: PublicationPreSubmission
Source-ID: 134439164
Publication: Research - peer-review › Article in proceedings – Annual report year: 2017

On the approximation of the canard explosion point in singularly perturbed systems without an explicit small parameter

A canard explosion is the dramatic change of period and amplitude of a limit cycle of a system of nonlinear ODEs in a very narrow interval of the bifurcation parameter. It occurs in slow–fast systems and is well understood in singular perturbation problems where a small parameter epsilon defines the time-scale separation. We present an iterative algorithm for the determination of the canard explosion point which can be applied for a general slow–fast system without an explicit small parameter. We also present assumptions under which the algorithm gives accurate estimates of the canard explosion point. Finally, we apply the algorithm to the van der Pol equations, a Templator model for a self-replicating system and a model for intracellular calcium oscillations with no explicit small parameters and obtain very good agreement with results from numerical simulations.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Brøns, M. (Intern), Kristiansen, K. U. (Intern)
Pages: 1-23
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Dynamical Systems
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On the difference between permutation polynomials over finite fields
The well-known Chowla and Zassenhaus conjecture, proven by Cohen in 1990, states that if p > (d^2 - 3d + 4)^2, then
there is no complete mapping polynomial f in F_p[x] of degree d ≥ 2. For arbitrary finite fields F_q, a similar non-existence
result is obtained recently by Işık, Topuzoğlu and Winterhof in terms of the Carlitz rank of f. Cohen, Mullen and Shiue
generalized the Chowla-Zassenhaus-Cohen Theorem significantly in 1995, by considering differences of permutation
polynomials. More precisely, they showed that if f and f + g are both permutation polynomials of degree d ≥ 2 over F_p, with
p > (d^2 - 3d + 4)^2, then the degree k of g satisfies k ≥ 3d/5, unless g is constant. In this article, assuming f and f + g are
permutation polynomials in F_q[x], we give lower bounds for k in terms of the Carlitz rank of f and q. Our results generalize
the above mentioned result of Işık et al. We also show for a special class of polynomials f of Carlitz rank n ≥ 1 that if f + x
k is a permutation over F_q, with gcd(k + 1, q - 1) = 1, then k ≥ (q - n)/(n + 3).

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Sarajevo,
University of Warwick, Universidade Federal do Rio de Janeiro, Leiden University, Sabancı University
Authors: Anbar Meidl, N. (Intern), Odzak, A. (Ekstern), Patel, V. (Ekstern), Quoos, L. (Ekstern), Somoza, A. (Ekstern),
Topuzoglu, A. (Ekstern)
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On the regularization of impact without collision: the Painlevé paradox and compliance
We consider the problem of a rigid body, subject to a unilateral constraint, in the presence of Coulomb friction. We regularize the problem by assuming compliance (with both stiffness and damping) at the point of contact, for a general class of normal reaction forces. Using a rigorous mathematical approach, we recover impact without collision (IWC) in both the inconsistent and the indeterminate Painlevé paradoxes, in the latter case giving an exact formula for conditions that separate IWC and lift-off. We solve the problem for arbitrary values of the compliance damping and give explicit asymptotic expressions in the limiting cases of small and large damping, all for a large class of rigid bodies.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Bristol
Authors: Hogan, S. J. (Ekstern), Kristiansen, K. U. (Intern)
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BFI (2018): BFI-level 1
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BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.85 SJR 0.754 SNIP 1.081
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.866 SNIP 1.279 CiteScore 2.07
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.949 SNIP 1.437 CiteScore 2.15
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.003 SNIP 1.589 CiteScore 2.35
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.969 SNIP 1.521 CiteScore 2.08
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.867 SNIP 1.464 CiteScore 1.88
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.938 SNIP 1.507
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.001 SNIP 1.571
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.071 SNIP 1.415
Scopus rating (2007): SJR 1.139 SNIP 1.532
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.041 SNIP 1.456
Scopus rating (2005): SJR 1.14 SNIP 1.419
Scopus rating (2004): SJR 1.068 SNIP 1.339
On Wilson bases in $L^2(\mathbb{R}^d)$

A Wilson system is a collection of finite linear combinations of time frequency shifts of a square integrable function. It is well known that, starting from a tight Gabor frame for $L^2(\mathbb{R})$ with redundancy 2, one can construct an orthonormal Wilson basis for $L^2(\mathbb{R})$ whose generator is well localized in the time-frequency plane. In this paper we use the fact that a Wilson system is a shift-invariant system to explore its relationship with Gabor systems. Specifically, we show that one can construct $d$-dimensional orthonormal Wilson bases starting from tight Gabor frames of redundancy $2^k$, where $k=1, 2, \ldots, d$. These results generalize most of the known results about the existence of orthonormal Wilson bases.
Operator representations of frames

The purpose of this paper is to consider representations of frames \( \{ f_k \}_{k \in I} \) in a Hilbert space \( \mathcal{H} \) of the form \( \{ f_k \}_{k \in I} = \{ T f_k \}_{k \in I} \) for a linear operator \( T \); here the index set \( I \) is either \( \mathbb{Z} \) or \( \mathbb{L}_0 \). While a representation of this form is available under weak conditions on the frame, the analysis of the properties of the operator \( T \) requires more work. For example it is a delicate issue to obtain a representation with a bounded operator, and the availability of such a representation not only depends on the frame considered as a set, but also on the chosen indexing. Using results from operator theory we show that by embedding the Hilbert space \( \mathcal{H} \) into a larger Hilbert space, we can always represent a frame via iterations of a bounded operator, composed with the orthogonal projection onto \( \mathcal{H} \). The paper closes with a discussion of an open problem concerning representations of Gabor frames via iterations of a bounded operator.

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General information
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Authors: Christensen, O. (Intern), Hasannasab, M. (Intern)
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Main Research Area: Technical/natural sciences
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DOIs: 10.1109/SAMPTA.2017.8024348
Operator Representations of Frames: Boundedness, Duality, and Stability

The purpose of the paper is to analyze frames (Formula presented.) having the form (Formula presented.) for some linear operator (Formula presented.). A key result characterizes boundedness of the operator T in terms of shift-invariance of a certain sequence space. One of the consequences is a characterization of the case where the representation (Formula presented.) can be achieved for an operator T that has an extension to a bounded bijective operator (Formula presented.). In this case we also characterize all the dual frames that are representable in terms of iterations of an operator V; in particular we prove that the only possible operator is (Formula presented.) Finally, we consider stability of the representation (Formula presented.) rather surprisingly, it turns out that the possibility to represent a frame on this form is sensitive towards some of the classical perturbation conditions in frame theory. Various ways of avoiding this problem will be discussed. Throughout the paper the results will be connected with the operators and function systems appearing in applied harmonic analysis, as well as with general group representations.

General information

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Authors: Christensen, O. (Intern), Hasannasab, M. (Intern)
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BFI (2015): BFI-level 1
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BFI (2014): BFI-level 1
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BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.15 SNIP 1.181 CiteScore 0.8
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.204 SNIP 1.301 CiteScore 0.81
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.045 SNIP 0.993 CiteScore 0.62
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.773 SNIP 0.936
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.027 SNIP 0.779
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.828 SNIP 0.773
Scopus rating (2007): SJR 1.247 SNIP 1.431
Scopus rating (2006): SJR 0.855 SNIP 0.923
Optimization on Spaces of Curves
This thesis is concerned with computational and theoretical aspects of Riemannian metrics on spaces of regular curves, and their applications. It was recently proved that second order constant coefficient Sobolev metrics on curves are geodesically complete. We extend this result to the case of Sobolev metrics with coefficient functions depending on the length of the curve. We show how to apply this result to analyse a wide range of metrics on the submanifold of unit and constant speed curves.

We present a numerical discretization of second order Sobolev metrics on the space of regular curves in $\mathbb{R}^d$, and methods to solve the initial and boundary value problem for geodesics allowing us to compute the Karcher mean and principal components analysis of data of curves. We apply the methods to study shape variation in synthetic data in the Kimia shape database, in HeLa cell nuclei and cycles of cardiac deformations.

Finally we investigate a new application of Riemannian shape analysis in shape optimization. We setup a simple elliptic model problem, and describe how to apply shape calculus to obtain directional derivatives in the manifold of planar curves. We present an implementation based on parametrization of immersions by B-splines, which ties in naturally with Isogeometric Analysis to solve the PDE. We give numerical examples of solutions, and compare the Riemannian optimization algorithms with different choices of metrics to a naive unregularized discretize-first approach.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Møller-Andersen, J. (Intern), Gravesen, J. (Intern)
Number of pages: 113
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Electronic versions: phd432_MollerAndersen_J.pdf

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Projects:
Optimization on Spaces of Curves
Publication: Research › Ph.D. thesis – Annual report year: 2017

Paley-wiener type perturbations of frames and the deviation from perfect reconstruction
Frame theory is an efficient tool to obtain expansions of elements in separable Hilbert spaces that are similar to the ones obtained via orthonormal bases, however, with considerably more exibility. In this paper we give a survey of known results
about frame expansions and perturbation theory, combined with an extension to approximately dual frames. We will show, e.g., that perturbation of a pair of dual frames in the Paley-Wiener sense leads to a deviation from perfect reconstruction that can be controlled in terms of the frame bounds of the involved sequences. The paper contains an Appendix, which motivates the analysis of frames via classical results.

Pseudospherical surfaces with singularities
We study a generalization of constant Gauss curvature −1 surfaces in Euclidean 3-space, based on Lorentzian harmonic maps, that we call pseudospherical frontals. We analyse the singularities of these surfaces, dividing them into those of characteristic and non-characteristic type. We give methods for constructing all non-degenerate singularities of both types, as well as many degenerate singularities. We also give a method for solving the singular geometric Cauchy problem: construct a pseudospherical frontal containing a given regular space curve as a non-degenerate singular curve. The solution is unique for most curves, but for some curves there are infinitely many solutions, and this is encoded in the curvature and torsion of the curve.

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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Universidad Nacional de San Luis
Authors: Christensen, O. (Intern), Zakowicz, M. I. (Ekstern)
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Scopus rating (2015): SJR 0.193 SNIP 0.439 CiteScore 0.21
Scopus rating (2014): SJR 0.318 SNIP 1.091 CiteScore 0.43
Scopus rating (2013): SJR 0.261 SNIP 1.592 CiteScore 0.47
ISI indexed (2013): ISI indexed no
Scopus rating (2012): SJR 0.135 SNIP 0.624
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Publication: Research - peer-review › Journal article – Annual report year: 2017

Pseudospherical surfaces with singularities
We study a generalization of constant Gauss curvature −1 surfaces in Euclidean 3-space, based on Lorentzian harmonic maps, that we call pseudospherical frontals. We analyse the singularities of these surfaces, dividing them into those of characteristic and non-characteristic type. We give methods for constructing all non-degenerate singularities of both types, as well as many degenerate singularities. We also give a method for solving the singular geometric Cauchy problem: construct a pseudospherical frontal containing a given regular space curve as a non-degenerate singular curve. The solution is unique for most curves, but for some curves there are infinitely many solutions, and this is encoded in the curvature and torsion of the curve.

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Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Brander, D. (Intern)
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BFI (2018): BFI-level 1
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Web of Science (2017): Indexed Yes
Rationalization in architecture with surfaces foliated by elastic curves

We develop methods for rationalization of CAD surfaces using elastic curves, aiming at a cost-effective fabrication method for architectural designs of complex shapes. By moving a heated flexible metal rod though a block of expanded polystyrene, it is possible to produce shapes with both positive and negative Gaussian curvature, either for direct use or for use as moulds for concrete casting. If we can control the shape of the rod, while moving, we can produce prescribed shapes.

The flexible rod assumes at all times the shape of an Euler elastica (or elastic curve). The elastica are given in closed analytic form using elliptic functions. We use a gradient-driven optimization to approximate arbitrary planar curves by planar elastic curves. The method depends on an explicit parameterization of the space of elastic curves and on a method for finding a good initial guess for the optimization.

We approximate CAD surfaces by first extracting a collection of planar surface curves and approximating these by elastica. Providing the data for these curves to robots holding the flexible rod, we can produce an elastica-foliated surface that approximates the given CAD surface. Since not all surfaces can be closely approximated by an elastica-foliated surface, an arbitrary CAD surface must first be subdivided into segments that can be approximated. We discuss strategies for subdividing an arbitrary surface into segments that can be closely approximated, taking into account the aesthetics of the segmentation and the production constraints. If the given surface is smooth, we want the approximating surface to be smooth as well, so we must ensure smooth transition between the surface segments of the final result.
As an alternative to rationalization of arbitrary designs, we also present a method for direct generation of design surfaces using foliated Euler elastica. Here we work from a grid of blocks, so the segmentation is given, but we must still ensure smooth transition between segments.

**General information**
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Nørbjerg, T. B. (Intern), Gravesen, J. (Intern), Brander, D. (Intern)
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Projects:
Rationalization in architecture with surfaces foliated by elastic curves
Publication: Research › Ph.D. thesis – Annual report year: 2017

**Remarks on the boundary curve of a constant mean curvature topological disc**
We discuss some consequences of the existence of the holomorphic quadratic Hopf differential on a conformally immersed constant mean curvature topological disc with analytic boundary. In particular, we derive a formula for the mean curvature as a weighted average of the normal curvature of the boundary curve, and a condition for the surface to be totally umbilic in terms of the normal curvature.

**General information**
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Universidad De Granada
Authors: Brander, D. (Intern), Lopéz, R. (Ekstern)
Pages: 1037-1043
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Main Research Area: Technical/natural sciences

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Journal: Complex Variables and Elliptic Equations
Volume: 62
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BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.55 SJR 0.467 SNIP 0.864
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.599 SNIP 0.871 CiteScore 0.55
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.776 SNIP 1.22 CiteScore 0.61
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.774 SNIP 1.117 CiteScore 0.67
BFI (2012): BFI-level 1
Row Reduction Applied to Decoding of Rank Metric and Subspace Codes

We show that decoding of $\ell$-Interleaved Gabidulin codes, as well as list-$\ell$ decoding of Mahdavifar–Vardy (MV) codes can be performed by row reducing skew polynomial matrices. Inspired by row reduction of $F[x]$ matrices, we develop a general and flexible approach of transforming matrices over skew polynomial rings into a certain reduced form. We apply this to solve generalised shift register problems over skew polynomial rings which occur in decoding $\ell$-Interleaved Gabidulin codes. We obtain an algorithm with complexity $O(\mu^2)$ where $\mu$ measures the size of the input problem and is proportional to the code length $n$ in the case of decoding. Further, we show how to perform the interpolation step of list-$\ell$-decoding MV codes in complexity $O(n^2)$, where $n$ is the number of interpolation constraints.
Singular limit analysis of a model for earthquake faulting

In this paper we consider the one dimensional spring-block model describing earthquake faulting. By using geometric singular perturbation theory and the blow-up method we provide a detailed description of the periodicity of the earthquake episodes. In particular, the limit cycles arise from a degenerate Hopf bifurcation whose degeneracy is due to an underlying Hamiltonian structure that leads to large amplitude oscillations. We use a Poincaré compactification to study the system near infinity. At infinity the critical manifold loses hyperbolicity with an exponential rate. We use an adaptation of the blow-up method to recover the hyperbolicity. This enables the identification of a new attracting manifold that organises the dynamics at infinity. This in turn leads to the formulation of a conjecture on the behaviour of the limit cycles as the time-scale separation increases. We provide the basic foundation for the proof of this conjecture and illustrate our findings with numerics.
Sparse identification of a predator-prey system from simulation data of a convection model

The use of low-dimensional dynamical systems as reduced models for plasma dynamics is useful as solving an initial value problem requires much less computational resources than fluid simulations. We utilize a data-driven modeling approach to identify a reduced model from simulation data of a convection problem. A convection model with a pressure source centered at the inner boundary models the edge dynamics of a magnetically confined plasma. The convection
problem undergoes a sequence of bifurcations as the strength of the pressure source increases. The time evolution of the energies of the pressure profile, the turbulent flow, and the zonal flow capture the fundamental dynamic behavior of the full system. By applying the sparse identification of nonlinear dynamics (SINDy) method, we identify a predator-prey type dynamical system that approximates the underlying dynamics of the three energy state variables. A bifurcation analysis of the system reveals consistency between the bifurcation structures, observed for the simulation data, and the identified underlying system.

General information
State: Published
Authors: Dam, M. (Intern), Brøns, M. (Intern), Rasmussen, J. J. (Intern), Naulin, V. (Intern), Hesthaven, J. S. (Ekstern)
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BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.08 SJR 0.702 SNIP 0.685
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.599 SNIP 0.671 CiteScore 1.02
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.126 SNIP 1.154 CiteScore 1.69
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.109 SNIP 1.256 CiteScore 1.7
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.463 SNIP 1.267 CiteScore 1.83
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.224 SNIP 1.282 CiteScore 2.09
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.471 SNIP 1.309
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.602 SNIP 1.332
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.562 SNIP 1.37
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.494 SNIP 1.209
Web of Science (2007): Indexed yes
Surfaces foliated by planar geodesics: a model for curved wood design

Surfaces foliated by planar geodesics are a natural model for surfaces made from wood strips. We outline how to construct all solutions, and produce non-trivial examples, such as a wood-strip Klein bottle.

The Exact Limit of Some Cubic Towers

Recently, a new explicit tower of function fields was introduced by Bassa, Beelen, Garcia and Stichtenoth (BBGS). This resulted in currently the best known lower bound for Ihara’s constant in the case of non-prime finite fields. In particular over cubic fields, the tower’s limit is at least as good as Zink’s bound; i.e. \( \lambda(BBGS/F_{q^3}) \geq 2(q^2 - 1)/(q + 2) \). In this paper, the exact value of \( \lambda(BBGS/F_{q^3}) \) is computed. We also settle a question stated by Ihara.
The Fine Structure of Herman Rings
We study the geometric structure of the boundary of Herman rings in a model family of Blaschke products of degree 3 (up to quasiconformal deformation). Shishikura's quasiconformal surgery relates the Herman ring to the Siegel disk of a quadratic polynomial. By studying the regularity properties of the maps involved, we transfer McMullen's results on the fine local geometry of Siegel disks to the Herman ring setting.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Universitat de Barcelona
Authors: Fagella, N. (Ekstern), Henriksen, C. (Intern)
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Main Research Area: Technical/natural sciences

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BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 0.95 SJR 1.537 SNIP 1.211
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.57 SNIP 1.49 CiteScore 0.94
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.515 SNIP 1.139 CiteScore 0.79
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.498 SNIP 1.351 CiteScore 0.69
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.3 SNIP 1.087 CiteScore 0.68
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.663 SNIP 1.195 CiteScore 0.59
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.442 SNIP 1.229
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.657 SNIP 1.166
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.328 SNIP 1.122
Web of Science (2008): Indexed yes
The period adding and incrementing bifurcations: from rotation theory to applications

This survey article is concerned with the study of bifurcations of piecewise-smooth maps. We review the literature in circle maps and quasi-contractions and provide paths through this literature to prove sufficient conditions for the occurrence of two types of bifurcation scenarios involving rich dynamics. The first scenario consists of the appearance of periodic orbits whose symbolic sequences and "rotation" numbers follow a Farey tree structure; the periods of the periodic orbits are given by consecutive addition. This is called the period adding bifurcation, and its proof relies on results for maps on the circle. In the second scenario, symbolic sequences are obtained by consecutive attachment of a given symbolic block and the periods of periodic orbits are incremented by a constant term. It is called the period incrementing bifurcation, in its proof relies on results for maps on the interval.

We also discuss the expanding cases, as some of the partial results found in the literature also hold when these maps lose contractiveness. The higher dimensional case is also discussed by means of quasi-contractions. We also provide applied examples in control theory, power electronics and neuroscience where these results can be applied to obtain precise descriptions of their dynamics.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Universidad Autonoma de Barcelona, Inria Sophia-Antipolis Research Center
Authors: Granados, A. (Intern), Alsedà, L. (Ekstern), Krupa, M. (Intern)
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Scopus rating (2016): CiteScore 3.26 SJR 2.254 SNIP 3.594
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.654 SNIP 4.178 CiteScore 2.62
The unitary extension principle on locally compact abelian groups

The unitary extension principle (UEP) by Ron and Shen yields conditions for the construction of a multi-generated tight wavelet frame for $L^2(R_s)$ based on a given refinable function. In this paper we show that the UEP can be generalized to locally compact abelian groups. In the general setting, the resulting frames are generated by modulates of a collection of functions; via the Fourier transform this corresponds to a generalized shift-invariant system. Both the stationary and the nonstationary case are covered. We provide general constructions, based on B-splines on the group itself as well as on characteristic functions on the dual group. Finally, we consider a number of concrete groups and derive explicit constructions of the resulting frames.
Topological bifurcations in the evolution of coherent structures in a convection model

Blob filaments are coherent structures in a turbulent plasma flow. Understanding the evolution of these structures is important to improve magnetic plasma confinement. Three state variables describe blob filaments in a plasma convection model. A dynamical systems approach analyzes the evolution of these three variables. A critical point of a variable defines a feature point for a region where that variable is significant. For a range of Rayleigh and Prandtl numbers, the bifurcations of the critical points of the three variables are investigated with time as the primary bifurcation parameter. Bifurcation curves separate the parameter planes into regions with different critical point configurations for the state variables. For
Prandtl number equal to 1, the number of critical points of each state variable increases with increasing Rayleigh number. For Rayleigh number equal to 104, the number of critical points is the greatest for Prandtl numbers of magnitude 100.
We explore the two-dimensional flow around a circular cylinder with the aim of elucidating the changes in the topology of the vorticity field that lead to the formation of the Kármán vortex street. Specifically, we analyse the formation and disappearance of extremal points of vorticity, which we consider to be feature points for vortices. The basic vortex creation mechanism is shown to be a topological cusp bifurcation in the vorticity field, where a saddle and an extremum of the vorticity are created simultaneously. We demonstrate that vortices are first created approximately 100 diameters downstream of the cylinder, at a Reynolds number, $Re_K$, which is slightly larger than the critical Reynolds number, $Re_{crit} \sim 46$, at which the flow becomes time periodic. For $Re$ slightly above $Re_K$, the newly created vortices disappear again a short distance further downstream. As is further increased, the points of creation and disappearance move rapidly upstream and downstream, respectively, and the Kármán vortex street persists over increasingly large streamwise distances.

