Mathematics - Publications - DTU Orbit (18/03/2018)

**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 $0 < \varepsilon < 1$. 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 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.
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 $R_5^1$, 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 Hélein to derive a solution: in this case the map \( y \) 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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Authors: Brander, D. (Intern), Wang, P. (Ekstern)
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Web of Science (2013): Indexed yes
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BFI (2011): BFI-level 2
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Scopus rating (2010): SJR 3.019 SNIP 1.998
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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.

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
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 xd. 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 $F[c; s, d]$ 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 $A \in F[c; s, d]^{n \times n}$. Our main focus is to ensure controlled growth in the size of coefficients from $F$ in the case $F = k(c)$, and even $k = Q$. 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
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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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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 $C_{n}/F_{q2n}$ 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
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Authors: Anbar, N. (Intern), Bassa, A. (Ekstern), Beelen, P. (Intern)
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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
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ISI indexed (2013): ISI indexed yes
Algorithms for Zero-Dimensional Ideals Using Linear Recurrent Sequences

Inspired by Faugére 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.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Waterloo
Authors: Neiger, V. (Intern), Rahkooy, H. (Ekstern), Schost, É. (Ekstern)
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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.

General information

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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Boğaziçi University
Authors: Anbar Meidl, N. (Intern), Bassa, A. (Ekstern), Beelen, P. (Intern)
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Scopus rating (2016): CiteScore 0.7 SJR 1.007 SNIP 1.232
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.868 SNIP 1.143 CiteScore 0.59
BFI (2014): BFI-level 1
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BFI (2013): BFI-level 1
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ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.115 SNIP 1.199 CiteScore 0.57
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.006 SNIP 1.079 CiteScore 0.51
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.025 SNIP 1.23
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 0.985 SNIP 1.124
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.065 SNIP 1.202
Scopus rating (2007): SJR 0.724 SNIP 1.09
Scopus rating (2006): SJR 1.136 SNIP 1.194
Scopus rating (2005): SJR 0.926 SNIP 1.025
Scopus rating (2004): SJR 1.026 SNIP 0.935
Scopus rating (2003): SJR 1.015 SNIP 0.931
Scopus rating (2002): SJR 0.875 SNIP 1.128
Scopus rating (2001): SJR 1.073 SNIP 1.22
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.
A Note on a Tower by Bassa, Garcia and Stichtenoth

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Scopus rating (2014): SJR 0.161 SNIP 0.111 CiteScore 0.06
Scopus rating (2013): SJR 0.162 SNIP 0.247
Scopus rating (2012): SJR 0.102 SNIP 0.053
Scopus rating (2011): SJR 0.162 SNIP 0.143
Scopus rating (2010): SJR 0.174 SNIP 0.255
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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
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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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Scopus rating (2016): CiteScore 3.5 SJR 1.824 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
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Scopus rating (2012): SJR 2.174 SNIP 3.985 CiteScore 4.26
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.899 SNIP 1.467 CiteScore 2.17
ISI indexed (2011): ISI indexed no
BFI (2010): BFI-level 2
BFI (2009): BFI-level 2
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Original language: English
Mathematics (all), Applied Mathematics, B-splines, Geodesics, Karcher mean, Shape analysis, Shape registration, Sobolev metric, Boundary value problems, Geometry, Optimization, Sobolev spaces, B splines, Karcher means, Sobolev, Principal component analysis, COMPUTER, MATHEMATICS, IMAGING, RIEMANNIAN-MANIFOLDS, SHAPE SPACES, STATISTICAL-ANALYSIS, PLANE-CURVES, HELA-CELLS, TRACKING, TRAJECTORIES, GEOMETRIES, shape analysis, shape registration, geodesics, Graphics techniques, Other topics in statistics, Combinatorial mathematics, Optimisation techniques, Interpolation and function approximation (numerical analysis), computational geometry, curve fitting, optimisation, principal component analysis, set theory, Sobolev metrics, curve space, statistical shape analysis, Riemannian framework, Riemannian metric, unparametrized curves, Riemannian gradient-based optimization scheme
Bent and bent(4) spectra of Boolean functions over finite fields