**General information**

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Manchester, Ecole Centrale de Lyon
Authors: Heil, M. (Ekstern), Rosso, J. (Ekstern), Hazel, A. L. (Ekstern), Brøns, M. (Intern)
Pages: 199-221
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Main Research Area: Technical/natural sciences

**Publication information**

Journal: Journal of Fluid Mechanics
Volume: 812
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Ratings:
- BFI (2018): BFI-level 2
- Web of Science (2018): Indexed yes
- BFI (2017): BFI-level 2
- Web of Science (2017): Indexed yes
- BFI (2016): BFI-level 2
- Scopus rating (2016): CiteScore 2.82 SJR 1.671 SNIP 1.636
- Web of Science (2016): Indexed yes
- BFI (2015): BFI-level 2
- Scopus rating (2015): SJR 1.912 SNIP 1.676 CiteScore 2.57
- Web of Science (2015): Indexed yes
- BFI (2014): BFI-level 2
- Scopus rating (2014): SJR 1.865 SNIP 1.808 CiteScore 2.66
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 2
- Scopus rating (2013): SJR 1.894 SNIP 1.915 CiteScore 2.71
Twisted Reed-Solomon Codes

We present a new general construction of MDS codes over a finite field \( \mathbb{F}_q \). We describe two explicit subclasses which contain new MDS codes of length at least \( q/2 \) for all values of \( q \geq 11 \). Moreover, we show that most of the new codes are not equivalent to a Reed-Solomon code.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Ulm
Authors: Beelen, P. (Intern), Puchinger, S. (Ekstern), Rosenkilde ne Nielsen, J. (Intern)
Pages: 336-40
Publication date: 2017
Two-Point Codes for the Generalised GK curve

We improve previously known lower bounds for the minimum distance of certain two-point AG codes constructed using a Generalized Giulietti–Korchmaros curve (GGK). Castellanos and Tizziotti recently described such bounds for two-point codes coming from the Giulietti–Korchmaros curve (GK). Our results completely cover and in many cases improve on their results, using different techniques, while also supporting any GGK curve. Our method builds on the order bound for AG codes: to enable this, we study certain Weierstrass semigroups. This allows an efficient algorithm for computing our improved bounds. We find several new improvements upon the MinT minimum distance tables.

General information

State: Accepted/In press
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Ecole Polytechnique
Authors: Barelli, É. (Ekstern), Beelen, P. (Intern), Datta, M. (Intern), Neiger, V. (Intern), Rosenkilde, J. S. H. (Intern)
Number of pages: 9
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information

Journal: IEEE Transactions on Information Theory
ISSN (Print): 0018-9448
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.34 SJR 1.678 SNIP 2.004
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.796 SNIP 2.317 CiteScore 3.3
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.944 SNIP 2.544 CiteScore 3.71
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 3.012 SNIP 3.29 CiteScore 4.37
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.838 SNIP 3.078 CiteScore 4.07
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.779 SNIP 3.313 CiteScore 4.32
ISI indexed (2011): ISI indexed yes
We describe how to solve simultaneous Padé approximations over a power series ring $K[[x]]$ for a field $K$ using $O(n^\omega - 1)$ operations in $K$, where $d$ is the sought precision and $n$ is the number of power series to approximate. We develop two algorithms using different approaches. Both algorithms return a reduced sub-bases that generates the complete set of solutions to the input approximations problem that satisfy the given degree constraints. Our results are made possible by recent breakthroughs in fast computations of minimal approximant bases and Hermite Padé approximations.
Approximation by planar elastic curves
We give an algorithm for approximating a given plane curve segment by a planar elastic curve. The method depends on an analytic representation of the space of elastic curve segments, together with a geometric method for obtaining a good initial guess for the approximating curve. A gradient-driven optimization is then used to find the approximating elastic curve.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Brander, D. (Intern), Gravesen, J. (Intern), Nørbjerg, T. B. (Intern)
Number of pages: 19
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Advances in Computational Mathematics
ISSN (Print): 1019-7168
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.3 SJR 0.848 SNIP 1.06
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.161 SNIP 1.354 CiteScore 1.33
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.307 SNIP 1.54 CiteScore 1.57
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.039 SNIP 1.604 CiteScore 1.5
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.05 SNIP 1.696 CiteScore 1.42
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.946 SNIP 1.347 CiteScore 1.11
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.311 SNIP 1.154
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.952 SNIP 1.643
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.761 SNIP 1.071
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.92 SNIP 1.08
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.062 SNIP 1.119
Scopus rating (2005): SJR 1.148 SNIP 1.745
Scopus rating (2004): SJR 0.875 SNIP 0.984
A continuous autorotation vector field along a framed space curve is defined, which describes the rotational progression of the frame. We obtain an exact integral for the length of the autorotation vector. This invokes the infinitesimal rotation vector of the frame progression and the unit vector field for the corresponding autorotation vector field. For closed curves we define an autorotation number whose integer value depends on the starting point of the curve. Upon curve deformations, the autorotation number is either constant, or can make a jump of (multiples of) plus-minus two, which corresponds to a change in rotation of multiples of 4π. The autorotation number is therefore not topologically conserved under all transformations. We discuss this within the context of generalised inflection points and of frame revisit points. The results may be applicable to physical systems such as polymers, proteins, and DNA. Finally, turbulence is discussed in the light of autorotation, as is the Philippine wine dance, the Dirac belt trick, and the 4π cycle of the flying snake.
Closed space curves, Darboux vector, DNA, Dirac belt trick, Integration of generalised Frenet Serret equations, Ribbon, Signed 3D curvature

Electronic versions:
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10.1088/0031-8949/91/2/023005
Source: FindIt
Source-ID: 277031421
Publication: Research - peer-review › Journal article – Annual report year: 2016

Bifurcations of a creeping air–water flow in a conical container

This numerical study describes the eddy emergence and transformations in a slow steady axisymmetric air–water flow, driven by a rotating top disk in a vertical conical container. As water height (Formula presented.) and cone half-angle (Formula presented.) vary, numerous flow metamorphoses occur. They are investigated for (Formula presented.), and (Formula presented.). For small (Formula presented.), the air flow is multi-cellular with clockwise meridional circulation near the disk. The air flow becomes one cellular as (Formula presented.) exceeds a threshold depending on (Formula presented.). For all (Formula presented.), the water flow has an unbounded number of eddies whose size and strength diminish as the cone apex is approached. As the water level becomes close to the disk, the outmost water eddy with clockwise meridional circulation expands, reaches the interface, and induces a thin layer with anticlockwise circulation in the air. Then this layer expands and occupies the entire air domain. The physical reasons for the flow transformations are provided. The results are of fundamental interest and can be relevant for aerial bioreactors.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Office for Study Programmes and Student Affairs, Universidad de Sevilla, Shtern Research and Consulting
Authors: Balci, A. (Intern), Brøns, M. (Intern), Herrada, M. A. (Ekstern), Shtern, V. N. (Ekstern)
Pages: 485-496
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Theoretical and Computational Fluid Dynamics
Volume: 30
Issue number: 5
ISSN (Print): 0935-4964
Ratings:
BFI (2018): BFI-level 1
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BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.574 SNIP 0.836 CiteScore 1.42
Co-compact Gabor Systems on Locally Compact Abelian Groups

In this work we extend classical structure and duality results in Gabor analysis on the euclidean space to the setting of second countable locally compact abelian (LCA) groups. We formulate the concept of rationally oversampling of Gabor systems in an LCA group and prove corresponding characterization results via the Zak transform. From these results we derive non-existence results for critically sampled continuous Gabor frames. We obtain general characterizations in time and in frequency domain of when two Gabor generators yield dual frames. Moreover, we prove the Walnut and Janssen representation of the Gabor frame operator and consider the Wexler–Raz biorthogonality relations for dual generators.

Finally, we prove the duality principle for Gabor frames. Unlike most duality results on Gabor systems, we do not rely on the fact that the translation and modulation groups are discrete and co-compact subgroups. Our results only rely on the assumption that either one of the translation and modulation group (in some cases both) are co-compact subgroups of the time and frequency domain. This presentation offers a unified approach to the study of continuous and the discrete Gabor frames.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Jakobsen, M. S. (Intern), Lemvig, J. (Intern)
Number of pages: 35
Pages: 36-70
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Fourier Analysis and Applications
Volume: 22
Issue number: 1
ISSN (Print): 1069-5869
Ratings:
  BFI (2018): BFI-level 2
  Web of Science (2018): Indexed yes
  BFI (2017): BFI-level 2
  Web of Science (2017): Indexed Yes
  BFI (2016): BFI-level 2
  Scopus rating (2016): CiteScore 1.09 SJR 0.755 SNIP 1.078
  Web of Science (2016): Indexed yes
  BFI (2015): BFI-level 2
  Scopus rating (2015): SJR 1.103 SNIP 1.396 CiteScore 1.42
  Web of Science (2015): Indexed yes
  BFI (2014): BFI-level 2
  Scopus rating (2014): SJR 1.116 SNIP 1.406 CiteScore 1.21
  BFI (2013): BFI-level 2
  Scopus rating (2013): SJR 1.22 SNIP 1.464 CiteScore 1.23
  ISI indexed (2013): ISI indexed yes
  BFI (2012): BFI-level 2
  Scopus rating (2012): SJR 1.042 SNIP 1.575 CiteScore 1.25
  ISI indexed (2012): ISI indexed yes
  Web of Science (2012): Indexed yes
  BFI (2011): BFI-level 2
  Scopus rating (2011): SJR 2.158 SNIP 2.482 CiteScore 2.7
  ISI indexed (2011): ISI indexed yes
  Web of Science (2011): Indexed yes
  BFI (2010): BFI-level 2
  Scopus rating (2010): SJR 1.431 SNIP 1.682
  Web of Science (2010): Indexed yes
  BFI (2009): BFI-level 2
  Scopus rating (2009): SJR 1.331 SNIP 1.991
  BFI (2008): BFI-level 2
  Scopus rating (2008): SJR 0.948 SNIP 1.704
  Scopus rating (2007): SJR 1.072 SNIP 1.781
  Web of Science (2007): Indexed yes
  Scopus rating (2006): SJR 0.797 SNIP 1.441
  Scopus rating (2005): SJR 0.774 SNIP 1.457
  Web of Science (2005): Indexed yes
  Scopus rating (2004): SJR 1.251 SNIP 1.613
  Scopus rating (2003): SJR 0.852 SNIP 1.009
  Scopus rating (2002): SJR 1.032 SNIP 1.187
  Scopus rating (2001): SJR 0.959 SNIP 1.859
  Scopus rating (2000): SJR 1.679 SNIP 1.836
  Scopus rating (1999): SJR 1.385 SNIP 1.317
Original language: English

Dual frames, Duality principle, Fiberization, Frame, Gabor System, Janssen representation, LCA group, Walnut representation, Wexler–Raz biorthogonality relations, Zak transform
Counterexamples to the B-spline Conjecture for Gabor Frames

The frame set conjecture for B-splines $B_n$, $n \geq 2$, states that the frame set is the maximal set that avoids the known obstructions. We show that any hyperbola of the form $ab=r$, where $r$ is a rational number smaller than one and $a$ and $b$ denote the sampling and modulation rates, respectively, has infinitely many pieces, located around $b=2,3,\ldots$, not belonging to the frame set of the $n$th order B-spline. This, in turn, disproves the frame set conjecture for B-splines. On the other hand, we uncover a new region belonging to the frame set for B-splines $B_n$, $n \geq 2$. 

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Technical University of Denmark
Authors: Lemvig, J. (Intern), Nielsen, K. H. (Ekstern)
Number of pages: 12
Pages: 1440–1451
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Fourier Analysis and Applications
Volume: 22
Issue number: 6
ISSN (Print): 1069-5869
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.09 SJR 0.755 SNIP 1.078
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.103 SNIP 1.396 CiteScore 1.42
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.116 SNIP 1.406 CiteScore 1.21
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.22 SNIP 1.464 CiteScore 1.23
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.042 SNIP 1.575 CiteScore 1.25
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.158 SNIP 2.482 CiteScore 2.7
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.431 SNIP 1.682
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.331 SNIP 1.991
BFI (2008): BFI-level 2
Cuttable Ruled Surface Strips for Milling

This paper proposes a novel pre-processing method for industrial robotic CNC-milling. The method targets a hybrid machining process, in which the main bulk of material is removed through robotic hot or abrasive wire cutting, after which regular CNC-machining is employed for removal of the remaining material volume. Hereby, the roughing process is significantly sped up, reducing overall machining time. We compare our method to the convex hull and remove between 5% and 75% more material; on most models we obtain a 50% improvement. Our method ensures that no overcutting happens and that the result is cuttable by wire cutting.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Image Analysis & Computer Graphics, Mathematics, Odico Formwork Robotics Aps
Authors: Steenstrup, K. H. (Intern), Nørbjerg, T. B. (Intern), Søndergaard, A. (Ekstern), Bærentzen, J. A. (Intern), Gravesen, J. (Intern)
Pages: 328-342
Publication date: 2016

Host publication information

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Publisher: vdf Hochschulverlag AG an der ETH Zürich
Editors: Adriaenssens, S., Gramazio, F., Kohler, M., Menges, A., Pauly, M.
ISBN (Print): 978-3-7281-3778-4
Main Research Area: Technical/natural sciences
Piecewise-ruled surfaces, CAD, Milling, Free form architecture
Electronic versions:
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DOIs: 10.3218/3778-4_22
Source: PublicationPreSubmission
Source-ID: 127346970
Publication: Research - peer-review › Article in proceedings – Annual report year: 2016

Designing for hot-blade cutting: Geometric Approaches for High-Speed Manufacturing of Doubly-Curved Architectural Surfaces

In this paper we present a novel method for the generation of doubly-curved, architectural design surfaces using swept Euler elastica and cubic splines. The method enables a direct design to production workflow with robotic hot-blade cutting, a novel robotic fabrication method under development by authors of the paper, which facilitates high-speed production of

Scopus rating (2008): SJR 0.948 SNIP 1.704
Scopus rating (2007): SJR 1.072 SNIP 1.781
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.797 SNIP 1.441
Scopus rating (2005): SJR 0.774 SNIP 1.457
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.251 SNIP 1.613
Scopus rating (2003): SJR 0.852 SNIP 1.009
Scopus rating (2002): SJR 1.032 SNIP 1.187
Scopus rating (2001): SJR 0.959 SNIP 1.859
Scopus rating (2000): SJR 1.679 SNIP 1.836
Scopus rating (1999): SJR 1.385 SNIP 1.317
Original language: English
B-spline, Frame, Frame set, Gabor system, Zibulski–Zeevi matrix
DOIs: 10.1007/s00041-016-9462-1
Source: FindIt
Source-ID: 2295554464
Publication: Research - peer-review › Journal article – Annual report year: 2016

Designing for hot-blade cutting: Geometric Approaches for High-Speed Manufacturing of Doubly-Curved Architectural Surfaces

In this paper we present a novel method for the generation of doubly-curved, architectural design surfaces using swept Euler elastica and cubic splines. The method enables a direct design to production workflow with robotic hot-blade cutting, a novel robotic fabrication method under development by authors of the paper, which facilitates high-speed production of
doubly-curved foam moulds. Complementary to design rationalisation, in which arbitrary surfaces are translated to hot-blade-cuttable geometries, the presented method enables architects and designers to design directly with the non-trivial constraints of blade-cutting in a bottom-up fashion, enabling an exploration of the unique architectural potential of this fabrication approach. The method is implemented as prototype design tools in MatLAB, C++, GhPython, and Python and demonstrated through cutting of expanded polystyrene foam design examples.

General information
State: Published
Authors: Brander, D. (Intern), Bærentzen, J. A. (Intern), Clausen, K. (Ekstern), Fisker, A. (Intern), Gravesen, J. (Intern), Lund, M. N. (Ekstern), Nørbjerg, T. B. (Intern), Steenstrup, K. H. (Intern), Søndergaard, A. (Ekstern)
Pages: 306-327
Publication date: 2016

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Publisher: vdf Hochschulverlag AG an der ETH Zürich
Editors: Adriaenssens, S., Gramazio, F., Kohler, M., Menges, A., Pauly, M.
ISBN (Print): 978-3-7281-3778-4
Main Research Area: Technical/natural sciences
Robotic fabrication, Hot blade, Digital design, EPS-moulds, Cost-efficiency, Concrete structures
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10.3218/3778-4_21
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Estimates of the first Dirichlet eigenvalue from exit time moment spectra
We compute the first Dirichlet eigenvalue of a geodesic ball in a rotationally symmetric model space in terms of the moment spectrum for the Brownian motion exit times from the ball. As an application of the model space theory we prove lower and upper bounds for the first Dirichlet eigenvalues of extrinsic metric balls in submanifolds of ambient Riemannian spaces which have model space controlled curvatures. Moreover, from this general setting we thereby obtain new generalizations of the classical and celebrated results due to McKean and Cheung-Leung concerning the fundamental tones of Cartan-Hadamard manifolds and the fundamental tones of submanifolds with bounded mean curvature in hyperbolic spaces, respectively.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Universidad De Granada, Universitat Jaume I
Authors: Hurtado, A. (Ekstern), Markvorsen, S. (Intern), Palmer, V. (Ekstern)
Pages: 1603-1632
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Main Research Area: Technical/natural sciences

Publication information
Journal: Mathematische Annalen
Volume: 365
Issue number: 3
ISSN (Print): 0025-5831
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Explicit constructions and properties of generalized shift-invariant systems in $L^2(\mathbb{R})$

Generalized shift-invariant (GSI) systems, originally introduced by Hernández et al. and Ron and Shen, provide a common framework for analysis of Gabor systems, wavelet systems, wave packet systems, and other types of structured function systems. In this paper we analyze three important aspects of such systems. First, in contrast to the known cases of Gabor frames and wavelet frames, we show that for a GSI system forming a frame, the Calderón sum is not necessarily bounded by the lower frame bound. We identify a technical condition implying that the Calderón sum is bounded by the lower frame bound and show that under a weak assumption the condition is equivalent with the local integrability condition introduced by Hernández et al. Second, we provide explicit and general constructions of frames and dual pairs of frames having the GSI-structure. In particular, the setup applies to wave packet systems and in contrast to the constructions in the literature, these constructions are not based on characteristic functions in the Fourier domain. Third, our results provide insight into the local integrability condition (LIC).
Exponential estimates of symplectic slow manifolds

In this paper we prove the existence of an almost invariant symplectic slow manifold for analytic Hamiltonian slow-fast systems with finitely many slow degrees of freedom for which the error field is exponentially small. We allow for infinitely many fast degrees of freedom. The method we use is motivated by a paper of MacKay from 2004. The method does not notice resonances, and therefore we do not pose any restrictions on the motion normal to the slow manifold other than it being fast and analytic. We also present a stability result and obtain a generalization of a result of Gelfreich and Lerman on an invariant slow manifold to (finitely) many fast degrees of freedom.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Surrey
Authors: Kristiansen, K. U. (Intern), Wulff, C. (Ekstern)
Number of pages: 46
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information

Journal: Journal of Differential Equations
Volume: 261
Issue number: 1
ISSN (Print): 0022-0396
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.98 SJR 2.454 SNIP 1.844
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.752 SNIP 1.931 CiteScore 1.95
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 3.042 SNIP 1.891 CiteScore 1.78
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.715 SNIP 1.726 CiteScore 1.76
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.655 SNIP 1.778 CiteScore 1.64
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.188 SNIP 1.41 CiteScore 1.31
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.354 SNIP 1.58
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.417 SNIP 1.751
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.32 SNIP 1.606
Scopus rating (2007): SJR 2.018 SNIP 1.766
Scopus rating (2006): SJR 2.05 SNIP 1.74
Scopus rating (2005): SJR 1.892 SNIP 1.601
Scopus rating (2004): SJR 2.035 SNIP 1.547
Scopus rating (2003): SJR 1.928 SNIP 1.691
Scopus rating (2002): SJR 2.345 SNIP 1.775
From Canards of Folded Singularities to Torus Canards in a Forced van der Pol Equation

In this article, we study canard solutions of the forced van der Pol equation in the relaxation limit for low-, intermediate-, and high-frequency periodic forcing. A central numerical observation made herein is that there are two branches of canards in parameter space which extend across all positive forcing frequencies. In the low-frequency forcing regime, we demonstrate the existence of primary maximal canards induced by folded saddle nodes of type I and establish explicit formulas for the parameter values at which the primary maximal canards and their folds exist. Then, we turn to the intermediate- and high-frequency forcing regimes and show that the forced van der Pol possesses torus canards instead. These torus canards consist of long segments near families of attracting and repelling limit cycles of the fast system, in alternation. We also derive explicit formulas for the parameter values at which the maximal torus canards and their folds exist. Primary maximal canards and maximal torus canards correspond geometrically to the situation in which the persistent manifolds near the family of attracting limit cycles coincide to all orders with the persistent manifolds that lie near the family of repelling limit cycles. The formulas derived for the folds of maximal canards in all three frequency regimes turn out to be representations of a single formula in the appropriate parameter regimes, and this unification confirms the central numerical observation that the folds of the maximal canards created in the low-frequency regime continue directly into the folds of the maximal torus canards that exist in the intermediate- and high-frequency regimes. In addition, we study the secondary canards induced by the folded singularities in the low-frequency regime and find that the fold curves of the secondary canards turn around in the intermediate-frequency regime, instead of continuing into the high-frequency regime. Also, we identify the mechanism responsible for this turning. Finally, we show that the forced van der Pol equation is a normal form-type equation for a class of single-frequency periodically driven slow/fast systems with two fast variables and one slow variable which possess a non-degenerate fold of limit cycles. The analytic techniques used herein rely on geometric desingularisation, invariant manifold theory, Melnikov theory, and normal form methods. The numerical methods used herein were developed in Desroches et al. (SIAM J Appl Dyn Syst 7:1131–1162, 2008, Nonlinearity 23:739–765 2010).
Hot Blade Cuttings for the Building Industries

The constructions of advanced architectural designs are presently very labour intensive, time consuming, and expensive. They are therefore only applied to a few prestige projects, and it is a major challenge for the building industry to bring the costs down and thereby offer the architects more variability in the (economically allowed) designs - i.e., to allow them to think out of the box. To address this challenge The Danish National Advanced Technology Foundation (now InnovationsFonden) is currently supporting the BladeRunner project that involves several Danish companies and public institutions. The project aims to reduce the amount of manual labour as well as production time by applying robots to cut expanded polystyrene (EPS) moulds for the concrete to form doubly curved surfaces. The scheme is based upon the so-called Hot Wire or Hot Blade technology where the surfaces are essentially swept out by driving an Euler elastica through a block of EPS. This paper will be centered around the mathematical challenges encountered in the implementation of this idea. Since the elastica themselves are well known and described in the works of Euler et al. already in eighteenth century, these new challenges are mainly concerned with the rationalization of the architects' CAD drawings into surfaces that can be created via this particular sweeping and cutting technology.

General information
State: Published
Authors: Brander, D. (Intern), Bærentzen, J. A. (Intern), Evgrafov, A. (Ekstern), Gravesen, J. (Intern), Markvorsen, S. (Intern), Nørbjerg, T. B. (Intern), Nørtoft, P. (Intern), Steenstrup, K. H. (Intern)
Number of pages: 19
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BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.648 SNIP 1.738 CiteScore 1.92
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.78 SNIP 1.811 CiteScore 2.18
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.443 SNIP 1.897 CiteScore 1.91
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.827 SNIP 1.427 CiteScore 0.93
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.751 SNIP 1.951
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.482 SNIP 1.538
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.999 SNIP 1.779
Scopus rating (2007): SJR 0.974 SNIP 1.568
Scopus rating (2006): SJR 1.041 SNIP 1.408
Scopus rating (2005): SJR 1.325 SNIP 1.732
Scopus rating (2004): SJR 1.314 SNIP 1.432
Scopus rating (2003): SJR 1.526 SNIP 1.735
Scopus rating (2002): SJR 1.035 SNIP 0.915
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Source: PublicationPreSubmission
Source-ID: 118224528
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Hot Blade Cuttings for the Building Industries

The constructions of advanced architectural designs are presently very labour intensive, time consuming, and expensive. They are therefore only applied to a few prestige projects, and it is a major challenge for the building industry to bring the costs down and thereby offer the architects more variability in the (economically allowed) designs - i.e., to allow them to think out of the box. To address this challenge The Danish National Advanced Technology Foundation (now InnovationsFonden) is currently supporting the BladeRunner project that involves several Danish companies and public institutions. The project aims to reduce the amount of manual labour as well as production time by applying robots to cut expanded polystyrene (EPS) moulds for the concrete to form doubly curved surfaces. The scheme is based upon the so-called Hot Wire or Hot Blade technology where the surfaces are essentially swept out by driving an Euler elastica through a block of EPS. This paper will be centered around the mathematical challenges encountered in the implementation of this idea. Since the elastica themselves are well known and described in the works of Euler et al. already in eighteenth century, these new challenges are mainly concerned with the rationalization of the architects’ CAD drawings into surfaces that can be created via this particular sweeping and cutting technology.
New basis set for the prediction of the specific rotation in flexible biological molecules

Using a novel method based on increasingly accurate calculations, we obtain the main conformers of a set of flexible molecules. We then employ the recently developed ORP basis set for calculating the specific rotation of the found set carried out at the TD-DFT level of theory. The results are compared to those obtained with the (d-)aug-cc-pVXZ (X = D, T and Q) basis sets of Dunning et al. The ORP values are in good overall agreement with the aug-cc-pVTZ results making the ORP a good basis set for routine TD-DFT optical rotation calculations of conformationally flexible molecules. The results presented for the investigated chiral azido alcohols are to our knowledge the first estimations of their specific rotations.
On Partition of Unities Generated by Entire Functions and Gabor Frames in $L^2(\mathbb{R}^d)$ and $\ell^2(\mathbb{Z}^d)$

We characterize the entire functions $P$ of $d$ variables, $d \geq 2$, for which the $\mathbb{Z}^d$-translates of $P_x[0,N]^d$ satisfy the partition of unity for some $N \in \mathbb{N}$. In contrast to the one-dimensional case, these entire functions are not necessarily periodic. In the case where $P$ is a trigonometric polynomial, we characterize the maximal smoothness of $P_x[0,N]^d$, as well as the function that achieves it. A number of especially attractive constructions are achieved, e.g., of trigonometric polynomials leading to any desired (finite) regularity for a fixed support size. As an application we obtain easy constructions of matrix-generated Gabor frames in $L^2(\mathbb{R}^d)$, with small support and high smoothness. By sampling this yields dual pairs of finite Gabor frames in $\ell^2(\mathbb{Z}^d)$.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Yeungnam University, Ulsan National Institute of Science and Technology
Authors: Christensen, O. (Intern), Kim, H. O. (Ekstern), Kim, R. Y. (Ekstern)
Pages: 1121-1140
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Fourier Analysis and Applications
Volume: 22
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Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.09 SJR 0.755 SNIP 1.078
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.103 SNIP 1.396 CiteScore 1.42
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.116 SNIP 1.406 CiteScore 1.21
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.22 SNIP 1.464 CiteScore 1.23
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.042 SNIP 1.575 CiteScore 1.25
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.158 SNIP 2.482 CiteScore 2.7
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.431 SNIP 1.682
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.331 SNIP 1.991
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 0.948 SNIP 1.704
Web of Science (2007): Indexed yes
Scopus rating (2007): SJR 1.072 SNIP 1.781
Web of Science (2006): Indexed yes
Scopus rating (2006): SJR 0.797 SNIP 1.441
Scopus rating (2005): SJR 0.774 SNIP 1.457
On some Hermite series identities and their applications to Gabor analysis

We prove some infinite series identities for the Hermite functions. From these identities we disprove the Gabor frame set conjecture for Hermite functions of order (Formula presented.) and (Formula presented.) for (Formula presented.). The results hold not only for Hermite functions, but for two large classes of eigenfunctions of the Fourier transform associated with the eigenvalues (Formula presented.) and i, and the results indicate that the Gabor frame set of all such functions must have a rather complicated structure.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Lemvig, J. (Intern)
Pages: 899–912
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Monatshefte fuer Mathematik
Volume: 182
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.6 SJR 0.701 SNIP 0.924
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.807 SNIP 1.041 CiteScore 0.63
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.929 SNIP 1.065 CiteScore 0.66
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.866 SNIP 1.077 CiteScore 0.71
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.618 SNIP 0.984 CiteScore 0.59
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.873 SNIP 1.088 CiteScore 0.61
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.762 SNIP 0.912
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.826 SNIP 1.463
BFI (2008): BFI-level 1
On the Gabor frame set for compactly supported continuous functions

We identify a class of continuous compactly supported functions for which the known part of the Gabor frame set can be extended. At least for functions with support on an interval of length two, the curve determining the set touches the known obstructions. Easy verifiable sufficient conditions for a function to belong to the class are derived, and it is shown that the B-splines $B_N$, and certain 'continuous and truncated' versions of several classical functions (e.g., the Gaussian and the two-sided exponential function) belong to the class. The sufficient conditions for the frame property guarantees the existence of a dual window with a prescribed size of the support.

General information
State: Published
Organisations: Department of Applied Chemistry, Department of Applied Mathematics and Computer Science, Mathematics, Yeungnam University, Division of General Studies
Authors: Christensen, O. (Intern), Kim, H. O. (Ekstern), Kim, R. Y. (Ekstern)
Number of pages: 17
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Main Research Area: Technical/natural sciences

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Journal: Journal of Inequalities and Applications
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
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BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.767 SNIP 0.708 CiteScore 0.75
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.483 SNIP 0.576 CiteScore 0.57
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.387 SNIP 0.734 CiteScore 0.74
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.376 SNIP 0.728 CiteScore 0.85
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.512 SNIP 0.757 CiteScore 0.87
On the Number of Rational Points on Prym Varieties over Finite Fields

We give upper and lower bounds for the number of rational points on Prym varieties over finite fields. Moreover, we determine the exact maximum and minimum number of rational points on Prym varieties of dimension 2.
On Various R-duals and the Duality Principle

The duality principle states that a Gabor system is a frame if and only if the corresponding adjoint Gabor system is a Riesz sequence. In general Hilbert spaces and without the assumption of any particular structure, Casazza, Kutyniok and Lammers have introduced the so-called R-duals that also lead to a characterization of frames in terms of associated Riesz sequences; however, it is still an open question whether this abstract theory is a generalization of the duality principle. In this paper we prove that a modified version of the R-duals leads to a generalization of the duality principle that keeps all the attractive properties of the R-duals. In order to provide extra insight into the relations between a given sequence and its R-duals, we characterize all the types of R-duals that are available in the literature for the special case where the underlying sequence is a Riesz basis.
Patterns of a slow air-water flow in a semispherical container

This numerical study analyzes the development of eddies in a slow steady axisymmetric air-water flow in a sealed semispherical container, driven by a rotating top disk. As the water height, $H_w$, increases, new flow cells emerge in both water and air. First, an eddy emerges near the axis-bottom intersection. Then this eddy expands and reaches the interface, inducing a new cell in the air flow. This cell appears as a thin near-axis layer which then expands and occupies the entire air domain. As the disk rotation intensifies at $H_w = 0.8$, the new air cell shrinks to the axis and disappears. The bulk water circulation becomes separated from the interface by a thin layer of water counter-circulation. These changes in the flow topology occur due to (a) competing effects of the air meridional flow and swirl, which drive meridional motions of opposite directions in water, and (b) feedback of water flow on the air flow. In contrast to flows in cylindrical and conical containers, there is no interaction with Moffatt corner vortices here.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Office for Study Programmes and Student Affairs, Universidad de Sevilla, Shtern Research and Consulting
Authors: Balci, A. (Intern), Brøns, M. (Intern), Herrada, M. A. (Ekstern), Shtern, V. N. (Ekstern)
Pages: 1-8
Publication date: 2016
Rationalization with ruled surfaces in architecture
This thesis addresses the problems of rationalizing and segmenting large scale 3D models, and how to handle difficult production constraints in this area. The design choices when constructing large scale architecture are influenced by the budget. Therefore I strive to minimize the amount of time and material needed for production. This makes advanced free form architecture viable for low cost projects, allowing the architects to realize their designs.

By pre-cutting building blocks using hot wire robots, the amount of milling necessary can be reduced drastically. I do this by rationalizing the intended shape as a piecewise ruled surface; the developed method was able to cut away up to 95% of the excess material. Methods were developed to minimize the number of blocks necessary to build advanced large scale 3D shapes. Using stochastic optimization to guide the segmentation, it was possible to remove up to 48% of the building blocks. Hot blade cutting for constructing models with positive Gauss curvature is an upcoming technology. Three segmentation algorithms were developed to solve construction constraints that arises when using this technique. One of the algorithms focusses on creating an aesthetic segmentation.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Image Analysis & Computer Graphics, Mathematics
Authors: Steenstrup, K. H. (Intern), Gravesen, J. (Intern), Bærentzen, J. A. (Intern)
Number of pages: 70
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Relations
Projects:
Rationalization with ruled surfaces in architecture
Publication: Research › Ph.D. thesis – Annual report year: 2016

Regularization by External Variables
Regularization was a big topic at the 2016 CRM Intensive Research Program on Advances in Nonsmooth Dynamics. There are many open questions concerning well known kinds of regularization (e.g., by smoothing or hysteresis). Here, we propose a framework for an alternative and important kind of regularization, by external variables that shadow either the state or the switch of the original system. The shadow systems are derived from and inspired by various applications in electronic control, predator-prey preference, time delay, and genetic regulation.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Victoria, University of Manchester, University of Bristol
Authors: Bossolini, E. (Intern), Edwards, R. (Ekstern), Glendinning, P. A. (Ekstern), Jeffrey, M. R. (Ekstern), Webber, S. (Ekstern)
Pages: 19-24
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10.1007/978-3-319-55642-0_4
Reproducing formulas for generalized translation invariant systems on locally compact abelian groups

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Jakobsen, M. S. (Intern), Lemvig, J. (Intern)
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Main Research Area: Technical/natural sciences

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Web of Science (2018): Indexed yes
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 2.233 SNIP 1.871 CiteScore 1.34
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.171 SNIP 1.775 CiteScore 1.18
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.392 SNIP 1.688 CiteScore 1.13
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.272 SNIP 1.764 CiteScore 1.09
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.067 SNIP 1.705 CiteScore 1.07
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.029 SNIP 1.643 CiteScore 1.07
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.203 SNIP 1.572
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.897 SNIP 1.576
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.066 SNIP 1.744
Scopus rating (2007): SJR 1.648 SNIP 1.58
Scopus rating (2006): SJR 1.973 SNIP 1.656
Scopus rating (2005): SJR 2.107 SNIP 1.615
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.84 SNIP 1.396
Scopus rating (2003): SJR 1.697 SNIP 1.428
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.694 SNIP 1.363
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.523 SNIP 1.462
Robotic Hot-Blade Cutting: An Industrial Approach to Cost-Effective Production of Double Curved Concrete Structures

This paper presents a novel method for cost-effective, robotic production of double curved formwork in Expanded Polystyrene (EPS) for in situ and prefabricated concrete construction. A rationalization and segmentation procedure is developed, which allows for the transliteration of double curved NURBS surfaces to Euler elastica surface segments, while respecting various constraints of production. An 18 axis, tri-robot system approximates double curved NURBS surfaces by means of an elastically deformed and heated blade, mounted on the flanges of two manipulators. Re-orienting or translating either end of the blade dynamically deforms the blade’s curvature. The blade follows the contours of the rationalized surface by continuous change in position and orientation of the end-effectors. The concept’s potential is studied by a pilot production of a full-scale demonstrator panel assembly.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Image Analysis & Computer Graphics, Department of Mechanical Engineering, Manufacturing Engineering, Odico Formwork Robotics Aps, GXN A/S, Danish Technological Institute
Pages: 150-164
Publication date: 2016

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Publisher: Springer
Editors: Reinhardt, D., Saunders, R., Burry, J.
ISBN (Print): 978-3-319-26376-2
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Main Research Area: Technical/natural sciences
Robotic fabrication, Hot-Blade, EPS-molds, Cost-efficiency, concrete structures
DOIs: 10.1007/978-3-319-26378-6_11
Source: PublicationPreSubmission
Source-ID: 125390367
Publication: Research - peer-review › Book chapter – Annual report year: 2016

Sculpturing Surfaces with Cartan Ribbons
Using the concepts of Cartan development and rolling from differential geometry we develop a method for sculpturing any surface with the use of Cartan ribbons.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Department of Micro- and Nanotechnology, Theoretical Biophysics
Authors: Raffaelli, M. (Intern), Bohr, J. (Intern), Markvorsen, S. (Intern)
Pages: 457-460
Publication date: 2016

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Title of host publication: Proceedings of Bridges 2016: Mathematics, Music, Art, Architecture, Education, Culture
Publisher: Tessellations Publishing
ISBN (Print): 978-1-938664-19-9
Series: Bridges (Winfield)
Sixth International Symposium on Bifurcations and Instabilities in Fluid Dynamics (BIFD2015): Foreword

Hydrodynamic stability is of fundamental importance in fluid dynamics. As a well-established subject of scientific investigation, it continues to attract great interest in the fluid mechanics community. Bifurcations and instabilities are observed in all areas of fundamental and applied fluid dynamics and remain a challenge for experimental, theoretical and computational studies. Examples of prototypical hydrodynamic instabilities are the Rayleigh–Bénard, Taylor–Couette, Bénard–Marangoni, Rayleigh–Taylor, and Kelvin–Helmholtz instabilities. A fundamental understanding of bifurcation patterns requires the identification of mechanisms responsible for the instability. From an applied point of view, such knowledge is also necessary in order to design reliable and efficient industrial processes, such as melting, mixing, crystal growth, coating, and welding. Modeling of instability mechanisms in biological and biomedical devices is currently a very active and rapidly developing area of research with important biotechnological and medical applications, such as biofilm engineering and wound healing. The understanding of symmetry-breaking in hemodynamics could have important consequences for vascular diseases, such as atherosclerotic and vulnerable plaques, abdominal aortic aneurisms, carotid artery disease, and pulmonary embolisms and implications for vascular interventions such as grafting and stenting. The collection of papers in this issue is a selection of the presentations given at the Sixth International Symposium on Instability and Bifurcations in Fluid Dynamics (BIFD) held at the ESPCI, Paris, 15–17 July 2015. With four invited and nearly 400 contributed talks, the symposium gave an overview of the state of the art of the field including experimental, theoretical, and computational approaches to convection, effects of magnetic fields, wake flows, rotating flows, and many other problems. The complete program can be found at the conference website http://bifd2015.sciencesconf.org/.
Spherical Surfaces

We study surfaces of constant positive Gauss curvature in Euclidean 3-space via the harmonicity of the Gauss map. Using the loop group representation, we solve the regular and the singular geometric Cauchy problems for these surfaces, and use these solutions to compute several new examples. We give the criteria on the geometric Cauchy data for the generic singularities, as well as for the cuspidal beaks and cuspidal butterfly singularities. We consider the bifurcations of generic one parameter families of spherical fronts and provide evidence that suggests that these are the cuspidal beaks, cuspidal butterfly and one other singularity. We also give the loop group potentials for spherical surfaces with finite order rotational symmetries and for surfaces with embedded isolated singularities.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science , Mathematics
Authors: Brander, D. (Intern)
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Journal: Experimental Mathematics
Volume: 25
Issue number: 3
ISSN (Print): 1058-6458
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
The structure of dual Grassmann codes

In this article we study the duals of Grassmann codes, certain codes coming from the Grassmannian variety. Exploiting their structure, we are able to count and classify all their minimum weight codewords. In this classification the lines lying on the Grassmannian variety play a central role. Related codes, namely the affine Grassmann codes, were introduced more recently in Beelen et al. (IEEE Trans Inf Theory 56(7):3166–3176, 2010), while their duals were introduced and studied in Beelen et al. (IEEE Trans Inf Theory 58(6):3843–3855, 2010). In this paper we also classify and count the minimum weight codewords of the dual affine Grassmann codes. Combining the above classification results, we are able to show that the dual of a Grassmann code is generated by its minimum weight codewords. We use these properties to establish that the increase of value of successive generalized Hamming weights of a dual Grassmann code is 1 or 2.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Beelen, P. (Intern), Pinero, F. (Intern)
Pages: 451-470
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Topological Fluid Dynamics For Free and Viscous Surfaces

In an incompressible fluid flow, streamline patterns and their bifurcations are investigated close to wall for two-dimensional system and close to free and viscous surfaces in three-dimensional system. Expanding the velocity field in a Taylor series, we conduct a local analysis at the given expansion point. Applying the boundary conditions, some relations are obtained among the coefficients of the expansions. Series of coordinate transformations, which preserves the boundary conditions, are used to reduce the number of coefficients. Finally, using the normal form and unfolding theory, the velocity field is analysed structurally and bifurcation diagrams are obtained.

First, two-dimensional viscous flow close to wall for non-simple degenerate critical point is considered depending on three-parameter space. Second, threedimensional axisymmetric, viscous and steady flow is analysed close to free and viscous surfaces into three situations: Local analysis close to center axis; away from the axis and close to a stationary wall. Next, in the absence of axisymmetric condition, three-dimensional viscous flow is consider close to a free surface.

As an application of the bifurcation diagrams for three-dimensional axisymmetric viscous flow, three different shaped container driven by a rotating top disk is considered. Using a spectral collocation method, a code is constructed to obtain the meridional and swirl velocities. In a result of this code, all structural changes on the streamline patterns are observed and the occurring bifurcations are determined. These bifurcations are compared with the bifurcations obtained from topologically.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Balci, A. (Intern), Brøns, M. (Intern)
Number of pages: 194
Publication date: 2016

Wavelets for Non-expanding Dilations and the Lattice Counting Estimate

We show that problems of existence and characterization of wavelets for non-expanding dilations are intimately connected with the geometry of numbers; more specifically, with a bound on the number of lattice points in balls dilated by the powers of a dilation matrix \(A \in \text{GL}(n, \mathbb{R})\). This connection is not visible for the well-studied class of expanding dilations since the desired lattice counting estimate holds automatically. We show that the lattice counting estimate holds for all dilations \(A\) with \(|\det A|\neq 1\) and for almost every lattice \(\Gamma\) with respect to the invariant probability measure on the set of lattices. As a consequence, we deduce the existence of minimally supported frequency (MSF) wavelets associated with such dilations for almost every choice of a lattice. Likewise, we show that MSF wavelets exist for all lattices and almost every choice of a dilation \(A\) with respect to the Haar measure on \(\text{GL}(n, \mathbb{R})\).

General information

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Authors: Bownik, M. (Ekstern), Lemvig, J. (Intern)
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A flow meter for ultrasonically measuring the flow velocity of fluids.

The invention regards a flow meter for ultrasonically measuring the flow velocity of fluids comprising a duct having a flow channel with an internal cross section comprising variation configured to generate at least one acoustic resonance within the flow channel for a specific ultrasonic frequency, and at least two transducers for generating and sensing ultrasonic pulses, configured to transmit ultrasonic pulses at least at said specific ultrasonic frequency into the flow channel such that the ultrasonic pulses propagate through a fluid flowing in the flow channel, wherein the flow meter is configured to determine the flow velocity of the fluid flowing in the flow channel based on a change in transit time, phase and/or pulse such as amplitude and/or form, of the ultrasonic pulses.
A characterization of tight and dual generalized translation invariant frames

We present results concerning generalized translation invariant (GTI) systems on a second countable locally compact abelian group $G$. These are systems with a family of generators $\{g_j, P_j\}_{j \in J}$, $P_j \subset L^2(G)$, where $J$ is a countable index set, and $P_j$ are certain measure spaces. Furthermore, for each $j$ we let $G_j$ be a closed subgroup of $G$ such that $G/G_j$ is compact. A GTI system is then the collection of functions $U_j \{g_j, P(\cdot - \gamma_j), \gamma_j \in G_j, P_j\}$. Many well known systems, such as wavelet, shearlet and Gabor systems, both the discrete and continuous types, are GTI systems. We characterize when such systems form tight frames, and when two GTI Bessel systems form dual frames for $L^2(G)$. In particular, this offers a unified approach to the theory of discrete and continuous frames and, e.g., yields well known results for discrete and continuous Gabor and wavelet systems.