For \( c \in \mathbb{F}(2)^n \), a \( c \)-bent4 function \( f \) from the finite field \( \mathbb{F}(2)^n \) to \( \mathbb{F}_2 \) 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.
Blowup for flat slow manifolds: Paper

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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Authors: Kristiansen, K. U. (Intern)
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Scopus rating (2015): SJR 1.352 SNIP 1.239 CiteScore 1.36
Web of Science (2015): Indexed yes
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Scopus rating (2014): SJR 1.468 SNIP 1.32 CiteScore 1.35
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 \((\alpha,\beta)\), the scaled version of \((\phi_\alpha,\psi_\beta)\) 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 almost perfect reconstruction \(\text{within any desired error tolerance whenever the product } ab \text{ 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 (Formula presented.)-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)

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**Main Research Area:** Technical/natural sciences

**Journal:** Journal of Fourier Analysis and Applications
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.

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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
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.306 SNIP 1.34 CiteScore 1.85
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.221 SNIP 1.486 CiteScore 1.77
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.494 SNIP 1.41 CiteScore 1.91
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.204 SNIP 1.187
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.299 SNIP 1.613
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.276 SNIP 1.508
Scopus rating (2007): SJR 1.55 SNIP 1.472
Scopus rating (2006): SJR 1.781 SNIP 1.465
Scopus rating (2005): SJR 1.227 SNIP 1.899
Scopus rating (2004): SJR 1.107 SNIP 2.233
Scopus rating (2003): SJR 0.536 SNIP 0.702
Original language: English
Stiction, Friction oscillator, non-Filippov, Regularization, Canard, Slip-stick, Delayed slip onset
Charaterisations 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 $(P \chi_{[0,N]^d})(x+n)$ 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.

General information
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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)
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Scopus rating (2016): CiteScore 0.51 SJR 0.523 SNIP 0.726
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.505 SNIP 0.771 CiteScore 0.44
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.635 SNIP 0.968 CiteScore 0.55
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.781 SNIP 0.963 CiteScore 0.56
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.573 SNIP 0.893 CiteScore 0.52
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.781 SNIP 0.948 CiteScore 0.53
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.542 SNIP 0.871
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.556 SNIP 0.903
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.626 SNIP 0.806
Scopus rating (2007): SJR 0.528 SNIP 0.727
Scopus rating (2006): SJR 0.692 SNIP 0.823
Scopus rating (2005): SJR 0.615 SNIP 0.876
Scopus rating (2004): SJR 0.552 SNIP 0.606
Scopus rating (2003): SJR 0.394 SNIP 0.676
Counting generalized Reed-Solomon codes
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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Journal: Advances in Mathematics of Communication
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BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.65 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
Scopus rating (2014): SJR 0.687 SNIP 1.209 CiteScore 0.84
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.747 SNIP 1.068 CiteScore 0.82
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.506 SNIP 0.963 CiteScore 0.71
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.575 SNIP 0.969 CiteScore 0.66
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.413 SNIP 1.063
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.343 SNIP 0.986
BFI (2008): BFI-level 1
Original language: English
**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 $O((3n(\omega+1)/2)\log(n))$ 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)
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  - 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
  - Scopus rating (2012): SJR 0.314 SNIP 0.366 CiteScore 0.26
  - ISI indexed (2012): ISI indexed no
  - BFI (2011): BFI-level 1
  - Scopus rating (2011): SJR 0.318 SNIP 0.351 CiteScore 0.25
  - ISI indexed (2011): ISI indexed no
  - BFI (2010): BFI-level 1
  - Scopus rating (2010): SJR 0.343 SNIP 0.338
  - BFI (2009): BFI-level 1
  - Scopus rating (2009): SJR 0.324 SNIP 0.368
  - BFI (2008): BFI-level 1
  - Scopus rating (2008): SJR 0.187 SNIP 0.211
  - Scopus rating (2007): SJR 0.157 SNIP 0.225
  - Scopus rating (2006): SJR 0.149 SNIP 0.159
  - Scopus rating (2005): SJR 0.182 SNIP 0.35
  - Scopus rating (2004): SJR 0.132 SNIP 0.108
  - Scopus rating (2003): SJR 0.128 SNIP 0.052
  - Scopus rating (2002): SJR 0.111 SNIP 0.031
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 $1 - R_m/m+1$ 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.

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 $(\alpha, \ell)$ with $\alpha = \Re z \geq 1$. This allows increased flexibility in regard to smoothness: instead of working with a discrete family of functions from $C_m, m \in \mathbb{N}$, 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.

Gabor Frames in $\ell^2(\mathbb{Z})$ and Linear Dependence
We prove that an overcomplete Gabor frame in $(\ell^2(\mathbb{Z})$) 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 $(\ell^2(\mathbb{Z})$) with modulation parameter $1 / M$ and translation parameter $N$ for some $(\ell^2(\mathbb{Z})$) and generated by a finite sequence $g$ in $(\ell^2(\mathbb{Z})$) with $K$ nonzero entries.
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BFI (2018): BFI-level 2
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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
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Frames, Gabor system in $${\ell }^2({\mathbb {Z}})$$, Linear dependency of Gabor systems

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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)
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Gabor frames on locally compact abelian groups and related topics
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Generalized shift-invariant systems and approximately dual frames
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.

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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Universidad Nacional de San Luis
Idempotent and p-potent quadratic functions: distribution of nonlinearity and co-dimension

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Austrian Academy of Sciences, Sabanci University
Authors: Anbar Meidl, N. (Intern), Meidl, W. M. (Ekstern), Topuzoglu, A. (Ekstern)
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BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.09 SJR 0.64 SNIP 1.393
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.604 SNIP 1.095 CiteScore 0.82
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.73 SNIP 1.441 CiteScore 0.99
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.788 SNIP 1.447 CiteScore 0.92
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.849 SNIP 1.519 CiteScore 0.98
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.

Bibliographical note
This paper is dedicated to the memory of Tosun Terzioglu

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Publication: Research - peer-review › Journal article – Annual report year: 2016
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.

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Organisations: Department of Applied Mathematics and Computer Science, Mathematics
Authors: Granados, A. (Intern)
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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): SJR 0.845 SNIP 1.266 CiteScore 1.71
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.035 SNIP 1.312 CiteScore 1.79
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.067 SNIP 1.204 CiteScore 1.71
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.029 SNIP 1.364 CiteScore 1.76
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.067 SNIP 1.234 CiteScore 1.69
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.959 SNIP 1.144 CiteScore 1.58
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.037 SNIP 1.11
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.009 SNIP 1.133
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Maximum number of common zeros of homogeneous polynomials over finite fields