A Finsler geodesic spray paradigm for wildfire spread modelling

One of the finest and most powerful assets of Finsler geometry is its ability to model, describe, and analyze in precise geometric terms an abundance of physical phenomena that are genuinely asymmetric, see e.g. [1, 2, 3, 4, 5, 6, 7, 8, 9]. In this paper we show how wildfires can be naturally included into this family. Specifically we show how the celebrated and much applied Richards' equations for the large scale elliptic wildfire spreads have a rather simple Finsler-geometric formulation. The general Finsler framework can be explicitly 'integrated' to provide detailed - and curvature sensitive - geodesic solutions to the wildfire spread problem. The methods presented here stem directly from first principles of 2-dimensional Finsler geometry, and they can be readily extracted from the seminal monographs [10] and [11], but we will take special care to introduce and exemplify the necessary framework for the implementation of the geometric machinery into this new application - not least in order to facilitate and support the dialog between geometers and the wildfire modelling community. The 'integration' part alluded to above is obtained via the geodesics of the ensuing Finsler metric.
which represents the local fire templates. The 'paradigm' part of the present proposal is thus concerned with the corresponding shift of attention from the actual fire-lines to consider instead the geodesic spray - the 'fire-particles' - which together, side by side, mold the fire-lines at each instant of time and thence eventually constitute the local and global structure of the wildfire spread.

**General information**

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Authors: Markvorsen, S. (Intern)  
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Scopus rating (2011): SJR 1.792 SNIP 1.515 CiteScore 2.43  
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Scopus rating (2005): SJR 0.678 SNIP 1.18  
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Finsler geometry, Wildfire spread, Geodesic spray, Richards' equations, Zermelo data, Huyghens' enveloping principle, Hamilton orthogonality, First variation of arc length, indicatrix Fields, Fire templates, Strongly convex ovals  
Electronic versions:  
Wildfire_06.pdf
An algebraic approach to graph codes
This thesis consists of six chapters. The first chapter contains a short introduction to coding theory in which we explain the coding theory concepts we use. In the second chapter, we present the required theory for evaluation codes and also give an example of some fundamental codes in coding theory as evaluation codes. Chapter three consists of the introduction to graph based codes, such as Tanner codes and graph codes. In Chapter four, we compute the dimension of some graph based codes with a result combining graph based codes and subfield subcodes. Moreover, some codes in chapter four are optimal or best known for their parameters. In chapter five we study some graph codes with Reed–Solomon component codes. The underlying graph is well known and widely used for its good characteristics. This helps us to compute the dimension of the graph codes. We also introduce a combinatorial concept related to the iterative encoding of graph codes with MDS component code. The last chapter deals with affine Grassmann codes and Grassmann codes. We begin with some previously known codes and prove that they are also Tanner codes of the incidence graph of the point–line partial geometry of the Grassmannian. We expect that the techniques exposed in chapter six are also applicable to other codes as well.

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Bifurcation Analysis of Structures in a Convection Model

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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Plasma Physics and Fusion Energy, Department of Physics
Authors: Dam, M. (Intern), Brøns, M. (Intern), Rasmussen, J. J. (Intern), Naulin, V. (Intern)
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Codimension three bifurcation of streamline patterns close to a no-slip wall: A topological description of boundary layer eruption
A vortex close to a no-slip wall gives rise to the creation of new vorticity at the wall. This vorticity may organize itself into vortices that erupt from the separated boundary layer. We study how the eruption process in terms of the streamline topology is initiated and varies in dependence of the Reynolds number Re. We show that vortex structures are created in the boundary layer for Re around 600, but that these disappear again without eruption unless Re > 1000. The eruption process is topologically unaltered for Re up to 5000. Using bifurcation theory, we obtain a topological phase space for the eruption process, which can account for all observed changes in the Reynolds number range we consider. The bifurcation diagram complements previously analyzes such that the classification of topological bifurcations of flows close to no-slip walls with up to three parameters is now complete.
Computation of saddle-type slow manifolds using iterative methods

This paper presents an alternative approach for the computation of trajectory segments on slow manifolds of saddle type. This approach is based on iterative methods rather than collocation-type methods. Compared to collocation methods, which require mesh refinements to ensure uniform convergence with respect to \( \epsilon \), appropriate estimates are directly attainable using the method of this paper. The method is applied to several examples, including a model for a pair of neurons coupled by reciprocal inhibition with two slow and two fast variables, and the computation of homoclinic connections in the FitzHugh–Nagumo system.

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Curve Matching with Applications in Medical Imaging

In the recent years, Riemannian shape analysis of curves and surfaces has found several applications in medical image analysis. In this paper we present a numerical discretization of second order Sobolev metrics on the space of regular curves in Euclidean space. This class of metrics has several desirable mathematical properties. We propose numerical solutions for the initial and boundary value problems of finding geodesics. These two methods are combined in a Riemannian gradient-based optimization scheme to compute the Karcher mean. We apply this to a study of the shape variation in HeLa cell nuclei and cycles of cardiac deformations, by computing means and principal modes of variations.

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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Technische Universität Wien, Brunel University, ETH Zurich
Authors: Bauer, M. (Ekstern), Bruveris, M. (Ekstern), Harms, P. (Ekstern), Møller-Andersen, J. (Intern)
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Curve matching, Sobolev metrics, Riemannian shape analysis, Discrete geodesics, Minimizing geodesics
Deformations of constant mean curvature surfaces preserving symmetries and the Hopf differential

We define certain deformations between minimal and non-minimal constant mean curvature (CMC) surfaces in Euclidean space $\mathbb{E}^3$ which preserve the Hopf differential. We prove that, given a CMC $H$ surface $f$, either minimal or not, and a fixed basepoint $z_0$ on this surface, there is a naturally defined family $f_h$, for all real $h$, of CMC $h$ surfaces that are tangent to $f$ at $z_0$, and which have the same Hopf differential. Given the classical Weierstrass data for a minimal surface, we give an explicit formula for the generalized Weierstrass data for the non-minimal surfaces $f_h$, and vice versa. As an application, we use this to give a well-defined dressing action on the class of minimal surfaces. In addition, we show that symmetries of certain types associated with the basepoint are preserved under the deformation, and this gives a canonical choice of basepoint for surfaces with symmetries. We use this to define new examples of non-minimal CMC surfaces naturally associated to known minimal surfaces with symmetries.
Density and duality theorems for regular Gabor frames

We investigate Gabor frames on locally compact abelian groups with time–frequency shifts along non-separable, closed subgroups of the phase space. Density theorems in Gabor analysis state necessary conditions for a Gabor system to be a frame or a Riesz basis, formulated only in terms of the index subgroup. In the classical results the subgroup is assumed to be discrete. We prove density theorems for general closed subgroups of the phase space, where the necessary conditions are given in terms of the “size” of the subgroup. From these density results we are able to extend the classical Wexler–Raz biorthogonal relations and the duality principle in Gabor analysis to Gabor systems with time–frequency shifts along non-separable, closed subgroups of the phase space. Even in the euclidean setting, our results are new.

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Scopus rating (2010): SJR 2.6 SNIP 1.6
Directional Time-frequency Analysis via Continuous Frames

Grafakos and Sansing [‘Gabor frames and directional time–frequency analysis’, Appl. Comput. Harmon. Anal. 25 (2008), 47–67] have shown how to obtain directionally sensitive time–frequency decompositions in $L^2(\mathbb{R}^n)$ based on Gabor systems in $L^2(\mathbb{R})$. The key tool is the ‘ridge idea’, which lifts a function of one variable to a function of several variables. We generalise their result in two steps: first by showing that similar results hold starting with general frames for $L^2(\mathbb{R})$, in the settings of both discrete frames and continuous frames, and second by extending the representations to Sobolev spaces. The first step allows us to apply the theory to several other classes of frames, for example wavelet frames and shift-invariant systems, and the second one significantly extends the class of examples and applications. We consider applications to the Meyer wavelet and complex B-splines. In the special case of wavelet systems we show how to discretise the representations using $\epsilon$-nets.
Duality results for co-compact Gabor systems

In this paper we give an account of recent developments in the duality theory of Gabor frames. We prove the Wexler-Raz biorthogonality relations and the duality principle for co-compact Gabor systems on second countable, locally compact abelian groups $G$. Our presentation does not rely on the existence of uniform lattices in $G$.

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Ends, fundamental tones and capacity of minimal submanifolds via extrinsic comparison theory
We study the volume of extrinsic balls and the capacity of extrinsic annuli in minimal submanifolds which are properly immersed with controlled radial sectional curvatures into an ambient manifold with a pole. The key results are concerned
with the comparison of those volumes and capacities with the corresponding entities in a rotationally symmetric model manifold. Using the asymptotic behavior of the volumes and capacities we then obtain upper bounds for the number of ends as well as estimates for the fundamental tone of the submanifolds in question.

First Dirichlet eigenvalue, Capacity, Effective resistance, Minimal submanifolds, Fundamental tone
Extending the zero-derivative principle for slow–fast dynamical systems

Slow–fast systems often possess slow manifolds, that is invariant or locally invariant sub-manifolds on which the dynamics evolves on the slow time scale. For systems with explicit timescale separation, the existence of slow manifolds is due to Fenichel theory, and asymptotic expansions of such manifolds are easily obtained. In this paper, we discuss methods of approximating slow manifolds using the so-called zero-derivative principle. We demonstrate several test functions that work for systems with explicit time scale separation including ones that can be generalized to systems without explicit timescale separation. We also discuss the possible spurious solutions, known as ghosts, as well as treat the Templator system as an example.

General information

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Authors: Benoît, E. (Ekstern), Brøns, M. (Intern), Desroches, M. (Ekstern), Krupa, M. (Ekstern)
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Scopus rating (2011): SJR 0.728 SNIP 0.976 CiteScore 1.03
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.714 SNIP 1.04
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.727 SNIP 1.236
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BFI (2008): BFI-level 1
Fourier-like frames on locally compact abelian groups
We consider a class of functions, defined on a locally compact abelian group by letting a class of modulation operators act
on a countable collection of functions. We derive sufficient conditions for such a class of functions to form a Bessel
sequence or a frame and for two such systems to be dual frames. Explicit constructions are obtained via various
generalizations of the classical B-splines to the setting of locally compact abelian groups. (C) 2014 Elsevier Inc. All rights
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Authors: Christensen, O. (Intern), Goh, S. S. (Ekstern)
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Scopus rating (2014): SJR 0.935 SNIP 1.256 CiteScore 0.96
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Web of Science (2013): Indexed yes
Gabor Analysis for Imaging

In contrast to classical Fourier analysis, time–frequency analysis is concerned with localized Fourier transforms. Gabor analysis is an important branch of time–frequency analysis. Although significantly different, it shares with the wavelet transform methods the ability to describe the smoothness of a given function in a location-dependent way.

The main tool is the sliding window Fourier transform or short-time Fourier transform (STFT) in the context of audio signals. It describes the correlation of a signal with the time–frequency shifted copies of a fixed function (or window or atom). Thus, it characterizes a function by its transform over phase space, which is the time–frequency plane (TF-plane) in a musical context or the location–wave-number domain in the context of image processing.

Since the transition from the signal domain to the phase space domain introduces an enormous amount of data redundancy, suitable subsampling of the continuous transform allows for complete recovery of the signal from the sampled STFT. The knowledge about appropriate choices of windows and sampling lattices has increased significantly during the last three decades. Since the suggestion goes back to the idea of D. Gabor [45], this branch of TF analysis is called Gabor analysis. Gabor expansions are not only of interest due to their very natural interpretation but also algorithmically convenient due to a good understanding of algebraic and analytic properties of Gabor families.

In this chapter, we describe some of the generalities relevant for an understanding of Gabor analysis of functions on $\mathbb{R}^d$. We pay special attention to the case $d=2$, which is the most important case for image processing and image analysis applications.

The chapter is organized as follows. Section 2 presents central tools from functional analysis in Hilbert spaces, e.g., the pseudo-inverse of a bounded operator and the central facts from frame theory. In Sect. 3, we introduce several operators that play important roles in Gabor analysis. Gabor frames on $L^2(\mathbb{R}^d)$ are introduced in Sect. 4, and their discrete counterpart are treated in Sect. 5. Finally, the application of Gabor expansions to image representation is considered in Sect. 6.
Good families of Drinfeld modular curves

In this paper, we investigate examples of good and optimal Drinfeld modular towers of function fields. Surprisingly, the optimality of these towers has not been investigated in full detail in the literature. We also give an algorithmic approach for obtaining explicit defining equations for some of these towers and, in particular, give a new explicit example of an optimal tower over a quadratic finite field.
Good towers of function fields

Algebraic curves are used in many different areas, including error-correcting codes. In such applications, it is important that the algebraic curve $C$ meets some requirements. The curve must be defined over a finite field $\mathbb{F}(q)$ with $q$ elements, and then the curve also should have many points over this field. There are limits on how many points $N(C)$ an algebraic curve $C$ defined over a finite field can have.

An invariant of the curve which is important in this context is the curve’s genus $g(C)$. Hasse and Weil proved that $N(C) \leq q+1+2g(C) \sqrt{q}$, and this bound cannot in general be improved. However, if the genus is large compared with $q$, the bound can be improved. Drinfeld and Vladut showed the asymptotic result:

$$A(q) = \limsup \left( \frac{N(C)}{g(C)} \to \infty \frac{g(C)}{g(C)} \right) \leq \sqrt{q-1}.$$ 

The quantity $A(q)$ is called Ihara’s constant. If $q$ is a square, it is known that $A(q)=\sqrt{q-1}$, while the value of the $A(q)$ is unknown for all other values of $q$.

In this thesis, we study a construction using Drinfeld modules that produces explicitly defined families of algebraic curves that asymptotically achieve Ihara’s constant. Such families of curves can also be described using towers of function fields. Restated in this language the aim of the project is to find good and optimal towers. Using the theory of Drinfeld modules and computer algebraic techniques, some new examples of good towers are obtained. We analyse towers of Drinfeld modular curves describing certain equivalence classes of rank 2 Drinfeld modules. Using rank 3 Drinfeld modules further examples of good towers are produced.

Isogeometric analysis of sound propagation through laminar flow in 2-dimensional ducts

We consider the propagation of sound through a slowly moving fluid in a 2-dimensional duct. A detailed description of a flow-acoustic model of the problem using B-spline based isogeometric analysis is given. The model couples the nonlinear, steady-state, incompressible Navier-Stokes equation in the laminar regime for the flow field, to a linear, time-harmonic acoustic equation in the low Mach number regime for the sound signal. B-splines are used both to represent the duct geometry and to approximate the flow and sound fields. This facilitates an exact representation of complex duct geometries, as well as high continuity approximations of state variables. Acoustic boundary conditions on artificial truncation boundaries are treated using a mode matching formulation. We validate the model against known acoustic modes for a uniform flow through a straight duct. Improved error convergence rates are found when the acoustic pressure is approximated by higher order polynomials. Based on the model, we examine how the acoustic signal varies with sound frequency, flow speed and duct geometry. A combination of duct geometry and sound frequency is identified for which the acoustic signal is particularly sensitive to the flow speed.
Linear codes associated to determinantal varieties

We consider a class of linear codes associated to projective algebraic varieties defined by the vanishing of minors of a fixed size of a generic matrix. It is seen that the resulting code has only a small number of distinct weights. The case of varieties defined by the vanishing of 2×2 minors is considered in some detail. Here we obtain the complete weight distribution. Moreover, several generalized Hamming weights are determined explicitly and it is shown that the first few of them coincide with the distinct nonzero weights. One of the tools used is to determine the maximum possible number of matrices of rank 1 in a linear space of matrices of a given dimension over a finite field. In particular, we determine the structure and the maximum possible dimension of linear spaces of matrices in which every nonzero matrix has rank 1.
Linear complexity for multidimensional arrays - a numerical invariant

Linear complexity is a measure of how complex a one dimensional sequence can be. In this paper we extend the concept of linear complexity to multiple dimensions and present a definition that is invariant under well-orderings of the arrays. As a result we find that our new definition for the process introduced in the patent titled “Digital Watermarking” produces arrays with good asymptotic properties.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Universidad de Cantabria, Gauss Research Foundation, University of Puerto Rico
Authors: Gomez-Perez, D. (Ekstern), Høholdt, T. (Intern), Moreno, O. (Ekstern), Rubio, I. (Ekstern)
Pages: 2697-2701
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Mathematical modelling of membrane separation

This thesis concerns mathematical modelling of membrane separation. The thesis consists of introductory theory on membrane separation, equations of motion, and properties of dextran, which will be the solute species throughout the thesis. Furthermore, the thesis consist of three separate mathematical models, each with a different approach to membrane separation.

The first model is a statistical model investigating the interplay between solute shape and the probability of entering the membrane. More specific the transition of solute particles from being spherical to becoming more elongated as prolate ellipsoids with the same volume. The porous membrane is assumed isotropic such that the model reduces to a two dimensional model. With this assumption ellipsoids with the same volume reduces to ellipses with the same area. The model finds the probability of entering the pore of the membrane. It is found that the probability of entering the pore is highest when the largest of the radii in the ellipse is equal to half the radius of the pore, in case of molecules with circular radius less than the pore radius. The results are directly related to the macroscopic distribution coefficient and the rejection coefficient.

The second model is a stationary model for the flux of solvent and solute in a hollow fibre membrane. In the model we solve the time independent equations for transport of solvent and solute within the hollow fibre. Furthermore, the flux of solute and solvent through the membrane is coupled through the boundary conditions. The model investigates how the true and observed rejection coefficient depends on the transmembrane pressure, the average inlet velocity, and the molecular weight. Furthermore, the effect of concentration dependent viscosity on the rejection coefficients is investigated. The results show that the true rejection coefficient is increasing as a function of increasing transmembrane pressure, increasing inlet velocity, and decreasing molecular weight. Furthermore, it is found that a concentration dependent viscosity decreases the true rejection. The observed rejection is increasing for decreasing molecular weight and increasing inlet velocities. The observed rejection can be either increasing or decreasing as a function of increasing transmembrane pressure. Moreover, the observed rejection is reduced when the viscosity depends on the concentration. The study is a time dependent model of back-shocking. During back-shocking the pressure difference across the membrane is reversed for a given time. This implies that the concentration polarization at the membrane surface is flushed away. When the pressure is reversed back to normal the membrane performs better resulting in an increased average flux. Two models of the problem was made.

In a two dimensional model, limited to capture the dynamics close to the membrane, a positive effect was observed on both the observed rejection and the average solvent flux. Furthermore, an analytical upper estimate for the optimal back-shock time is given. In a three dimensional model, where the flow within the entire hollow fibre is modelled, the mentioned upper estimate is used to obtain a positive effect on both the observed rejection and the average solvent flux. Moreover, the effect of a concentration dependent viscosity was investigated. It was found that the average flux compared to the steady-state solution increased when the viscosity depends on the concentration.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Vinther, F. (Intern), Brøns, M. (Intern), Meyer, A. S. (Intern)
Number of pages: 130
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Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Original language: English

Series: DTU Compute PHD-2013
Number: 320
ISSN: 0909-3192
Main Research Area: Technical/natural sciences
Electronic versions:
phd320_Vinther_F.pdf
Publication: Research › Ph.D. thesis – Annual report year: 2015

Mixed-Mode Oscillations Due to a Singular Hopf Bifurcation in a Forest Pest Model

In a forest pest model, young trees are distinguished from old trees. The pest feeds on old trees. The pest grows on a fast scale, the young trees on an intermediate scale, and the old trees on a slow scale. A combination of a singular Hopf bifurcation and a “weak return” mechanism, characterized by a small change in one of the variables, determines the features of the mixed-mode oscillations. Period-doubling and saddle-node bifurcations lead to closed families (called isolas) of periodic solutions in a bifurcation corresponding to a singular Hopf bifurcation.
On extensions of wavelet systems to dual pairs of frames

It is an open problem whether any pair of Bessel sequences with wavelet structure can be extended to a pair of dual frames by adding a pair of singly generated wavelet systems. We consider the particular case where the given wavelet systems are generated by the multiscale setup with trigonometric masks and provide a positive answer under extra assumptions. We also identify a number of conditions that are necessary for the extension to dual (multi-) wavelet frames with any number of generators, and show that they imply that an extension with two pairs of wavelet systems is possible. Along the way we provide examples that demonstrate the extra flexibility in the extension to dual pairs of frames compared with the more popular extensions to tight frames.

General information

State: Published
Organisations: Department of Applied Chemistry, Department of Applied Mathematics and Computer Science, Mathematics, Division of General Studies, Yeungnam University
Authors: Christensen, O. (Intern), Kim, H. O. (Ekstern), Kim, R. Y. (Ekstern)
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Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.3 SJR 0.848 SNIP 1.06
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.161 SNIP 1.354 CiteScore 1.33
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.307 SNIP 1.54 CiteScore 1.57
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.039 SNIP 1.604 CiteScore 1.5
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.05 SNIP 1.696 CiteScore 1.42
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.946 SNIP 1.347 CiteScore 1.11
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.311 SNIP 1.154
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.952 SNIP 1.643
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.761 SNIP 1.071
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.92 SNIP 1.08
Web of Science (2007): Indexed yes
On Gabor frames generated by sign-changing windows and B-splines

For a class of compactly supported windows we characterize the frame property for a Gabor system \( \{ E^{\text{m,n}}_{a,b} \}_{m,n} \), for translation parameters \( a \) belonging to a certain range depending on the support size. We show that the obstructions to the frame property are located on a countable number of "curves." For functions that are positive on the interior of the support these obstructions do not appear, and the considered region in the \((a,b)\) plane is fully contained in the frame set. In particular this confirms a recent conjecture about B-splines by Gröchenig in that particular region. We prove that the full conjecture is true if it can be proved in a certain "hyperbolic strip."