About two decades ago, Tsfasman and Boguslavsky conjectured a formula for 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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  - 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
  - BFI (2013): BFI-level 1
  - Scopus rating (2013): SJR 1.22 SNIP 1.121 CiteScore 0.71
  - ISI indexed (2013): ISI indexed yes
  - BFI (2012): BFI-level 1
  - Scopus rating (2012): SJR 1.123 SNIP 1.065 CiteScore 0.64
  - ISI indexed (2012): ISI indexed yes
  - Web of Science (2012): Indexed yes
  - BFI (2011): BFI-level 1
  - Scopus rating (2011): SJR 1.201 SNIP 1.091 CiteScore 0.63
  - ISI indexed (2011): ISI indexed yes
  - BFI (2010): BFI-level 1
  - Scopus rating (2010): SJR 1.182 SNIP 0.974
  - BFI (2009): BFI-level 1
  - Scopus rating (2009): SJR 1.102 SNIP 0.975
  - BFI (2008): BFI-level 1
  - Scopus rating (2008): SJR 1.168 SNIP 1.161
  - Scopus rating (2007): SJR 0.921 SNIP 1.098
  - Web of Science (2007): Indexed yes
  - Scopus rating (2006): SJR 1.092 SNIP 1.13
  - Web of Science (2006): Indexed yes
  - Scopus rating (2005): SJR 1.013 SNIP 1.05
  - Scopus rating (2004): SJR 0.992 SNIP 0.96
  - Scopus rating (2003): SJR 0.915 SNIP 0.928
  - Scopus rating (2002): SJR 1 SNIP 1.015
  - Web of Science (2002): Indexed yes
  - Scopus rating (2001): SJR 0.913 SNIP 0.961
  - Web of Science (2001): Indexed yes
  - Scopus rating (2000): SJR 1.048 SNIP 0.981
  - Scopus rating (1999): SJR 0.962 SNIP 0.919
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 \(F_{2^n}\), 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 bent\(_4\) functions, they are bent or semibent functions shifted by a certain quadratic term, a property which they share with their multivariate counterpart.
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)
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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
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.22 SNIP 1.121 CiteScore 0.71
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.123 SNIP 1.065 CiteScore 0.64
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.201 SNIP 1.091 CiteScore 0.63
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.182 SNIP 0.974
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.102 SNIP 0.975
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.168 SNIP 1.161
Scopus rating (2007): SJR 0.921 SNIP 1.098
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.092 SNIP 1.13
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.013 SNIP 1.05
Scopus rating (2004): SJR 0.992 SNIP 0.96
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
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Conference: 2017 International Conference on Sampling Theory and Applications, Tallinn, Estonia, 03/07/2017 - 03/07/2017
DOIs: 10.1109/SAMPTA.2017.8024456
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Publication: Research - peer-review › Article in proceedings – Annual report year: 2017

On permutation polynomials over finite fields: differences and iterations
The Carlitz rank of a permutation polynomial f over a finite field F_q is a simple concept that was introduced in the last decade. Classifying permutations over 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 F_q of a given Carlitz rank, and g ∈ 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)
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Title of host publication: Women in Numbers
Main Research Area: Technical/natural sciences
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.
On the difference between permutation polynomials over finite fields
The well-known Chowla and Zassenhaus conjecture, proven by Cohen in 1990, states that if \( p > (d \cdot 2 - 3d + 4)^2 \), then there is no complete mapping polynomial \( f \) in \( \mathbb{F}_p[x] \) of degree \( d \geq 2 \). For arbitrary finite fields \( \mathbb{F}_q \), a similar non-existence result is obtained recently by İskik, Topuzo˘glu 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 \( d \geq 2 \) over \( \mathbb{F}_p \), with \( p > (d \cdot 2 - 3d + 4)^2 \), then the degree \( k \) of \( g \) satisfies \( k \geq 3d/5 \), unless \( g \) is constant. In this article, assuming \( f \) and \( f + g \) are permutation polynomials in \( \mathbb{F}_q[x] \), we give lower bounds for \( k \) in terms of the Carlitz rank of \( f \) and \( q \). Our results generalize the above mentioned result of İskik et al. We also show for a special class of polynomials \( f \) of Carlitz rank \( n \geq 1 \) that if \( f + x \) \( k \) is a permutation over \( \mathbb{F}_q \), with \( \gcd(k + 1, q - 1) = 1 \), then \( k \geq (q - n)/(n + 3) \).

General information
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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)
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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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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
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 $L^{2}(\mathbb{R}^{d})$ 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.
The purpose of this paper is to consider representations of frames \( \{ \phi_k \}_{k \in I} \) in a Hilbert space \( \mathcal{H} \) of the form \( \{ \phi_k \}_{k \in I} = \{ T \phi_0 \}_{k \in I} \) for a linear operator \( T \); here the index set \( I \) is either \( \mathbb{Z} \) or \( \mathcal{F}_0 \). 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.

### General information

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Organizations: Department of Applied Mathematics and Computer Science, Mathematics  
Authors: Christensen, O. (Intern), Hasannasab, M. (Intern)  
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Conference: 2017 International Conference on Sampling Theory and Applications, Tallinn, Estonia, 03/07/2017 - 03/07/2017  
DOI: 10.1109/SAMPTA.2017.8024348  
Source: FindIt  
Source-ID: 2374256674  
Publication: Research - peer-review > Article in proceedings – Annual report year: 2017

### Operator Representations of Frames: Boundedness, Duality, and Stability

The purpose of the paper is to analyze frames \( \{ \phi_k \} \) having the form \( \{ T \phi_0 \} \) for some linear operator \( T \). 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 \( \{ T \phi_0 \} \) can be achieved for an operator \( T \) that has an extension to a bounded bijective operator \( V \). 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 \( V \). Finally, we consider stability of the representation \( \{ V \phi_0 \} \); 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.

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Web of Science (2017): Indexed Yes
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.
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 flexibility. 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.

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Authors: Møller-Andersen, J. (Intern), Gravesen, J. (Intern)
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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 flexibility. 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.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Universidad Nacional de San Luis
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Scopus rating (2016): SJR 0.335 SNIP 0.673 CiteScore 0.51
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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
ISI indexed (2012): ISI indexed no
Original language: English
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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
Web of Science (2018): Indexed yes
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.81 SJR 1.032 SNIP 0.96
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.128 SNIP 0.965 CiteScore 0.7
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.001 SNIP 0.858 CiteScore 0.74
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.911 SNIP 1.264 CiteScore 0.77
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.002 SNIP 0.933 CiteScore 0.73
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.494 SNIP 1.17 CiteScore 0.82
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.691 SNIP 1.17
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.257 SNIP 1.478
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.382 SNIP 1.432
Scopus rating (2007): SJR 0.806 SNIP 1.21
Scopus rating (2006): SJR 0.884 SNIP 1.197
Scopus rating (2005): SJR 0.379 SNIP 0.686
Scopus rating (2004): SJR 0.491 SNIP 0.667
Scopus rating (2003): SJR 0.524 SNIP 0.624
Scopus rating (2002): SJR 0.565 SNIP 0.718
Scopus rating (2001): SJR 0.77 SNIP 0.761
Scopus rating (2000): SJR 0.327 SNIP 0.482
Scopus rating (1999): SJR 0.533 SNIP 0.524
Original language: English
Differential geometry, Integrable systems, Loop groups, Pseudospherical surfaces, Constant Gauss curvature, Singularities
Electronic versions:
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.
Row Reduction Applied to Decoding of Rank Metric and Subspace Codes

We show that decoding of $r$-Interleaved Gabidulin codes, as well as list-$r$ 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 $r$-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-$r$-decoding MV codes in complexity $O(n^2)$, where $n$ is the number of interpolation constraints.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Ulm, Technische Universität München
Authors: Puchinger, S. (Ekstern), Nielsen, J. S. R. (Intern), Li, W. (Ekstern), Sidorenko, V. (Ekstern)
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 Poincar'e 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.