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Yeungnam University, Ulsan National Institute of Science and Technology
Authors: Christensen, O. (Intern), Kim, H. O. (Ekstern), Kim, R. Y. (Ekstern)
Pages: 534-544
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Publication information

Journal: Applied and Computational Harmonic Analysis
Volume: 39
Issue number: 3
ISSN (Print): 1063-5203
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.73 SJR 1.594 SNIP 1.781
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.524 SNIP 1.818 CiteScore 2.46
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.906 SNIP 2.909 CiteScore 3.27
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.857 SNIP 2.95 CiteScore 3.3
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
On R-duals and the duality principle

In 2004 Casazza, Kutyniok and Lammers introduced the R-duals of sequences in a general Hilbert space. The purpose was to obtain a general version of the duality principle in Gabor analysis. It was shown that the R-duals cover the duality principle for tight Gabor frames and Gabor Riesz bases. In this paper we discuss the relationship between the R-duals and a variant, called R-duals of type III, introduced in 2014. In contrast to the original R-duals, it is known that the R-duals of type III generalize the duality principle for all Gabor frames, but we believe that a smaller and more convenient class will work as well. The purpose of the paper is to give a focussed presentation of the R-duals of type I and III that can trigger the research on this.
On R-Duals and the Duality Principle in Gabor Analysis

The concept of R-duals of a frame was introduced by Casazza, Kutyniok and Lammers in 2004, with the motivation to obtain a general version of the duality principle in Gabor analysis. For tight Gabor frames and Gabor Riesz bases the three authors were actually able to show that the duality principle is a special case of general results for R-duals. In this paper we introduce various alternative R-duals, with focus on what we call R-duals of type II and III. We show how they are related and provide characterizations of the R-duals of type II and III. In particular, we prove that for tight frames these classes coincide with the R-duals by Casazza et al., which is desirable in the sense that the motivating case of tight Gabor frames already is well covered by these R-duals. On the other hand, all the introduced types of R-duals generalize the duality principle for larger classes of Gabor frames than just the tight frames and the Riesz bases; in particular, the R-duals of type III cover the duality principle for all Gabor frames.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Acoustics Research Institute
Authors: Stoeva, D. T. (Ekstern), Christensen, O. (Intern)
Pages: 383-400
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Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Fourier Analysis and Applications
Volume: 21
Issue number: 2
ISSN (Print): 1069-5869
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.09 SJR 0.755 SNIP 1.078
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.103 SNIP 1.396 CiteScore 1.42
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.116 SNIP 1.406 CiteScore 1.21
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.22 SNIP 1.464 CiteScore 1.23
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.042 SNIP 1.575 CiteScore 1.25
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.158 SNIP 2.482 CiteScore 2.7
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.431 SNIP 1.682
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.331 SNIP 1.991
On the nonlinearity of idempotent quadratic functions and the weight distribution of subcodes of Reed-Muller codes

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Austrian Academy of Sciences, Sabancı University
Authors: Anbar, N. (Intern), Meidl, W. M. (Ekstern), Topuzoglu, A. (Ekstern)
Number of pages: 10
Publication date: 2015
Main Research Area: Technical/natural sciences
Electronic versions:
amt_1.pdf
Source: PublicationPreSubmission
Source-ID: 118024213
Publication: Research - peer-review › Paper – Annual report year: 2015

On the use of blowup to study regularizations of singularities of piecewise smooth dynamical systems in R^3

In this paper we use the blowup method of Dumortier and Roussarie, in the formulation due to Krupa and Szomolyan, to study the regularization of singularities of piecewise smooth dynamical systems in R^3. Using the regularization method of Sotomayor and Teixeira, we first demonstrate the power of our approach by considering the case of a fold line. We quickly extend a main result of Reves and Seara in a simple manner. Then, for the two-fold singularity, we show that the regularized system only fully retains the features of the singular canards in the piecewise smooth system in the cases when the sliding region does not include a full sector of singular canards. In particular, we show that every locally unique primary singular canard persists the regularizing perturbation. For the case of a sector of primary singular canards, we show that the regularized system contains a canard, provided a certain nonresonance condition holds. Finally, we provide numerical evidence for the existence of secondary canards near resonance.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Bristol
Authors: Kristiansen, K. U. (Intern), Hogan, S. J. (Ekstern)
Pages: 382–422
Publication date: 2015
Main Research Area: Technical/natural sciences
Periodic orbits near a bifurcating slow manifold

This paper studies a class of $1\frac{1}{2}$-degree-of-freedom Hamiltonian systems with a slowly varying phase that unfolds a Hamiltonian pitchfork bifurcation. The main result of the paper is that there exists an order of $\ln^2 \epsilon^{-1}$-many periodic orbits that all stay within an $\mathcal{O}(\epsilon^{1/3})$-distance from the union of the normally elliptic slow manifolds that occur as a result of the bifurcation. Here $\epsilon$ measures the time scale separation. These periodic orbits are predominantly unstable. The proof is based on averaging of two blowup systems, allowing one to estimate the effect of the singularity, combined with results on asymptotics of the second Painleve equation. The stable orbits of smallest amplitude that are obtained by these methods remain slightly further away from the slow manifold than the periodic orbits being distant by an order $\mathcal{O}(\epsilon^{1/3} \ln \epsilon^{-1})$. 

Piecewise smooth systems, Blowup, Geometric singular perturbation theory, Sliding bifurcations, Canards

Electronic versions: 98099.pdf
DOIs: 10.1137/140980995
Source: PublicationPreSubmission
Source-ID: 114011143
Publication: Research - peer-review › Journal article – Annual report year: 2015
Perturbative Semiclassical Trace Formulae for Harmonic Oscillators

In this article we extend previous semiclassical studies by including more general perturbative potentials of the harmonic oscillator in arbitrary spatial dimensions. Our starting point is a radial harmonic potential with an arbitrary even monomial perturbation, which we use to study the resulting U(D) to O(D) symmetry breaking. We derive the gross structure of the semiclassical spectrum from periodic orbit theory, in the form of a perturbative (\(\hbar \rightarrow 0\)) trace formula. We then show how to apply the results to even-order polynomial potentials, possibly including mean-field terms. We have drawn the conclusion that the gross structure of the quantum spectrum is determined from only classical circular and diameter orbits for this class of systems.

**General information**

State: Published  
Organisations: Department of Applied Mathematics and Computer Science, Mathematics  
Authors: Møller-Andersen, J. (Intern), Ögren, M. (Intern)  
Number of pages: 24  
Pages: 359-382  
Publication date: 2015  
Main Research Area: Technical/natural sciences

**Publication information**

Journal: Reports on Mathematical Physics  
Volume: 75  
Issue number: 3  
ISSN (Print): 0034-4877  
Ratings:  
BFI (2018): BFI-level 1  
Web of Science (2018): Indexed yes  
BFI (2017): BFI-level 1  
Web of Science (2017): Indexed Yes  
BFI (2016): BFI-level 1  
Scopus rating (2016): SJR 0.368 SNIP 0.765 CiteScore 0.78  
BFI (2015): BFI-level 1  
Scopus rating (2015): SJR 0.476 SNIP 0.842 CiteScore 0.99  
Web of Science (2015): Indexed yes  
BFI (2014): BFI-level 1  
Scopus rating (2014): SJR 0.452 SNIP 0.755 CiteScore 0.97  
BFI (2013): BFI-level 1  
Scopus rating (2013): SJR 0.429 SNIP 0.933 CiteScore 1.03  
BFI (2012): BFI-level 1  
Scopus rating (2012): SJR 0.52 SNIP 0.751 CiteScore 0.77  
BFI (2011): BFI-level 1  
Scopus rating (2011): SJR 0.352 SNIP 0.657 CiteScore 0.55  
BFI (2010): BFI-level 1  
Scopus rating (2010): SJR 0.507 SNIP 1.086  
BFI (2009): BFI-level 1  
Scopus rating (2009): SJR 0.401 SNIP 0.7  
BFI (2008): BFI-level 1  
Scopus rating (2008): SJR 0.398 SNIP 0.634  
Scopus rating (2007): SJR 0.466 SNIP 0.752  
Scopus rating (2006): SJR 0.344 SNIP 0.663  
Scopus rating (2005): SJR 0.446 SNIP 0.732  
Scopus rating (2004): SJR 0.59 SNIP 0.71  
Scopus rating (2003): SJR 0.342 SNIP 0.649  
Scopus rating (2002): SJR 0.407 SNIP 0.74  
Scopus rating (2001): SJR 0.429 SNIP 0.717  
Scopus rating (2000): SJR 0.434 SNIP 0.638  
Scopus rating (1999): SJR 0.391 SNIP 0.573
Regularization of Piecewise Smooth Two-Folds

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Bristol
Authors: Kristiansen, K. U. (Intern), Hogan, S. J. (Ekstern)
Number of pages: 1
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Event: Poster session presented at EquaDiff 2015, Lyon, France.
Main Research Area: Technical/natural sciences

Electronic versions:
PosterEquaDiff15.pdf
Source: PublicationPreSubmission
Source-ID: 118523574
Publication: Research - peer-review › Poster – Annual report year: 2015

Regularizations of two-fold bifurcations in planar piecewise smooth systems using blowup
We use blowup to study the regularization of codimension one two-fold singularities in planar piecewise smooth (PWS) dynamical systems. We focus on singular canards, pseudo-equilibria and limit cycles that can occur in the PWS system. Using the regularization of Sotomayor and Teixeira [30], we show rigorously how singular canards can persist and how the bifurcation of pseudo-equilibria is related to bifurcations of equilibria in the regularized system. We also show that PWS limit cycles are connected to Hopf bifurcations of the regularization. In addition, we show how regularization can create another type of limit cycle that does not appear to be present in the original PWS system. For both types of limit cycle, we show that the criticality of the Hopf bifurcation that gives rise to periodic orbits is strongly dependent on the precise form of the regularization. Finally, we analyse the limit cycles as locally unique families of periodic orbits of the regularization and connect them, when possible, to limit cycles of the PWS system. We illustrate our analysis with numerical simulations and show how the regularized system can undergo a canard explosion phenomenon.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Bristol
Authors: Kristiansen, K. U. (Intern), Hogan, S. J. (Ekstern)
Pages: 1731-1786
Publication date: 2015
Main Research Area: Technical/natural sciences

Publication information
Journal: SIAM Journal on Applied Dynamical Systems
Volume: 14
Issue number: 4
ISSN (Print): 1536-0040
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.88 SJR 1.256 SNIP 1.297
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.358 SNIP 1.389 CiteScore 1.89
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.167 SNIP 1.217 CiteScore 1.67
Piecewise smooth systems, Blowup, Geometric singular perturbation theory, Sliding bifurcations, Canards, Pseudo-equilibrium, Limit cycles

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Source: PublicationPreSubmission
Source-ID: 114011697
Publication: Research - peer-review › Journal article – Annual report year: 2015

Second order elastic metrics on the shape space of curves
Second order Sobolev metrics on the space of regular unparametrized planar curves have several desirable completeness properties not present in lower order metrics, but numerics are still largely missing. In this paper, we present algorithms to numerically solve the initial and boundary value problems for geodesics. The combination of these algorithms allows to compute Karcher means in a Riemannian gradient-based optimization scheme. Our framework has the advantage that the constants determining the weights of the zero, first, and second order terms of the metric can be chosen freely. Moreover, due to its generality, it could be applied to more general spaces of mapping. We demonstrate the effectiveness of our approach by analyzing a collection of shapes representing physical objects.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Technische Universität Wien, Brunel University, ETH Zurich
Authors: Bauer, M. (Ekstern), Bruveris, M. (Ekstern), Harms, P., Møller-Andersen, J. (Intern)
Pages: 1-11
Publication date: 2015

Host publication information
Title of host publication: Proceedings of the 1st International Workshop on DIFFerential Geometry in Computer Vision for Analysis of Shapes, Images and Trajectories (DIFF-CV) 2015
Publisher: BMVA Press
Editors: Drira, H., Kurttek, S., Turaga, P.
ISBN (Print): 1-901725-56-1
BFI conference series: British Machine Vision Conference (5000330)
Sub-quadratic decoding of one-point hermitian codes

We present the first two sub-quadratic complexity decoding algorithms for one-point Hermitian codes. The first is based on a fast realization of the Guruswami-Sudan algorithm using state-of-the-art algorithms from computer algebra for polynomial-ring matrix minimization. The second is a power decoding algorithm: an extension of classical key equation decoding which gives a probabilistic decoding algorithm up to the Sudan radius. We show how the resulting key equations can be solved by the matrix minimization algorithms from computer algebra, yielding similar asymptotic complexities.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Ecole Polytechnique
Authors: Nielsen, J. S. R. (Intern), Beelen, P. (Intern)
Pages: 3225-3240
Publication date: 2015
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Transactions on Information Theory
Volume: 61
Issue number: 6
ISSN (Print): 0018-9448
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.34 SJR 1.678 SNIP 2.004
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.796 SNIP 2.317 CiteScore 3.3
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.944 SNIP 2.544 CiteScore 3.71
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 3.012 SNIP 3.29 CiteScore 4.37
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.838 SNIP 3.078 CiteScore 4.07
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.779 SNIP 3.313 CiteScore 4.32
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 3.17 SNIP 2.952
Web of Science (2010): Indexed yes
Surfaces with Natural Ridges

We discuss surfaces with singularities, both in mathematics and in the real world. For many types of mathematical surface, singularities are natural and can be regarded as part of the surface. The most emblematic example is that of surfaces of constant negative Gauss curvature, all of which necessarily have singularities. We describe a method for producing constant negative curvature surfaces with prescribed cusp lines. In particular, given a generic space curve, there is a unique surface of constant curvature $K = -1$ that contains this curve as a cuspidal edge. This is an effective means to easily generate many new and beautiful examples of surfaces with constant negative curvature.
The Metric of Colour Space
The space of colours is a fascinating space. It is a real vector space, but no matter what inner product you put on the space the resulting Euclidean distance does not correspond to human perception of difference between colours.

In 1942 MacAdam performed the first experiments on colour matching and found the MacAdam ellipses which are often interpreted as defining the metric tensor at their centres. An important question is whether it is possible to define colour coordinates such that the Euclidean distance in these coordinates correspond to human perception.

Using cubic splines to represent the colour coordinates and an optimisation approach we find new colour coordinates that make the MacAdam ellipses closer to uniform circles than the existing standards.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Gravesen, J. (Intern)
Pages: 77-86
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Publication information
Journal: Graphical Models
Volume: 82
Issue number: November
ISSN (Print): 1524-0703
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.523 SNIP 1.039 CiteScore 1.63
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.384 SNIP 0.951 CiteScore 1.28
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.555 SNIP 1.566 CiteScore 1.46
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.471 SNIP 1.594 CiteScore 1.34
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.471 SNIP 1.926 CiteScore 1.66
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.555 SNIP 1.533 CiteScore 2.05
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.463 SNIP 1.312
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.412 SNIP 1.457
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.638 SNIP 1.522
Scopus rating (2007): SJR 0.625 SNIP 1.477
Scopus rating (2006): SJR 0.52 SNIP 1.318
Scopus rating (2005): SJR 0.557 SNIP 1.896
Theoretical Study of the Pyridine-Helium van der Waals Complexes

In this study we evaluate a high-level ab initio ground-state intermolecular potential-energy surface for the pyridine–He van der Waals complex, using the CCSD(T) method and Dunning’s augmented correlation consistent polarized valence double-ζ basis set extended with a set of 3s3p2d1f1g midbond functions. The potential is characterized by two symmetric global minima of −93.2 cm⁻¹ that correspond to geometries where the distance between the helium atom and the pyridine center of mass is 3.105 Å and the angle with respect to the pyridine c rotational axis is 3.9°. Six local minima can be observed for geometries with the helium atom in the plane containing the pyridine molecule. To further analyze the nature of the intermolecular interactions in the complex, we use symmetry-adapted perturbation theory (SAPT). Additional consideration of the pyridine–He₂ complex provides a better insight into many-body nonadditive contributions to intermolecular interactions in systems with more helium atoms.
Towers of Function Fields over Non-prime Finite Fields

Over all non-prime finite fields, we construct some recursive towers of function fields with many rational places. Thus we obtain a substantial improvement on all known lower bounds for Ihara’s quantity $A(q)$, for $q = p^n$ with $p$ prime and $n > 3$ odd. We relate the explicit equations to Drinfeld modular varieties.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Sabanci University, Instituto Nacional de Matematica Pura E Aplicada
Authors: Bassa, A. (Ekstern), Beelen, P. (Intern), Garcia, A. (Ekstern), Stichtenoth, H. (Ekstern)
Pages: 1-29
Publication date: 2015
Main Research Area: Technical/natural sciences

Publication Information
Journal: Moscow Mathematical Journal
Volume: 15
Issue number: 1
ISSN (Print): 1609-3321
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.983 SNIP 1.267 CiteScore 0.77
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.83 SNIP 1.018 CiteScore 0.61
Twisted Polynomials and Forgery Attacks on GCM

Polynomial hashing as an instantiation of universal hashing is a widely employed method for the construction of MACs and authenticated encryption (AE) schemes, the ubiquitous GCM being a prominent example. It is also used in recent AE proposals within the CAESAR competition which aim at providing nonce misuse resistance, such as POET. The algebraic structure of polynomial hashing has given rise to security concerns: At CRYPTO 2008, Handschuh and Preneel describe key recovery attacks, and at FSE 2013, Procter and Cid provide a comprehensive framework for forgery attacks. Both approaches rely heavily on the ability to construct forgery polynomials having disjoint sets of roots, with many roots ("weak keys") each. Constructing such polynomials beyond naïve approaches is crucial for these attacks, but still an open problem.

In this paper, we comprehensively address this issue. We propose to use twisted polynomials from Ore rings as forgery polynomials. We show how to construct sparse forgery polynomials with full control over the sets of roots. We also achieve complete and explicit disjoint coverage of the key space by these polynomials. We furthermore leverage this new construction in an improved key recovery algorithm.

As cryptanalytic applications of our twisted polynomials, we develop the first universal forgery attacks on GCM in the weak-key model that do not require nonce reuse. Moreover, we present universal weak-key forgeries for the nonce-misuse resistant AE scheme POET, which is a CAESAR candidate.
VirtualTable: a projection augmented reality game

VirtualTable is a projection augmented reality installation where users are engaged in an interactive tower defense game. The installation runs continuously and is designed to attract people to a table, which the game is projected onto. Any number of players can join the game for an optional period of time. The goal is to prevent the virtual stylized soot balls, spawning on one side of the table, from reaching the cheese. To stop them, the players can place any kind of object on the table, that then will become part of the game. Depending on the object, it will become either a wall, an obstacle for the soot balls, or a tower, that eliminates them within a physical range. The number of enemies is dependent on the number of objects in the field, forcing the players to use strategy and collaboration and not the sheer number of objects to win the game.

General information
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Organisations: IT Service, Department of Applied Mathematics and Computer Science, Image Analysis & Computer Graphics, Mathematics, Statistics and Data Analysis
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Publisher: Association for Computing Machinery
Article number: 40
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BFI conference series: International Conference on Computer Graphics and Interactive Techniques (5000583)
Main Research Area: Technical/natural sciences
Electronic versions:
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DOIs:
10.1145/2820926.2820950
Source: PublicationPreSubmission
Source-ID: 117830919
Publication: Research - peer-review › Conference abstract in proceedings – Annual report year: 2015

Vortex breakdown in a truncated conical bioreactor

This numerical study explains the eddy formation and disappearance in a slow steady axisymmetric air–water flow in a vertical truncated conical container, driven by the rotating top disk. Numerous topological metamorphoses occur as the water height, Hw, and the bottom-sidewall angle, α, vary. It is found that the sidewall convergence (divergence) from the top to the bottom stimulates (suppresses) the development of vortex breakdown (VB) in both water and air. At α = 60°, the flow topology changes eighteen times as Hw varies. The changes are due to (a) competing effects of AMF (the air meridional flow) and swirl, which drive meridional motions of opposite directions in water, and (b) feedback of water flow on AMF. For small Hw, the AMF effect dominates. As Hw increases, the swirl effect dominates and causes VB. The water flow feedback produces and modifies air eddies. The results are of fundamental interest and can be relevant for aerial bioreactors.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Universidad de Sevilla, Shtern Research and Consulting
Authors: Balci, A. (Intern), Brøns, M. (Intern), Herrada, M. A. (Ekstern), Shtern, V. N. (Ekstern)
Number of pages: 26
Publication date: 2015
Main Research Area: Technical/natural sciences
An Improvement of the Gilbert–Varshamov Bound Over Nonprime Fields

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Sabanci University, Instituto Nacional de Matematica Pura E Aplicada
Authors: Bassa, A. (Ekstern), Beelen, P. (Intern), Garcia, A. (Ekstern), Stichtenoth, H. (Ekstern)
Pages: 3859-3861
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Main Research Area: Technical/natural sciences

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Journal: IEEE Transactions on Information Theory
Volume: 60
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.34 SJR 1.678 SNIP 2.004
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.796 SNIP 2.317 CiteScore 3.3
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.944 SNIP 2.544 CiteScore 3.71
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 3.012 SNIP 3.29 CiteScore 4.37
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.838 SNIP 3.078 CiteScore 4.07
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.779 SNIP 3.313 CiteScore 4.32
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 3.17 SNIP 2.952
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 4.941 SNIP 3.991
Web of Science (2008): Indexed yes
An Iterative Method for the Approximation of Fibers in Slow-Fast Systems

In this paper we extend a method for iteratively improving slow manifolds so that it also can be used to approximate the fiber directions. The extended method is applied to general finite-dimensional real analytic systems where we obtain exponential estimates of the tangent spaces to the fibers. The method is demonstrated on the Michaelis–Menten–Henri model and the Lindemann mechanism. The latter example also serves to demonstrate the method on a slow-fast system in nonstandard slow-fast form. Finally, we extend the method further so that it also approximates the curvature of the fibers.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Dynamical Systems
Authors: Kristiansen, K. U. (Intern), Brøns, M. (Intern), Starke, J. (Intern)
Pages: 861–900
Publication date: 2014
Main Research Area: Technical/natural sciences