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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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Web of Science (2017): Indexed Yes
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Scopus rating (2016): SJR 1.395 SNIP 1.389 CiteScore 1.67
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.352 SNIP 1.239 CiteScore 1.36
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.468 SNIP 1.32 CiteScore 1.35
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.615 SNIP 1.378 CiteScore 1.52
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.783 SNIP 1.61 CiteScore 1.74
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.455 SNIP 1.341 CiteScore 1.45
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.433 SNIP 1.313
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.181 SNIP 1.368
BFI (2008): BFI-level 1
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.
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

**General information**

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics
System bandwidth and the existence of generalized shift-invariant frames
We consider the question whether, given a countable system of lattices \((\Gamma_j)_{j \in J}\) in a locally compact abelian group \(G\), there exists a sequence of functions \((g_j)_{j \in J}\) such that the resulting generalized shift-invariant system \((g_j(\cdot - \gamma))_{j \in J, \gamma \in \Gamma_j}\) is a tight frame of \(L^2(G)\). This paper develops a new approach to the study of almost periodic functions for generalized shift-invariant systems based on an \textit{unconditionally convergence property}, replacing previously used local integrability conditions. From this theory, we derive characterizing relations for tight and dual frame generators, we introduce the \textit{system bandwidth} as a measure of the total bandwidth a generalized shift-invariant system can carry, and we show that the so-called Calderón sum is uniformly bounded from below for generalized shift-invariant frames. We exhibit a condition on the lattice system for which the unconditionally convergence property is guaranteed to hold. Without the unconditionally convergence property, we show, counter-intuitively, that even orthonormal bases can have arbitrary small system bandwidth. Our results show that the question of existence of frame generators for a general lattice system can be rather subtle, depending on analytical properties, such as the system bandwidth, as well as on algebraic properties of the lattice system.

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. \(\lambda(\text{BBGS}/F_{q^3}) \geq 2(q^2 - 1)/(q + 2)\). In this paper, the exact value of \(\lambda(\text{BBGS}/F_{q^3})\) 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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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
Scopus rating (2007): SJR 1.23 SNIP 1.124
Scopus rating (2006): SJR 1.395 SNIP 1.31
Web of Science (2006): 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
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Scopus rating (2015): SJR 2.654 SNIP 4.178 CiteScore 2.62
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.61 SNIP 5.092 CiteScore 3.7
BFI (2013): BFI-level 2
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.

General information
State: Accepted/In press
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, National University of Singapore
Authors: Christensen, O. (Intern), Goh, S. S. (Ekstern)
Number of pages: 33
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Applied and Computational Harmonic Analysis
ISSN (Print): 1063-5203
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
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.
Topological fluid mechanics of the formation of the Kármán-vortex street

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, ReK, which is slightly larger than the critical Reynolds number, Recrit~46, at which the flow becomes time periodic. For Re slightly above ReK, 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
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Fluid Mechanics
Volume: 812
ISSN (Print): 0022-1120
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
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
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 Nielsen, J. (Intern)
Pages: 336-40
Publication date: 2017

Host publication information
Title of host publication: Proceedings of 2017 IEEE International Symposium on Information Theory
Publisher: IEEE
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.
Algorithms for Simultaneous Padé Approximations

We describe how to solve simultaneous Padé approximations over a power series ring $K[[x]]$ for a field $K$ using $O((n^\omega - 1)^d)$ 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.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Waterloo
Authors: Rosenkilde, J. S. H. (Intern), Storjohann, A. (Ekstern)
Pages: 405-412
Publication date: 2016

Host publication information

Title of host publication: Proceedings of the 41st International Symposium on Symbolic and Algebraic Computation (ISSAC '16)
Publisher: Association for Computing Machinery
ISBN (Print): 978-1-4503-4380-0
BFI conference series: International Symposium on Symbolic and Algebraic Computation (5000493)
Main Research Area: Technical/natural sciences
Conference: 41st International Symposium on Symbolic and Algebraic Computation (ISSAC '16), Waterloo, Ontario, Canada, 19/07/2016 - 19/07/2016
Electronic versions:
2016_isaacsimpade.pdf
Source: PublicationPreSubmission
Source-ID: 127239655
Publication: Research - peer-review › Article in proceedings – Annual report year: 2016

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
  Scopus rating (2003): SJR 1.013 SNIP 1.489
  Scopus rating (2002): SJR 1.108 SNIP 1.374
  Web of Science (2002): Indexed yes
  Scopus rating (2001): SJR 1.068 SNIP 1.602
  Scopus rating (2000): SJR 1.28 SNIP 1.639
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 $4\pi$. 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 $4\pi$ cycle of the flying snake.
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 \( h \) and cone half-angle \( \theta \) vary, numerous flow metamorphoses occur. They are investigated for \( \theta \) exceeding a threshold depending on \( h \). For small \( \theta \), the air flow is multi-cellular with clockwise meridional circulation near the disk. The air flow becomes one cellular as \( \theta \) exceeds a threshold depending on \( h \). For all \( \theta \), 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

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 0.574 SNIP 0.836 CiteScore 1.42

Web of Science (2016): Indexed yes

BFI (2015): BFI-level 1

Scopus rating (2015): SJR 0.795 SNIP 1.543 CiteScore 1.63

BFI (2014): BFI-level 1

Scopus rating (2014): SJR 0.972 SNIP 1.637 CiteScore 2.06
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.

Co-compact Gabor 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)
Number of pages: 35
Pages: 36-70
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
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
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
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
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
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.
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**Explicit constructions and properties of generalized shift-invariant systems in L2(R)**

Generalized shift-invariant (GSI) systems, originally introduced by Hernández et al. and Ron and Shen, provide a common frame work 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).

**General information**

- State: Published
- Organisations: Department of Applied Mathematics and Computer Science, Mathematics
- Authors: Christensen, O. (Intern), Hasannasabjaldehbakhani, M. (Intern), Lemvig, J. (Intern)
- Pages: 443–472
- Publication date: 2016
- Main Research Area: Technical/natural sciences

**Publication information**

- Journal: Advances in Computational Mathematics
- Volume: 43
- Issue number: 2
- ISSN (Print): 1019-7168
- Ratings: BFI (2018): BFI-level 1
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
  Scopus rating (2001): SJR 1.884 SNIP 1.835
  Scopus rating (2000): SJR 2.583 SNIP 1.758
  Scopus rating (1999): SJR 2.523 SNIP 1.473
Original language: English
DOIs: 10.1016/j.jde.2016.03.003
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), Nørberg, T. B. (Intern), Nørtoft, P. (Intern), Steenstrup, K. H. (Intern)
Number of pages: 19
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Editors: Ghezzi, L., Hömberg, D., Landry, C.
Main Research Area: Technical/natural sciences
Workshop: KoMSO Challenge Workshop, Berlin, Germany, 07/05/2014 - 07/05/2014
Publication: Research - peer-review » Article in proceedings – Annual report year: 2016
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.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science , Mathematics , Kazimierz Wielki University, Nicolaus Copernicus University, University of Santiago de Compostela
Authors: Baranowska-Łaczkowska, A. (Ekstern), Z. Łaczkowski, K. Z. Ł. (Ekstern), Henriksen, C. (Intern), Fernandez, B. (Ekstern), Kozak, M. (Ekstern), Zielinska, S. (Ekstern)
Pages: 19897-19902
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information

Journal: RSC Advances
Volume: 6
Issue number: 24
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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 3.06 SJR 0.875 SNIP 0.743
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.959 SNIP 0.837 CiteScore 3.42
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.114 SNIP 0.965 CiteScore 3.87
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.117 SNIP 0.903 CiteScore 3.74
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Scopus rating (2012): SJR 0.863 SNIP 0.603 CiteScore 2.4
ISI indexed (2012): ISI indexed no
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Original language: English
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Publication: Research - peer-review › Journal article – Annual report year: 2016

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 $P_{X,0,N\mathbb{N}^d}$ 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 $P_{X,0,N\mathbb{N}^d}$ 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 $\ell^2(\mathbb{Z}^d)$. 