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Journal: SIAM Journal on Applied Dynamical Systems
Volume: 13
Issue number: 2
ISSN (Print): 1536-0040
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.88 SJR 1.256 SNIP 1.297
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.358 SNIP 1.389 CiteScore 1.89
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.167 SNIP 1.217 CiteScore 1.67
A short introduction to frames, Gabor systems, and wavelet systems
In this article we present a short survey of frame theory in Hilbert spaces. We discuss Gabor frames and wavelet frames, and a recent transform that allows to move results from one setting into the other and vice versa.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science , Mathematics
Authors: Christensen, O. (Intern)
Pages: 25-39
Publication date: 2014
Main Research Area: Technical/natural sciences

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Journal: Azerbaijan Journal of Mathematics
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Issue number: 1
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Ratings:
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Web of Science (2017): Indexed yes
Scopus rating (2016): SJR 0.335 SNIP 0.673 CiteScore 0.51
Scopus rating (2015): SJR 0.193 SNIP 0.439 CiteScore 0.21
Scopus rating (2014): SJR 0.318 SNIP 1.091 CiteScore 0.43
Scopus rating (2013): SJR 0.261 SNIP 1.592 CiteScore 0.47
ISI indexed (2013): ISI indexed no
Bifurcation Analysis and Dimension Reduction of a Predator-Prey Model for the L-H Transition

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Department of Physics, Plasma Physics and Fusion Energy, Chinese Academy of Sciences
Authors: Dam, M. (Intern), Brøns, M. (Intern), Juul Rasmussen, J. (Intern), Naulin, V. (Intern), Xu, G. (Ekstern)
Number of pages: 1
Publication date: 2014
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Main Research Area: Technical/natural sciences
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LH_transition_poster_Magnus.pdf

Relations
Activities:
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Publication: Research › Poster – Annual report year: 2014

Bifurcation analysis of a smoothed model of a forced impacting beam and comparison with an experiment
A piecewise-linear model with a single degree of freedom is derived from first principles for a driven vertical cantilever beam with a localized mass and symmetric stops. The aim is to show that this model constitutes a considerable step toward developing a vibro-impact model that is able to make qualitative and quantitative predictions of the observed dynamics. The resulting piecewise-linear dynamical system is smoothed by a switching function (nonlinear homotopy). For the chosen smoothing function, it is shown that the smoothing can induce bifurcations in certain parameter regimes. These induced bifurcations disappear when the transition of the switching is sufficiently and increasingly localized as the impact becomes harder. The bifurcation structure of the impact oscillator response is investigated via the one- and twoparameter continuation of periodic orbits in the driving frequency and/or forcing amplitude. The results are in good agreement with experimental measurements.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Department of Mechanical Engineering, Solid Mechanics, Dynamical Systems, University of Auckland
Authors: Elmegård, M. (Intern), Krauskopf, B. (Ekstern), Osinga, H. (Ekstern), Starke, J. (Intern), Thomsen, J. J. (Intern)
Pages: 951–966
Publication date: 2014
Main Research Area: Technical/natural sciences
In this paper we study constant positive Gauss curvature $K$ surfaces in the 3-sphere $S^3$ with $0<K<1$, as well as constant negative curvature surfaces. We show that the so-called normal Gauss map for a surface in $S^3$ with Gauss curvature $K<1$ is Lorentz harmonic with respect to the metric induced by the second fundamental form if and only if $K$ is constant. We give a uniform loop group formulation for all such surfaces with $K≠0$, and use the generalized d’Alembert method to construct examples. This representation gives a natural correspondence between such surfaces with $K<0$ and those with $0<K<1$.
Contaminant ingress into multizone buildings: An analytical state-space approach

The ingress of exterior contaminants into buildings is often assessed by treating the building interior as a single well-mixed space. Multizone modelling provides an alternative way of representing buildings that can estimate concentration time series in different internal locations. A state-space approach is adopted to represent the concentration dynamics within multizone buildings. Analysis based on this approach is used to demonstrate that the exposure in every interior location is limited to the exterior exposure in the absence of removal mechanisms. Estimates are also developed for the short term maximum concentration and exposure in a multizone building in response to a step-change in concentration. These have considerable potential for practical use. The analytical development is demonstrated using a simple two-zone building with an inner zone and a range of existing multizone models of residential buildings. Quantitative measures are provided of the...
standard deviation of concentration and exposure within a range of residential multizone buildings. Ratios of the maximum short term concentrations and exposures to single zone building estimates are also provided for the same buildings.

**General information**

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Defence Science and Technology Laboratory, GexCon UK, West Lancashire Investment Centre, Oxford Centre for Collaborative Applied Mathematics
Authors: Parker, S. (Ekstern), Coffey, C. (Ekstern), Gravesen, J. (Intern), Kirkpatrick, J. (Ekstern), Ratcliffe, K. (Ekstern), Lingard, B. (Ekstern), Nally, J. (Ekstern)
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Publication date: 2014
Main Research Area: Technical/natural sciences

**Publication information**

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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.56 SJR 0.784 SNIP 0.936
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.016 SNIP 1.154 CiteScore 1.74
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.827 SNIP 1.264 CiteScore 1.41
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.45 SNIP 0.649 CiteScore 0.77
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.444 SNIP 0.751 CiteScore 0.72
ISI indexed (2012): ISI indexed no
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.373 SNIP 0.858 CiteScore 0.95
ISI indexed (2011): ISI indexed no
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 0.364 SNIP 0.699
BFI (2009): BFI-level 2
BFI (2008): BFI-level 1
Original language: English
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Source: dtu
Source-ID: n:oai:DTIC-ART:springer/424310255::34554
Publication: Research - peer-review > Journal article – Annual report year: 2014

**Differential Geometry Applied to Rings and Möbius Nanostructures**

Nanostructure shape effects have become a topic of increasing interest due to advancements in fabrication technology. In order to pursue novel physics and better devices by tailoring the shape and size of nanostructures, effective analytical and computational tools are indispensable. In this chapter, we present analytical and computational differential geometry methods to examine particle quantum eigenstates and eigenenergies in curved and strained nanostructures. Example studies are carried out for a set of ring structures with different radii and it is shown that eigenstate and eigenenergy changes due to curvature are most significant for the groundstate eventually leading to qualitative and quantitative
changes in physical properties. In particular, the groundstate in-plane symmetry characteristics are broken by curvature effects, however, curvature contributions can be discarded at bending radii above 50 nm. In the second part of the chapter, a more complicated topological structure, the Möbius nanostructure, is analyzed and geometry effects for eigenstate properties are discussed including dependencies on the Möbius nanostructure width, length, thickness, and strain.

Experimental bifurcation analysis of an impact oscillator – Determining stability
We propose and investigate three different methods for assessing stability of dynamical equilibrium states during experimental bifurcation analysis, using a control-based continuation method. The idea is to modify or turn off the control at an equilibrium state and study the resulting behavior. As a proof of concept the three methods are successfully implemented and tested for a harmonically forced impact oscillator with a hardening spring nonlinearity, and controlled by electromagnetic actuators. We show that under certain conditions it is possible to quantify the instability in terms of finite-time Lyapunov exponents. As a special case we study an isolated branch in the bifurcation diagram brought into existence by a 1:3 subharmonic resonance. On this isola it is only possible to determine stability using one of the three methods, which is due to the fact that only this method guarantees that the equilibrium state can be restored after measuring stability.
Frames and extension problems I
In this article we present a short survey of frame theory in Hilbert spaces. We discuss Gabor frames and wavelet frames and set the stage for a discussion of various extension principles; this will be presented in the article Frames and extension problems II (joint with H.O. Kim and R.Y. Kim).
Frames and extension problems II

This article is a follow-up on the article Frames and Extension Problems I. Here we will go into more recent progress on the topic and also present some open problems.

From dual pairs of Gabor frames to dual pairs of wavelet frames and vice versa

We discuss an elementary procedure that allows us to construct dual pairs of wavelet frames based on certain dual pairs of Gabor frames and vice versa. The construction preserves tightness of the involved frames. Starting with Gabor frames generated by characteristic functions the construction leads to a class of tight wavelet frames that include the Shannon (orthonormal) wavelet, and applying the construction to Gabor frames generated by certain exponential B-splines yields wavelet frames generated by functions whose Fourier transforms are compactly supported splines with geometrically distributed knot sequences. On the other hand, the pendant of the Meyer wavelet turns out to be a tight Gabor frame generated by a \( C^\infty(\mathbb{R}) \) function with compact support. As an application of our results we show that for each given pair of bandlimited dual wavelet frames it is possible to construct dual wavelet frames for any desired scaling and translation.
In this paper we construct Galois towers with good asymptotic properties over any non-prime finite field $F_r$; i.e., we construct sequences of function fields $N=(N_1 \subset N_2 \subset \cdots)$ over $F_r$ of increasing genus, such that all the extensions $N_i/N_1$ are Galois extensions and the number of rational places of these function fields grows linearly with the genus. The limits of the towers satisfy the same lower bounds as the best currently known lower bounds for the Ihara constant for non-prime finite fields. Towers with these properties are important for applications in various fields including coding theory and cryptography.
Good Towers of Function Fields

In this paper, we will give an overview of known and new techniques on how one can obtain explicit equations for candidates of good towers of function fields. The techniques are founded in modular theory (both the classical modular theory and the Drinfeld modular theory). In the classical modular setup, optimal towers can be obtained, while in the Drinfeld modular setup, good towers over any non-prime field may be found. We illustrate the theory with several examples, thus explaining some known towers as well as giving new examples of good explicitly defined towers of function fields.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Bassa, A. (Intern), Beelen, P. (Intern), Nguyen, N. (Intern)
Publication date: 2014

Iso-geometric shape optimization of magnetic density separators
Purpose
The waste recycling industry increasingly relies on magnetic density separators. These devices generate an upward magnetic force in ferro-fluids allowing to separate the immersed particles according to their mass density. Recently, a new separator design has been proposed that significantly reduces the required amount of permanent magnet material. The purpose of this paper is to alleviate the undesired end-effects in this design by altering the shape of the ferromagnetic covers of the individual poles.

Design/methodology/approach
The paper represents the shape of the ferromagnetic pole covers with B-splines and defines a cost functional that measures the non-uniformity of the magnetic field in an area above the poles. The authors apply an iso-geometric shape optimization procedure, which allows us to accurately represent, analyze and optimize the geometry using only a few design variables. The design problem is regularized by imposing constraints that enforce the convexity of the pole cover.
shapes and is solved by a non-linear optimization procedure. The paper validates the implementation of the algorithm using a simplified variant of the design problem with a known analytical solution. The algorithm is subsequently applied to the problem posed.

Findings
The shape optimization attains its target and yields pole cover shapes that give rise to a magnetic field that is uniform over a larger domain.

Research limitations/implications
This increased magnetic field uniformity is obtained at the cost of a pole cover shape that differs per pole. This limitation has negligible impact on the manufacturing of the separator. The new pole cover shapes therefore lead to improved performance of the density separation.

Practical implications
Due to the larger uniformity the generated field, these shapes should enable larger amounts of waste to be processed than the previous design.

Originality/value
This paper treats the shapes optimization of magnetic density separators systematically and presents new shapes for the ferromagnetic poles covers.
Mathematical modelling of dextran filtration through hollow fibre membranes

In this paper we present a mathematical model of an ultrafiltration process. The results of the model are produced using standard numerical techniques with Comsol Multiphysics. The model describes the fluid flow and separation in hollow fibre membranes. The flow of solute and solvent within the hollow fibre is modelled by solving the Navier-Stokes equation along with the continuity equation for both the solute and the solvent. The flux of solute and solvent through the membrane are given by the solution diffusion model, since ultrafiltration occurs at high rejections. For a given set of parameters describing the characteristics of the membrane, effect on the observed and the intrinsic rejection of the membrane are investigated for the different working parameters: inlet velocity, molecular weight, and transmembrane pressure.

Furthermore, the model investigates the effect of a concentration dependent viscosity. The model shows that both the observed and intrinsic rejection increase when the inlet velocity increases. Moreover, the intrinsic rejection increases as a function of transmembrane pressure, but the observed rejection has a characteristic maximum. Therefore, the observed rejection can either increase or decrease as a function of pressure. The influence of a concentration dependent viscosity is to increase the concentration on the membrane surface. This leads to a decrease in both the observed and the intrinsic rejection, when compared to a constant viscosity. For small values of the solute permeability the concentration dependent viscosity decreases the volumetric flux through the membrane at high pressures. This effect is due to a very high concentration at the membrane surface. The model is related to experimental data. There is a good qualitative and a reasonable quantitative agreement between simulations and experimental data.

General information
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Organisations: Mathematics, Department of Applied Mathematics and Computer Science, Department of Chemical and Biochemical Engineering, Center for BioProcess Engineering
Pages: 21-36
Publication date: 2014
Main Research Area: Technical/natural sciences

Publication information
Journal: Separation and Purification Technology
Volume: 125
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.78 SJR 1.023 SNIP 1.394
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.078 SNIP 1.504 CiteScore 3.75
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.257 SNIP 1.54 CiteScore 3.5
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.325 SNIP 1.678 CiteScore 3.62
Moving least squares simulation of free surface flows

In this paper a Moving Least Squares method (MLS) for the simulation of 2D free surface flows is presented. The emphasis is on the governing equations, the boundary conditions, and the numerical implementation. The compressible viscous isothermal Navier–Stokes equations are taken as the starting point. Then a boundary condition for pressure (or density) is developed. This condition is applicable at interfaces between different media such as fluid–solid or fluid–void. The effect of surface tension is included. The equations are discretized by a moving least squares method for the spatial derivatives and a Runge–Kutta method for the time derivatives. The computational frame is Lagrangian, which means that the computational nodes are convected with the flow. The method proposed here is benchmarked using the standard lid driven cavity problem, a rotating free surface problem, and the simulation of drop oscillations. A new exact solution to the unsteady incompressible Navier–Stokes equations is introduced for the rotating free surface problem. © 2013 Elsevier Ltd. All rights reserved.

General information
State: Published
Organisations: Department of Mechanical Engineering, Fluid Mechanics, Coastal and Maritime Engineering, Department of Applied Mathematics and Computer Science, Mathematics, MAN Diesel & Turbo SE
Authors: Felter, C. L. (Intern), Walther, J. H. (Intern), Henriksen, C. (Intern)
Pages: 47-56
Publication date: 2014
Main Research Area: Technical/natural sciences
On entire functions restricted to intervals, partition of unities, and dual Gabor frames

Partition of unities appears in many places in analysis. Typically it is generated by compactly supported functions with a certain regularity. In this paper we consider partition of unities obtained as integer-translates of entire functions restricted to finite intervals. We characterize the entire functions that lead to a partition of unity in this way, and we provide characterizations of the “cut-off” entire functions, considered as functions of a real variable, to have desired regularity. In
particular we obtain partition of unities generated by functions with small support and desired regularity. Applied to Gabor analysis this leads to constructions of dual pairs of Gabor frames with low redundancy, generated by trigonometric polynomials with small support and desired regularity.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Ulsan National Institute of Science and Technology, Yeungnam University
Authors: Christensen, O. (Intern), Kim, H. O. (Ekstern), Kim, R. Y. (Ekstern)
Pages: 72-86
Publication date: 2014
Main Research Area: Technical/natural sciences

Publication information
Journal: Applied and Computational Harmonic Analysis
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BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.73 SJR 1.594 SNIP 1.781
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.524 SNIP 1.818 CiteScore 2.46
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.906 SNIP 2.909 CiteScore 3.27
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.857 SNIP 2.95 CiteScore 3.3
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.955 SNIP 3.687 CiteScore 4.63
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 3.264 SNIP 3.453 CiteScore 4.4
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 3.47 SNIP 2.804
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.194 SNIP 2.575
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.412 SNIP 2.255
Scopus rating (2007): SJR 1.516 SNIP 1.85
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.876 SNIP 2.474
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.216 SNIP 2.174
Scopus rating (2004): SJR 1.871 SNIP 2.608
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 2.056 SNIP 2.125
On Parseval Wavelet Frames with Two or Three Generators via the Unitary Extension Principle

The unitary extension principle (UEP) by A. Ron and Z. Shen yields a sufficient condition for the construction of Parseval wavelet frames with multiple generators. In this paper we characterize the UEP-type wavelet systems that can be extended to a Parseval wavelet frame by adding just one UEP-type wavelet system. We derive a condition that is necessary for the extension of a UEP-type wavelet system to any Parseval wavelet frame with any number of generators and prove that this condition is also sufficient to ensure that an extension with just two generators is possible.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Korea Advanced Institute of Science & Technology, Yeungnam University
Authors: Christensen, O. (Intern), Kim, H. O. (Ekstern), Kim, R. Y. (Ekstern)
Pages: 254-263
Publication date: 2014
Main Research Area: Technical/natural sciences

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Web of Science (2018): Indexed yes
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.513 SNIP 0.741 CiteScore 0.44
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.432 SNIP 0.776 CiteScore 0.35
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.725 SNIP 0.816 CiteScore 0.4
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.485 SNIP 0.777 CiteScore 0.34
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.306 SNIP 0.605 CiteScore 0.24
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.388 SNIP 0.798 CiteScore 0.37
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.5 SNIP 0.754
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.461 SNIP 0.718
On the sizes of expander graphs and minimum distances of graph codes

We give lower bounds for the minimum distances of graph codes based on expander graphs. The bounds depend only on the second eigenvalue of the graph and the parameters of the component codes. We also give an upper bound on the size of a degree regular graph with given second eigenvalue.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Høholdt, T. (Intern), Justesen, J. (Intern)
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Publication date: 2014
Main Research Area: Technical/natural sciences

Publication information
Journal: Discrete Mathematics
Volume: 325
ISSN (Print): 0012-365X
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.72 SJR 0.925 SNIP 1.005
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.933 SNIP 1.104 CiteScore 0.64
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.03 SNIP 1.211 CiteScore 0.68
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.005 SNIP 1.243 CiteScore 0.74
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
On the subfield subcodes of Hermitian codes

We present a fast algorithm using Gröbner basis to compute the dimensions of subfield subcodes of Hermitian codes. With these algorithms we are able to compute the exact values of the dimension of all subfield subcodes up to $q \leq 32$ and length up to 215. We show that some of the subfield subcodes of Hermitian codes are at least as good as the previously known codes, and we show the existence of good long codes.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Puerto Rico
Authors: Pinero, F. (Intern), Janwa, H. (Ekstern)
Pages: 157-173
Publication date: 2014
Main Research Area: Technical/natural sciences

Publication information
Journal: Designs, Codes and Cryptography
Volume: 70
Issue number: 1-2
ISSN (Print): 0925-1022
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Optimal codes as Tanner codes with cyclic component codes

In this article we study a class of graph codes with cyclic code component codes as affine variety codes. Within this class of Tanner codes we find some optimal binary codes. We use a particular subgraph of the point-line incidence plane of A(2,q) as the Tanner graph, and we are able to describe the codes succinctly using Gröbner bases.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, East China Normal University
Authors: Høholdt, T. (Intern), Pinero, F. (Intern), Zeng, P. (Intern)
Pages: 37-47
Publication date: 2014
Main Research Area: Technical/natural sciences
Pilot-wave hydrodynamics in a rotating frame: Exotic orbits

We present the results of a numerical investigation of droplets walking on a rotating vibrating fluid bath. The drop’s trajectory is described by an integro-differential equation, which is simulated numerically in various parameter regimes. As the forcing acceleration is progressively increased, stable circular orbits give way to wobbling orbits, which are succeeded...
in turn by instabilities of the orbital center characterized by steady drifting then discrete leaping. In the limit of large vibrational forcing, the walker’s trajectory becomes chaotic, but its statistical behavior reflects the influence of the unstable orbital solutions. The study results in a complete regime diagram that summarizes the dependence of the walker’s behavior on the system parameters. Our predictions compare favorably to the experimental observations of Harris and Bush ["Droplets walking in a rotating frame: from quantized orbits to multi-modal statistics," J. Fluid Mech. 739, 444–464 (2014)].
Planar Parametrization in Isogeometric Analysis

Before isogeometric analysis can be applied to solving a partial differential equation posed over some physical domain, one needs to construct a valid parametrization of the geometry. The accuracy of the analysis is affected by the quality of the parametrization. The challenge of computing and maintaining a valid geometry parametrization is particularly relevant in applications of isogeometric analysis to shape optimization, where the geometry varies from one optimization iteration to another. We propose a general framework for handling the geometry parametrization in isogeometric analysis and shape optimization. It utilizes an expensive non-linear method for constructing/updating a high quality reference parametrization, and an inexpensive linear method for maintaining the parametrization in the vicinity of the reference one. We describe several linear and non-linear parametrization methods, which are suitable for our framework. The non-linear methods we consider are based on solving a constrained optimization problem numerically, and are divided into two classes, geometry-oriented methods and analysis-oriented methods. Their performance is illustrated through a few numerical examples.
Predicting optimal back-shock times in ultrafiltration hollow fibre modules through path-lines

This paper presents a two dimensional mathematical model of back-shocking in ultrafiltration. The model investigates the effect of back-shocking on concentration polarization. The model shows a positive effect on both the volumetric flux and the observed rejection when back-shocking is applied as compared to the steady-state solution. Furthermore, the effect of changing different parameters such as inlet velocity, forward and backwards pressure on the back-shock time, the increase in volumetric flux and observed rejection, is presented. Moreover, two analytical estimates for the optimal back-shock time derived from calculating the path-lines during a back-shock cycle are presented. Both of these expressions are in good agreement with the results obtained from the mathematical model and data collected from the literature. Based on this, a simple expression for an optimal back-shock time in a multi-parameter problem is provided.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science , Department of Chemical and Biochemical Engineering, Center for BioProcess Engineering, Mathematics
Pages: 275-293
Publication date: 2014
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Membrane Science
Volume: 470
ISSN (Print): 0376-7388
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.13 SJR 2.062 SNIP 1.72
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2 SNIP 1.771 CiteScore 5.89
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.433 SNIP 1.935 CiteScore 5.42
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.452 SNIP 2.001 CiteScore 5.38
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.201 SNIP 1.968 CiteScore 4.37
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.82 SNIP 1.726 CiteScore 4.29
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.802 SNIP 1.821
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.638 SNIP 1.693
Web of Science (2009): Indexed yes
Prime tight frames

We introduce a class of finite tight frames called prime tight frames and prove some of their elementary properties. In particular, we show that any finite tight frame can be written as a union of prime tight frames. We then characterize all prime harmonic tight frames and use this characterization to suggest effective analysis and synthesis computation strategies for such frames. Finally, we describe all prime frames constructed from the spectral tetris method, and, as a byproduct, we obtain a characterization of when the spectral tetris construction works for redundancies below two.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Maryland
Authors: Lemvig, J. (Intern), Miller, C. (Ekstern), Okoudjou, K. A. (Ekstern)
Pages: 315-334
Publication date: 2014
Main Research Area: Technical/natural sciences

Publication information

Journal: Advances in Computational Mathematics
Volume: 40
Issue number: 2
ISSN (Print): 1019-7168
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.3 SJR 0.848 SNIP 1.06
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.161 SNIP 1.354 CiteScore 1.33
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.307 SNIP 1.54 CiteScore 1.57
Divisible frames, Equiangular tight frames, Frames, Harmonic tight frames, Prime frames, Spectral tetris frames, Tight frames

**Rotation reversal in a 1D turbulence spreading model**

**General information**
- **State:** Published
- **Organisations:** Department of Physics, Plasma Physics and Fusion Energy, Department of Applied Mathematics and Computer Science, Mathematics
- **Authors:** Naulin, V. (Intern), Juul Rasmussen, J. (Intern), Dam, M. (Intern), Brøns, M. (Intern)
- **Number of pages:** 4
- **Publication date:** 2014

**Host publication information**
- **Title of host publication:** Proceedings of the 41st EPS Conference on Plasma Physics : Europhysics Conference Abstracts
- **Volume:** 38F
- **Article number:** P2.067
- **Main Research Area:** Technical/natural sciences
**Six problems in frame theory**

We discuss various problems in frame theory that have been open for some years. A short discussion of frame theory is also provided, but it only contains the information that is necessary in order to understand the open problems and their role.

**General information**

State: Published  
Organisations: Department of Applied Mathematics and Computer Science, Mathematics  
Authors: Christensen, O. (Intern)  
Number of pages: 27  
Publication date: 2014

**Host publication information**

Title of host publication: Professor Butzer on the occasion of his eighty-fifth anniversary  
Publisher: Birkhäuser Verlag GmbH  
Main Research Area: Technical/natural sciences  
Links:  
http://arxiv.org/abs/1308.5065

**Bibliographical note**

Dedicated to Professor Butzer on the occasion of his eighty-fifth anniversary.  
Source: dtu  
Source-ID: n::oai:DTIC-ART:arxiv/390956909::36132  
Publication: Research - peer-review › Book chapter – Annual report year: 2014

**Sparse Matrices in Frame Theory**

Frame theory is closely intertwined with signal processing through a canon of methodologies for the analysis of signals using (redundant) linear measurements. The canonical dual frame associated with a frame provides a means for reconstruction by a least squares approach, but other dual frames yield alternative reconstruction procedures. The novel paradigm of sparsity has recently entered the area of frame theory in various ways. Of those different sparsity perspectives, we will focus on the situations where frames and (not necessarily canonical) dual frames can be written as sparse matrices. The objective for this approach is to ensure not only low-complexity computations, but also high compressibility. We will discuss both existence results and explicit constructions.

**General information**

State: Published  
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Georg-August-Universität Göttingen, Technische Universität Berlin  
Authors: Lemvig, J. (Intern), Krahmer, F. (Ekstern), Kutyniok, G. (Ekstern)  
Pages: 547-568  
Publication date: 2014  
Main Research Area: Technical/natural sciences

**Publication information**

Journal: Computational Statistics  
Volume: 29  
Issue number: 3-4  
ISSN (Print): 0943-4062  
Ratings:  
BFI (2018): BFI-level 2  
Web of Science (2018): Indexed yes  
BFI (2017): BFI-level 2  
Web of Science (2017): Indexed Yes  
BFI (2016): BFI-level 2  
Scopus rating (2016): SJR 0.724 SNIP 0.969 CiteScore 1.01  
BFI (2015): BFI-level 2  
Scopus rating (2015): SJR 0.657 SNIP 0.754 CiteScore 0.77
Timelike Constant Mean Curvature Surfaces with Singularities

We use integrable systems techniques to study the singularities of timelike non-minimal constant mean curvature (CMC) surfaces in the Lorentz–Minkowski 3-space. The singularities arise at the boundary of the Birkhoff big cell of the loop group involved. We examine the behavior of the surfaces at the big cell boundary, generalize the definition of CMC surfaces to include those with finite, generic singularities, and show how to construct surfaces with prescribed singularities by solving a singular geometric Cauchy problem. The solution shows that the generic singularities of the generalized surfaces are cuspidal edges, swallowtails, and cuspidal cross caps.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Southern Denmark
Authors: Brander, D. (Intern), Svensson, M. (Ekstern)
Pages: 1641-1672
Publication date: 2014
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Geometric Analysis
Volume: 24
Issue number: 3
**Differential geometry, Integrable systems, Timelike CMC surfaces, Singularities, Constant mean curvature**

Electronic versions:
- `timelikeCMCsingularities.pdf`

DOI:
- `10.1007/s12220-013-9389-6`

**Publication:** Research - peer-review › Journal article – Annual report year: 2013

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**Topology of helical fluid flow**

Considering a coordinate-free formulation of helical symmetry rather than more traditional definitions based on coordinates, we discuss basic properties of helical vector fields and compare results from the literature obtained with other approaches. In particular, we discuss the role of the stream function for the topology of the streamline pattern in incompressible flows. On this basis, we perform a comprehensive study of the topology of the flow field generated by a helical vortex filament in an ideal fluid. The classical expression for the stream function obtained by Hardin (Hardin, J. C. 1982 Phys. Fluids 25, 1949–1952) contains an infinite sum of modified Bessel functions. Using the approach by Okulov
(Okulov, V. L. 1995 Russ. J. Eng. Thermophys. 5, 63–75) we obtain a closed-form approximation which is considerably easier to analyze. Critical points of the stream function can be found from the zeroes of a single real function of one variable, and we show that three different flow topologies can occur, depending on a single dimensionless parameter. By including the self-induced velocity on the vortex filament by a localized induction approximation, the stream function is slightly modified and an extra parameter is introduced. In this setting two new flow topologies arise, but not more than two critical points occur for any combination of parameters.
Towards fusion energy as a sustainable energy source: Activities at DTU Physics

Nuclear fusion – the process from which the Sun derives its energy – holds the potential to become a clean, safe, highly efficient, and virtually inexhaustible energy source for the future. To mimic this process on earth, experimental fusion devices seek to heat gas to millions of degrees (creating a fusion plasma) and to confine it within magnetic fields. Learning how such plasmas behave and can be controlled is a crucial step towards realizing fusion as a sustainable energy source. At the Plasma Physics and Fusion Energy (PPFE) section at DTU Physics, we are exploring these issues, focusing on areas of high priority on the way towards a working fusion power plant. On the theoretical front, we are simulating plasma turbulence and transport of heat and particles in fusion plasmas (Fig. 1a). These issues play a key role in determining how the plasma behaves globally and how well it remains confined in the magnetic field of the fusion device. Understanding this is important for optimizing plasma performance and for controlling the heat load onto the walls of the confining vessel. Experimentally, we operate equipment to measure key plasma properties in experimental fusion devices such as ASDEX Upgrade in Germany (Fig. 1b+c). Using a technique called collective Thomson scattering (CTS), we can infer the plasma composition and the dynamics of energetic ions in the plasma. Control of these parameters is vital for achieving a high fusion yield in future power plants. We are also designing CTS equipment for the next-step fusion device ITER (Fig. 1d), in which plasma temperatures will exceed 200 million C. This machine is currently being built in France in a large international effort to experimentally demonstrate fusion as a viable energy source and pave the way for the first fusion power plant.
An iterative method for the canard explosion in general planar systems

The canard explosion is the change of amplitude and period of a limit cycle born in a Hopf bifurcation in a very narrow parameter interval. The phenomenon is well understood in singular perturbation problems where a small parameter controls the slow/fast dynamics. However, canard explosions are also observed in systems where no such parameter can obviously be identified. Here we show how the iterative method of Roussel and Fraser, devised to construct regular slow manifolds, can be used to determine a canard point in a general planar system of nonlinear ODEs. We demonstrate the method on the van der Pol equation, showing that the asymptotics of the method is correct, and on a templator model for a self-replicating system.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Brøns, M. (Intern)
Pages: 77-83
Publication date: 2013

Bifurcation analysis and dimension reduction of a predator-prey model for the L-H transition

The L-H transition denotes a shift to an improved confinement state of a toroidal plasma in a fusion reactor. A model of the L-H transition is required to simulate the time dependence of tokamak discharges that include the L-H transition. A 3-ODE predator-prey type model of the L-H transition is investigated with bifurcation theory of dynamical systems. The analysis shows that the model contains three types of transitions: an oscillating transition, a sharp transition with hysteresis, and a smooth transition. The model is recognized as a slow-fast system. A reduced 2-ODE model consisting of the full model restricted to the flow on the critical manifold is found to contain all the same dynamics as the full model. This means that all the dynamics in the system is essentially 2-dimensional, and a minimal model of the L-H transition could be a 2-ODE model.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Department of Physics, Plasma Physics and Fusion Energy, Chinese Academy of Sciences
Authors: Dam, M. (Intern), Brøns, M. (Intern), Juul Rasmussen, J. (Intern), Naulin, V. (Intern), Xu, G. (Ekstern)
Pages: 102302
Publication date: 2013
Main Research Area: Technical/natural sciences
Bounding the number of points on a curve using a generalization of Weierstrass semigroups

In this article we use techniques from coding theory to derive upper bounds for the number of rational places of the function field of an algebraic curve defined over a finite field. The used techniques yield upper bounds if the (generalized) Weierstrass semigroup (J Pure Appl Algebra 207(2), 243–260, 2006) for an n-tuple of places is known, even if the exact defining equation of the curve is not known. As shown in examples, this sometimes enables one to get an upper bound for the number of rational places for families of function fields. Our results extend results in (J Pure Appl Algebra 213(6), 1152–1156, 2009).

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Aalborg University
Authors: Beelen, P. (Intern), Ruano, D. (Ekstern)
Pages: 221-230
Publication date: 2013
Main Research Area: Technical/natural sciences
Construction of smooth compactly supported windows generating dual pairs of Gabor frames

Let \( g \) be any real-valued, bounded and compactly supported function, whose integer-translates \( \{ T_k g \} \) form a partition of unity. Based on a new construction of dual windows associated with Gabor frames generated by \( g \), we present a method to explicitly construct dual pairs of Gabor frames. This new method of construction is based on a family of polynomials which is closely related to the Daubechies polynomials, used in the construction of compactly supported wavelets. For any \( k \in \mathbb{N} \cup \{ \infty \} \) we consider the Meyer scaling functions and use these to construct compactly supported windows \( g \in C_k(\mathbb{R}) \) associated with a family of smooth compactly supported dual windows. For any \( n \in \mathbb{N} \) the pair of dual windows \( g, h_n \in C_k(\mathbb{R}) \) have compact support in the interval \([-2/3, 2/3]\) and share the property of being constant on half the length of their support. We therefore obtain arbitrary smoothness of the dual pair of windows \( g, h_n \) without increasing their support.
Estimates of the first Dirichlet eigenvalue from exit time moment spectra

We compute the first Dirichlet eigenvalue of a geodesic ball in a rotationally symmetric model space in terms of the moment spectrum for the Brownian motion exit times from the ball. This expression implies an estimate as exact as you want for the first Dirichlet eigenvalue of a geodesic ball in these rotationally symmetric spaces, including the real space forms of constant curvature. As an application of the model space theory we prove lower and upper bounds for the first Dirichlet eigenvalues of extrinsic metric balls in submanifolds of ambient Riemannian spaces which have model space controlled curvatures. Moreover, from this general setting we thereby obtain new generalizations of the classical and celebrated results due to McKean and Cheung–Leung concerning the fundamental tones of Cartan-Hadamard manifolds and the fundamental tones of submanifolds with bounded mean curvature in hyperbolic spaces, respectively.

Extensions of Bessel sequences to dual pairs of frames

Tight frames in Hilbert spaces have been studied intensively for the past years. In this paper we demonstrate that it often is an advantage to use pairs of dual frames rather than tight frames. We show that in any separable Hilbert space, any pairs of Bessel sequences can be extended to a pair of dual frames. If the given Bessel sequences are Gabor systems in L2(R), the extension can be chosen to have Gabor structure as well. We also show that if the generators of the given Gabor Bessel sequences are compactly supported, we can choose the generators of the added Gabor systems to be compactly supported as well. This is a significant improvement compared to the extension of a Bessel sequence to a tight frame, where the added generator only can be compactly supported in some special cases. We also analyze the wavelet case, and find sufficient conditions under which a pair of wavelet systems can be extended to a pair of dual frames. © 2012 Elsevier Inc. All rights reserved.
He-, Ne-, and Ar-phosgene intermolecular potential energy surfaces

Using the CCSD(T) model, we evaluated the intermolecular potential energy surfaces of the He-, Ne-, and Ar-phosgene complexes. We considered a representative number of intermolecular geometries for which we calculated the corresponding interaction energies with the augmented (He complex) and double augmented (Ne and Ar complexes)
correlation-consistent polarized valence triple-ζ basis sets extended with a set of 3s3p2d1f1g midbond functions. These basis sets were selected after systematic basis set studies carried out at geometries close to those of the surface minima. The He-, Ne-, and Ar-phosgene surfaces were found to have absolute minima of -72.1, -140.4, and -326.6 cm⁻¹ at distances between the rare-gas atom and the phosgene center of mass of 3.184, 3.254, and 3.516 Å, respectively. The potentials were further used in the evaluation of rovibrational states and the rotational constants of the complexes, providing valuable results for future experimental investigations. Comparing our results to those previously available for other phosgene complexes, we suggest that the results for Cl₂-phosgene should be revised.

**General information**
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Corun, University of California, University of Santiago de Compostela
Authors: Munteanu, C. R. (Ekstern), Henriksen, C. (Intern), Felker, P. M. (Ekstern), Fernández, B. (Ekstern)
Pages: 3835-3843
Publication date: 2013
Main Research Area: Technical/natural sciences

**Publication information**
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Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.64
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.78
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.65
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.84
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.78
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.87
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Web of Science (2008): Indexed yes
Web of Science (2007): Indexed yes
Web of Science (2006): Indexed yes
Web of Science (2005): Indexed yes
Web of Science (2004): Indexed yes
Isogeometric shape optimization in fluid mechanics

The subject of this work is numerical shape optimization in fluid mechanics, based on isogeometric analysis. The generic goal is to design the shape of a 2-dimensional flow domain to minimize some prescribed objective while satisfying given geometric constraints. As part of the design problem, the steady-state, incompressible Navier-Stokes equations, governing a laminar flow in the domain, must be solved. Based on isogeometric analysis, we use B-splines as the basis for both the design optimization and the flow analysis, thereby unifying the models for geometry and analysis, and, at the same time, facilitating a compact representation of complex geometries and smooth approximations of the flow fields. To drive the shape optimization, we use a gradient-based approach, and to avoid inappropriate parametrizations during optimization, we regularize the optimization problem by adding to the objective function a measure of the quality of the boundary parametrization. A detailed description of the methodology is given, and three different numerical examples are considered, through which we investigate the effects of the regularization, of the number of geometric design variables, and of variations in the analysis resolution, initial design and Reynolds number, and thereby demonstrate the robustness of the methodology.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Scientific Computing, Mathematics
Authors: Nørtoft, P. (Intern), Gravesen, J. (Intern)
Pages: 909-925
Publication date: 2013
Main Research Area: Technical/natural sciences

Publication information
Journal: Structural and Multidisciplinary Optimization
Volume: 48
Issue number: 5
ISSN (Print): 1615-147x
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.14
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 2.42
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 2.77
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 2.86
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 2.08
List Decoding of Algebraic Codes

We investigate three paradigms for polynomial-time decoding of Reed–Solomon codes beyond half the minimum distance: the Guruswami–Sudan algorithm, Power decoding and the Wu algorithm. The main results concern shaping the computational core of all three methods to a problem solvable by module minimisation; by applying the fastest known algorithms for this general problem, we then obtain realisations of each paradigm which are as fast or faster than all previously known methods. An element of this is the “2D key equation”, a heavily generalised form of the classical key equation, and we show how to solve such using module minimisation, or using our new Demand–Driven algorithm which is also based on module minimisation.

The decoding paradigms are all derived and analysed in a self-contained manner, often in new ways or examined in greater depth than previously. Among a number of new results, we give: a fast maximum-likelihood list decoder based on the Guruswami–Sudan algorithm; a new variant of Power decoding, Power Gao, along with some new insights into Power decoding; and a new, module based method for performing rational interpolation for the Wu algorithm. We also show how to decode Hermitian codes using Guruswami–Sudan or Power decoding faster than previously known, and we show how to Wu list decode binary Goppa codes.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Nielsen, J. S. R. (Intern), Beelen, P. (Intern), Høholdt, T. (Intern)
Number of pages: 178
Publication date: 2013

Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Original language: English
Series: DTU Compute PHD-2013
Mathematical modeling of the hypothalamic-pituitary-adrenal gland (HPA) axis, including hippocampal mechanisms

This paper presents a mathematical model of the HPA axis. The HPA axis consists of the hypothalamus, the pituitary and the adrenal glands in which the three hormones CRH, ACTH and cortisol interact through receptor dynamics. Furthermore, it has been suggested that receptors in the hippocampus have an influence on the axis. A model is presented with three coupled, non-linear differential equations, with the hormones CRH, ACTH and cortisol as variables. The model includes the known features of the HPA axis, and includes the effects from the hippocampus through its impact on CRH in the hypothalamus. The model is investigated both analytically and numerically for oscillating solutions, related to the ultradian rhythm seen in data, and for multiple fixed points related to hypercortisolemic and hypocortisolemic depression. The existence of an attracting trapping region guarantees that solution curves stay non-negative and bounded, which can be interpreted as a mathematical formulation of homeostasis. No oscillating solutions are present when using physiologically reasonable parameter values. This indicates that the ultradian rhythm originate from different mechanisms. Using physiologically reasonable parameters, the system has a unique fixed point, and the system is globally stable. Therefore, solutions converge to the fixed point for all initial conditions. This is in agreement with cortisol levels returning to normal, after periods of mild stress, in healthy individuals. Perturbing parameters lead to a bifurcation, where two additional fixed points emerge. Thus, the system changes from having a unique stable fixed point into having three fixed points. Of the three fixed points, two are stable and one is unstable. Further investigations show that solutions converge to one of the two stable fixed points depending on the initial conditions. This could explain why healthy people becoming depressed usually fall into one of two groups: a hypercortisolemic depressive group or a hypocortisolemic depressive group.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Roskilde University
Authors: Andersen, M. (Intern), Vinther, F. (Intern), Ottesen, J. T. (Forskerdatabase)
Pages: 122-138
Publication date: 2013
Main Research Area: Technical/natural sciences

Publication information

Journal: Mathematical Biosciences
Volume: 246
Issue number: 1
ISSN (Print): 0025-5564
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 0.645 SNIP 1 CiteScore 1.53
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.71 SNIP 0.977 CiteScore 1.43
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.712 SNIP 1.13 CiteScore 1.62
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.72 SNIP 1.038 CiteScore 1.75
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.682 SNIP 1.08 CiteScore 1.88
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Multi-Trial Guruswami–Sudan Decoding for Generalised Reed–Solomon Codes

An iterated refinement procedure for the Guruswami–Sudan list decoding algorithm for Generalised Reed–Solomon codes based on Alekhnovich’s module minimisation is proposed. The method is parametrisable and allows variants of the usual list decoding approach. In particular, finding the list of closest codewords within an intermediate radius can be performed with improved average-case complexity while retaining the worst-case complexity.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science , Mathematics , University of Ulm
Authors: Nielsen, J. S. R. (Intern), Zeh, A. (Ekstern)
Number of pages: 11
Publication date: 2013

Host publication information
Title of host publication: WCC 2013 International Workshop on Coding and Cryptography
BFI conference series: Workshop on Coding and Cryptography (5010052)
Main Research Area: Technical/natural sciences
Conference: International Workshop on Coding and Cryptography (WCC 2013), Bergen, Norway, 15/04/2013 - 15/04/2013
Guruswami–Sudan, List Decoding, Reed–Solomon Codes, Multi-Trial
Electronic versions:
1301.6236v2.pdf
Source: dtu
Source-ID: n::oai:DTIC-ART:arxiv/378491808::28618
Publication: Research - peer-review › Article in proceedings – Annual report year: 2013

On frame properties for Fourier-like systems
Fourier-like systems are formed by multiplying a class of exponentials with a set of window functions. Via the Fourier transform they are equivalent to shift-invariant systems. We present sufficient and easily verifiable conditions for such systems to form a frame with a dual frame having the same structure. An attractive class of frames is formed by letting the window functions be trigonometric polynomials, restricted to compact intervals. We prove, under weak conditions, that such systems generate a frame with a dual that is also generated by a trigonometric polynomial. For polynomial windows, a result of this type does not hold. Throughout the paper the results are related to the well established theory for Gabor systems.
General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Urmia University of Technology
Authors: Christensen, O. (Intern), Osgooei, E. (Ekstern)
Pages: 47-57
Publication date: 2013
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Approximation Theory
Volume: 172
ISSN (Print): 0021-9045
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.732 SNIP 1.125 CiteScore 0.76
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.906 SNIP 1.347 CiteScore 0.96
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.935 SNIP 1.256 CiteScore 0.96
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.768 SNIP 1.24 CiteScore 0.84
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.999 SNIP 1.165 CiteScore 0.8
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.848 SNIP 1.173 CiteScore 0.75
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.232 SNIP 1.206
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.142 SNIP 1.236
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.285 SNIP 1.227
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.023 SNIP 1.229
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.939 SNIP 1.064
Scopus rating (2005): SJR 0.897 SNIP 1.282
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.651 SNIP 0.845
Scopus rating (2003): SJR 0.862 SNIP 1.223
Scopus rating (2002): SJR 0.718 SNIP 1.03
Scopus rating (2001): SJR 0.841 SNIP 1.212
Scopus rating (2000): SJR 0.913 SNIP 1.035
Scopus rating (1999): SJR 1.124 SNIP 1.313

Original language: English
Dual pairs, Fourier-like systems, Shift-invariant systems
DOIs: 10.1016/j.jat.2013.04.004
On Rational Interpolation-Based List-Decoding and List-Decoding Binary Goppa Codes

We derive the Wu list-decoding algorithm for generalized Reed–Solomon (GRS) codes by using Gröbner bases over modules and the Euclidean algorithm as the initial algorithm instead of the Berlekamp–Massey algorithm. We present a novel method for constructing the interpolation polynomial fast. We give a new application of the Wu list decoder by decoding irreducible binary Goppa codes up to the binary Johnson radius. Finally, we point out a connection between the governing equations of the Wu algorithm and the Guruswami–Sudan algorithm, immediately leading to equality in the decoding range and a duality in the choice of parameters needed for decoding, both in the case of GRS codes and in the case of Goppa codes.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Sandforce Inc.
Authors: Beelen, P. (Intern), Høholdt, T. (Intern), Nielsen, J. S. R. (Intern), Wu, Y. (Ekstern)
Pages: 3269-3281
Publication date: 2013
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Transactions on Information Theory
Volume: 59
Issue number: 6
ISSN (Print): 0018-9448
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.34 SJR 1.678 SNIP 2.004
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.796 SNIP 2.317 CiteScore 3.3
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.944 SNIP 2.544 CiteScore 3.71
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 3.012 SNIP 3.29 CiteScore 4.37
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.838 SNIP 3.078 CiteScore 4.07
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.779 SNIP 3.313 CiteScore 4.32
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 3.17 SNIP 2.952
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 4.941 SNIP 3.991
On the Dimension of Graph Codes with Reed–Solomon Component Codes

We study a class of graph based codes with Reed-Solomon component codes as affine variety codes. We give a formulation of the exact dimension of graph codes in general. We give an algebraic description of these codes which makes the exact computation of the dimension of the graph codes easier.

On transforms between Gabor frames and wavelet frames

We describe a procedure that enables us to construct dual pairs of wavelet frames from certain dual pairs of Gabor frames. Applying the construction to Gabor frames generated by appropriate exponential Bsplines gives wavelet frames generated by functions whose Fourier transforms are compactly supported splines with geometrically distributed knot sequences. There is also a reverse transform, which yields pairs of dual Gabor frames when
Recent progress in the relative equilibria of point vortices — In memoriam Hassan Aref

Hassan Aref, who sadly passed away in 2011, was one of the world's leading researchers in the dynamics and equilibria of point vortices. We review two problems on the subject of point vortex relative equilibria in which he was engaged at the time of his death: bilinear relative equilibria and the geometry of the three-vortex problem as it relates to equilibria. A set of point vortices is in relative equilibrium if it is at most rotating rigidly around the center of vorticity, and the configuration is bilinear if the vortices are placed on two orthogonal lines in the co-rotating frame. A very complete characterisation of the bilinear case can be obtained when one of the lines contains only two vortices. The classic three-vortex problem can be viewed anew by considering the dy- namics of the circle circumscribing the vortex triangle and the interior angles of that triangle. This approach leads naturally to the observation that the equilateral triangle is the only equilibrium configuration for three point vortices, regardless of their strength values.

Refined ab initio intermolecular ground-state potential energy surface for the He-C_2H_2 van der Waals complex

A refined CCSD(T) intermolecular potential energy surface is developed for the He-C_2H_2 van der Waals complex. For this, 206 points on the intermolecular potential energy surface, evaluated using the CCSD(T) method and the aug-cc-pVQZ basis set extended with a set of 3s3p2d1f1g midbond functions, are fitted to a 15-parameter analytic function. The potential is characterised by minima of -24.21 cm^{-1} at distances between the rare gas atom and the C2H2 centre of mass.
of 4.3453 Å, and with the complex in a linear configuration. At intermediate distances the surface is rather similar to that
developed previously by Munteanu and Fernández (J. Chem. Phys., 123, 014309, 2005) but differs notably at short range. The improved potential energy surface should, therefore, be particularly useful for computations of collision line broadening. Dynamical calculations of a number of rovibrational bound state energies and wave functions are presented. Inspection of the nodal surfaces of several low lying excited states shows that the complex is close to the free rotor limit.

**General information**

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Santiago de Compostela, Utah State University
Authors: Fernández, B. (Ekstern), Henriksen, C. (Intern), Farrelly, D. (Ekstern)
Pages: 1173-1177
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Main Research Area: Technical/natural sciences

**Publication information**

Journal: Molecular Physics
Volume: 111
Issue number: 9-11
ISSN (Print): 0026-8976
Ratings:
- BFI (2018): BFI-level 1
- Web of Science (2018): Indexed yes
- BFI (2017): BFI-level 1
- Web of Science (2017): Indexed yes
- BFI (2016): BFI-level 1
- Scopus rating (2016): CiteScore 1.65 SJR 0.833 SNIP 0.729
- Web of Science (2016): Indexed yes
- BFI (2015): BFI-level 1
- Scopus rating (2015): SJR 0.761 SNIP 0.85 CiteScore 1.68
- BFI (2014): BFI-level 1
- Scopus rating (2014): SJR 0.697 SNIP 0.667 CiteScore 1.48
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 1
- Scopus rating (2013): SJR 0.678 SNIP 0.715 CiteScore 1.58
- ISI indexed (2013): ISI indexed yes
- Web of Science (2013): Indexed yes
- BFI (2012): BFI-level 1
- Scopus rating (2012): SJR 0.801 SNIP 0.738 CiteScore 1.62
- ISI indexed (2012): ISI indexed yes
- Web of Science (2012): Indexed yes
- BFI (2011): BFI-level 1
- Scopus rating (2011): SJR 0.824 SNIP 0.829 CiteScore 1.67
- ISI indexed (2011): ISI indexed yes
- Web of Science (2011): Indexed yes
- BFI (2010): BFI-level 1
- Scopus rating (2010): SJR 0.786 SNIP 0.722
- BFI (2009): BFI-level 1
- Scopus rating (2009): SJR 0.885 SNIP 0.717
- BFI (2008): BFI-level 1
- Scopus rating (2008): SJR 1.003 SNIP 0.765
- Scopus rating (2007): SJR 1.088 SNIP 0.775
- Web of Science (2007): Indexed yes
- Scopus rating (2006): SJR 1.023 SNIP 0.78
- Scopus rating (2005): SJR 0.895 SNIP 0.746
- Scopus rating (2004): SJR 0.979 SNIP 0.847
- Scopus rating (2003): SJR 1.016 SNIP 0.841
Regularity of Dual Gabor Windows

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Korea Advanced Institute of Science & Technology, Yeungnam University
Authors: Christensen, O. (Intern), Kim, H. O. (Ekstern), Kim, R. Y. (Ekstern)
Number of pages: 8
Publication date: 2013
Main Research Area: Technical/natural sciences

Publication information
Journal: Abstract and Applied Analysis
Volume: 2013
Article number: 747268
ISSN (Print): 1085-3375
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.489 SNIP 0.47 CiteScore 0.59
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.513 SNIP 0.473 CiteScore 0.62
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.467 SNIP 0.711 CiteScore 0.93
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.546 SNIP 0.843 CiteScore 1.18
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.723 SNIP 0.872 CiteScore 1.25
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.814 SNIP 0.861 CiteScore 1.22
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.653 SNIP 0.888
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.111 SNIP 0.902
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.428 SNIP 0.699
Scopus rating (2007): SJR 0.481 SNIP 0.941
Scopus rating (2006): SJR 0.591 SNIP 0.741
Scopus rating (2005): SJR 0.574 SNIP 0.676
Ribbon Crystals

A repetitive crystal-like pattern is spontaneously formed upon the twisting of straight ribbons. The pattern is akin to a tessellation with isosceles triangles, and it can easily be demonstrated with ribbons cut from an overhead transparency. We give a general description of developable ribbons using a ruled procedure where ribbons are uniquely described by two generating functions. This construction defines a differentiable frame, the ribbon frame, which does not have singular points, whereby we avoid the shortcomings of the Frenet–Serret frame. The observed spontaneous pattern is modeled using planar triangles and cylindrical arcs, and the ribbon structure is shown to arise from a maximization of the end-to-end length of the ribbon, i.e. from an optimal use of ribbon length. The phenomenon is discussed in the perspectives of incompatible intrinsic geometries and of the emergence of long-range order.
The geometric Cauchy problem for surfaces with Lorentzian harmonic Gauss maps

The geometric Cauchy problem for a class of surfaces in a pseudo-Riemannian manifold of dimension 3 is to find the surface which contains a given curve with a prescribed tangent bundle along the curve. We consider this problem for constant negative Gauss curvature surfaces (pseudospherical surfaces) in Euclidean 3-space, and for timelike constant non-zero mean curvature (CMC) surfaces in the Lorentz-Minkowski 3-space. We prove that there is a unique solution if the prescribed curve is non-characteristic, and for characteristic initial curves (asymptotic curves for pseudospherical surfaces and null curves for timelike CMC) it is necessary and sufficient for similar data to be prescribed along an additional characteristic curve that intersects the first. The proofs also give a means of constructing all solutions using loop group techniques. The method used is the infinite dimensional d'Alembert type representation for surfaces associated with Lorentzian harmonic maps (1-1 wave maps) into symmetric spaces, developed since the 1990's. Explicit formulae for the potentials in terms of the prescribed data are given, and some applications are considered.
Topology of streamlines and vorticity contours for two-dimensional flows

Considering a coordinate-free formulation of helical symmetry rather than more traditional definitions based on coordinates, we discuss basic properties of helical vector fields and compare results from the literature. For inviscid flow where a velocity field is generated by a sum of helical vortex filaments with same pitch we use the established results to prove briefly that the velocity field is helical. We discuss the role of the stream function for the topology of the streamlines in incompressible, helical flows. On this basis, we perform a comprehensive study of the topology of the flow field generated by a helical vortex filament in an ideal fluid. The classical expression for the stream function obtained by Hardin (Phys. Fluids 25, 1982) contains an infinite sum of modified Bessel functions. Using the approach by Okulov (Russ. J. Eng. Thermophys. 5, 1995) we obtain a closed-form approximation which is considerably easier to analyse. Critical points of the stream function can be found from the zeroes of a single real function of one variable, and we show that three different flow topologies can occur, depending on a single dimensionless parameter. Including the self-induced velocity on the vortex filament by the localised induction approximation the stream function is slightly modified and an extra parameter is introduced. In this setting two new flow topologies arise, but not more than two critical points occur for any combination of the parameters. The analysis of the closed form show promise for analysing more complex flow with helical symmetry e.g. multiple helical vortex filaments inside a cylinder which has industrial relevance.

We then change focus and study creation, destruction and interaction of vortices in two-dimensional flow. A vortex is advected above a wall causing a viscous response near the wall which generates a new vortex structure. The problem is studied numerically relying on the code developed by Prof. M. Thompson and his group at Monash University, Australia.
We also investigate the problem analytically using normal form theory. It is not a simple task to define a vortex in a proper way that allow the study of creation and destruction of vortices. We investigate three sound choices: the vorticity extrema, the streamline centers in a coordinate system with zero wall speed and the streamline centers in a frame moving with constant velocity as predicted by a point vortex above a wall in inviscid fluid. There is no reason to a priori expect equivalent results of the three vortex definitions. However, the study is mainly motivated by the findings of Kudela & Malecha (Fluid Dyn. Res. 41, 2009) who find good agreement between the vorticity and streamlines in the fixed wall system. For small Re no new vortices are observed. Creation of a vortex occurs for sufficiently large Re for all the applied vortex definitions. The new vortex alters the generating vortex motion by slowing its horizontal motion and lifting it further from the wall. In the fixed wall system vortex eruption happens through a characteristic 'figure 8' bifurcation. Considering the other coordinate system there is no topological change indicating when a vortex has left the boundary layer. However, here there is remarkable good agreement between streamlines and the vorticity contours even for short-lived vortices close to the wall. The normal form approach does not reveal simple connections between the streamline topology and the vorticity contour topology. Only for a non simple degenerate on wall critical point may a bifurcation occur in both the streamlines and the vorticity contours. The streamline bifurcations in this normal form contain the lower part of the 'figure 8' bifurcation observed in numerics. The similarities and differences of the streamlines in the two different coordinate systems are well described by normal form theory.

We derive the criterion, $\mathbf{u} \cdot \nabla \omega = 0$, for exactly matching contours of the vorticity contours and streamlines. This is fulfilled when the Navier - Stokes equations and the heat equation have identical solutions.

Finally we focus on the superposition of two rotational invariant vortices in $\mathbb{R}^2$. The topology of the streamlines and the topology of the vorticity contours are determined by the zeros of a single real function. For the canonical example of two Gaussian vortices three parameters exist. Three structurally stable topologies are observed. For the streamlines two of the topologies are well known for the corresponding situation of two point vortices when the singularities are treated as centers. The last topology is a single center which is consistent with the powerful result on the long time behaviour proved by Gallay & Wayne (Comm. in Math. Phys. 255, 2005). The case of three critical points of the streamlines is a subset of three critical points of the vorticity. This explains an observation in the simulations of vortex generation near a wall. Here, a long living erupted vortex disappears due to viscosity. This happens first considering the streamlines while being more robust when considering the vorticity formulation.
Shearlets and Optimally Sparse Approximations

Multivariate functions are typically governed by anisotropic features such as edges in images or shock fronts in solutions of transport-dominated equations. One major goal both for the purpose of compression as well as for an efficient analysis is the provision of optimally sparse approximations of such functions. Recently, cartoon-like images were introduced in 2D and 3D as a suitable model class, and approximation properties were measured by considering the decay rate of the $L^2$ error of the best $N$-term approximation. Shearlet systems are to date the only representation system which provide optimally sparse approximations of this model class in 2D as well as 3D. Even more, in contrast to all other directional representation systems, a theory for compactly supported shearlet frames was derived which moreover also satisfy this optimality benchmark. This chapter shall serve as an introduction to and a survey about sparse approximations of cartoon-like images by band-limited and also compactly supported shearlet frames as well as a reference for the state-of-the-art of this research field.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Technische Universität Berlin
Authors: Kutyniok, G. (Ekstern), Lemvig, J. (Intern), Lim, W. (Ekstern)
Pages: 145-198
Publication date: 2012

Host publication information
Title of host publication: Shearlets: Multiscale Analysis for Multivariate Data
Publisher: Birkhäuser Verlag GmbH
Editors: Kutyniok, G., Labate, D.
ISBN (Print): 978-0-8176-8316-0
Main Research Area: Technical/natural sciences
Sparse approximations, Cartoon-like images, Band-limited shearlets, Anisotropic features, Linear and non-linear approximations, Compactly supported shearlets, Multi-dimensional data
Source: orbit
Source-ID: 315862
Publication: Research - peer-review › Book chapter – Annual report year: 2012

Beneath the Wheel - Greenwood Engineering
This is the report from the 54th European Study Group wiht Industry of the Greenwood Engineering problem. We model pavement response to both a point and distributed loads and compare with data from Greenwood’s High Speed Deflectograph Measurements.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Department of Mathematics, Technical University of Denmark
Authors: Dias, K. (Intern), Gravesen, J. (Intern), Hjorth, P. G. (Intern), Larsen, P. (Ekstern), Please, C. (Ekstern), Radulovic, N. (Ekstern), Wang, L. (Ekstern), Aagaard Pedersen, L. (Ekstern)
Number of pages: 14
Publication date: 2005
A characterization of spheres, circles and cardioids

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Technical University of Denmark
Authors: Gæde, L. (Ekstern), Gravesen, J. (Intern), Markvorsen, S. (Intern)
Pages: 579-590
Publication date: Jun 1993
Main Research Area: Technical/natural sciences

Publication information
Journal: Archiv der Mathematik
Volume: 60
Issue number: 6
ISSN (Print): 0003-889X
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.61 SJR 0.646 SNIP 0.996
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.614 SNIP 0.812 CiteScore 0.46
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.591 SNIP 0.743 CiteScore 0.44
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.848 SNIP 0.927 CiteScore 0.52
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.577 SNIP 0.679 CiteScore 0.42
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.767 SNIP 0.9 CiteScore 0.46
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.677 SNIP 0.783
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.77 SNIP 0.917
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.931 SNIP 1.104
Scopus rating (2007): SJR 0.822 SNIP 0.901
Scopus rating (2006): SJR 0.766 SNIP 0.86
Scopus rating (2005): SJR 0.646 SNIP 0.771
Scopus rating (2004): SJR 0.553 SNIP 0.801
Scopus rating (2003): SJR 0.581 SNIP 0.87
Loop groups and Yang-Mills theory in dimension two

Given a connection $\omega$ in a $G$-bundle over $S^2$, then a process called radial trivialization from the poles gives a unique clutching function, i.e., an element $\gamma$ of the loop group $\Omega G$. Up to gauge equivalence, $\omega$ is completely determined by $\gamma$ and a map $f:S^2 \to g$ into the Lie algebra. Moreover, the Yang-Mills function of $\omega$ is the sum of the energy of $\gamma$ and the square of a certain norm of $f$. In particular, the Yang-Mills functional has the same Morse theory as the energy functional on $\Omega G$. There is a similar description of connections in a $G$-bundle over an arbitrary Riemann surface, but so far not of the Yang-Mills functional.
On the topology of spaces of holomorphic maps

**General information**
- **State:** Published
- **Organisations:** Department of Applied Mathematics and Computer Science, Mathematics
- **Authors:** Gravesen, J. (Intern)
- **Pages:** 247-286
- **Publication date:** Jul 1989
- **Main Research Area:** Technical/natural sciences

**Publication information**
- **Journal:** Acta Mathematica
- **Volume:** 162
- **ISSN (Print):** 0001-5962
- **Ratings:**
  - BFI (2018): BFI-level 2
  - Web of Science (2018): Indexed yes
  - BFI (2017): BFI-level 2
  - Web of Science (2017): Indexed Yes
  - BFI (2016): BFI-level 2
  - Scopus rating (2016): CiteScore 3.09 SJR 7.269 SNIP 4.18
  - BFI (2015): BFI-level 2
  - Scopus rating (2015): SJR 7.871 SNIP 4.433 CiteScore 3.23
  - BFI (2014): BFI-level 2
  - Scopus rating (2014): SJR 6.357 SNIP 3.878 CiteScore 3.45
  - BFI (2013): BFI-level 2
  - Scopus rating (2013): SJR 6.387 SNIP 4.032 CiteScore 3.04
  - ISI indexed (2013): ISI indexed yes
  - BFI (2012): BFI-level 2
  - Scopus rating (2012): SJR 7.412 SNIP 4.803 CiteScore 3.17
  - ISI indexed (2012): ISI indexed yes
  - BFI (2011): BFI-level 2
  - Scopus rating (2011): SJR 7.415 SNIP 4.998 CiteScore 3.94
  - ISI indexed (2011): ISI indexed yes
  - BFI (2010): BFI-level 2
  - Scopus rating (2010): SJR 10.71 SNIP 4.824
  - BFI (2009): BFI-level 2
  - Scopus rating (2009): SJR 7.211 SNIP 4.396
  - BFI (2008): BFI-level 2
  - Scopus rating (2008): SJR 3.65 SNIP 1.795
  - Scopus rating (2007): SJR 4.856 SNIP 4.005
  - Scopus rating (2006): SJR 4.332 SNIP 2.26
  - Scopus rating (2005): SJR 4.849 SNIP 2.725
  - Scopus rating (2004): SJR 3.612 SNIP 3.647
  - Scopus rating (2003): SJR 2.765 SNIP 2.997
  - Scopus rating (2002): SJR 3.81 SNIP 3.046
  - Scopus rating (2001): SJR 4.549 SNIP 2.436
  - Scopus rating (1999): SJR 4.856 SNIP 2.9
- **Original language:** English
- **DOIs:**
  - 10.1007/BF02392839
- **Source:** Scopus
- **Source-ID:** 0001355112
Complex structures in the Nash-Moser category

Working in the Nash-Moser category, it is shown that the harmonic and holomorphic differentials and the Weierstrass points on a closed Riemann surface depend smoothly on the complex structure. It is also shown that the space of complex structures on any compact surface forms a principal bundle over the Teichmüller space and hence that the uniformization maps of the closed disk and the sphere depend smoothly on the complex structure.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Gravesen, J. (Intern)
Pages: 155-161
Publication date: Jan 1989
Main Research Area: Technical/natural sciences

Publication information

Journal: Annals of Global Analysis and Geometry
Volume: 7
Issue number: 2
ISSN (Print): 0232-704X
Ratings: BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.71 SJR 0.813 SNIP 0.949
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.16 SNIP 1.051 CiteScore 0.8
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.94 SNIP 1.19 CiteScore 0.73
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.225 SNIP 1.149 CiteScore 0.72
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.063 SNIP 1.211 CiteScore 0.81
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.893 SNIP 1.211 CiteScore 0.63
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.803 SNIP 1.12
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.094 SNIP 1.535
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.778 SNIP 1.203
Scopus rating (2007): SJR 0.905 SNIP 1.002
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.827 SNIP 0.986
Scopus rating (2005): SJR 0.785 SNIP 0.818
Scopus rating (2004): SJR 0.914 SNIP 0.883
Scopus rating (2003): SJR 0.906 SNIP 0.798
Scopus rating (2002): SJR 0.898 SNIP 0.951
Scopus rating (2001): SJR 0.961 SNIP 1.305
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.944 SNIP 1.312
Catastrophe Theory and Caustics

It is shown by elementary methods that in codimension two and under the assumption that light rays are straight lines, a caustic is the catastrophe set for a time function. The general case is also discussed.
Scopus rating (2006): SJR 0.695 SNIP 0.723
Scopus rating (2005): SJR 0.628 SNIP 0.599
Scopus rating (2004): SJR 0.628 SNIP 0.709
Scopus rating (2003): SJR 0.689 SNIP 0.633
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.171 SNIP 0.857
Scopus rating (2001): SJR 0.69 SNIP 0.677
Scopus rating (2000): SJR 0.422 SNIP 0.547
Scopus rating (1999): SJR 0.82 SNIP 0.714
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