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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

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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 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
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 $n$ and $m$ for $n > m$. The results hold not only for Hermite functions, but for two large classes of eigenfunctions of the Fourier transform associated with the eigenvalues $1$ and $i$, and the results indicate that the Gabor frame set of all such functions must have a rather complicated structure.
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 $B_N$, $N \geq 2$, 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
Publication date: 2016
Main Research Area: Technical/natural sciences

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Journal: Journal of Inequalities and Applications
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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): 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
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.529 SNIP 0.698 CiteScore 0.64
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.495 SNIP 0.785
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.649 SNIP 0.731
BFI (2008): BFI-level 1
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.

General information
State: Published
Organisations: Mathematics, Department of Applied Mathematics and Computer Science, Aix-Marseille University
Authors: Aubry, Y. (Ekstern), Haloui, S. (Intern)
Pages: 55-68
Publication date: 2016
Main Research Area: Technical/natural sciences

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Journal: Glasgow Mathematical Journal
Volume: 58
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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 0.637 SNIP 0.853 CiteScore 0.48
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.715 SNIP 0.893 CiteScore 0.43
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.42 SNIP 0.545 CiteScore 0.38
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.61 SNIP 0.732 CiteScore 0.57
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.466 SNIP 1.047 CiteScore 0.64
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.677 SNIP 0.946 CiteScore 0.65
BFI (2010): BFI-level 1

Bibliographical note
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Source-ID: 2300198714
Publication: Research - peer-review › Journal article – Annual report year: 2016
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.
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
Publication date: 2016

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Main Research Area: Technical/natural sciences
Seminar: Intensive Research Program on Advances in Nonsmooth Dynamics 2016, Barcelona, Spain, 01/02/2016 - 01/02/2016
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Publication: Research - peer-review › Article in proceedings – Annual report year: 2017

**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)
Pages: 8447-8480
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

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
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 July2015. 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/.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Technion-Israel Institute of Technology, School of Mechanical Engineering, ESPCI
Authors: Bar-Yoseph, P. Z. (Ekstern), Brøns, M. (Intern), Gelfgat, A. (Ekstern), Oron, A. (Ekstern), Tuckerman, L. S. (Ekstern), Wesfreid, J. E. (Ekstern)
Number of pages: 2
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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 1
Scopus rating (2016): SJR 0.426 SNIP 0.67 CiteScore 0.74
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.607 SNIP 0.696 CiteScore 0.86
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.571 SNIP 0.954 CiteScore 0.92
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.478 SNIP 0.689 CiteScore 0.71
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.503 SNIP 0.65 CiteScore 0.79
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.684 SNIP 1.102 CiteScore 1.17
ISI indexed (2011): ISI indexed yes
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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Main Research Area: Technical/natural sciences

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Volume: 25
Issue number: 3
ISSN (Print): 1058-6458
Ratings:
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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): SJR 0.765 SNIP 0.947 CiteScore 0.62
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.621 SNIP 0.876 CiteScore 0.65
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.963 SNIP 1.24 CiteScore 0.85
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

Journal: Designs, Codes and Cryptography
Volume: 79
Issue number: 3
ISSN (Print): 0925-1022
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
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
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**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 $|\det A|=1$ 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 $\text{GL}(n, \mathbb{R})$.

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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.

General information
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Organisations: Department of Photonics Engineering, Department of Applied Mathematics and Computer Science, Mathematics
Authors: Willatzen, M. (Intern), Gravesen, J. (Intern), Nørtoft, P. (Intern)
Publication date: 7 May 2015

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IPC: G01F 1/66 A I
Patent number: WO2015063079
Date: 07/05/2015
Priority date: 28/10/2013
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 \( \{g_j, P_j\} \), where \( j \in J \), and \( P_j \) are certain measure spaces. Furthermore, for each \( j \) we let \( \Gamma_j \) be a closed subgroup of \( G \) such that \( G/\Gamma_j \) is compact. A GTI system is then the collection of functions \( U_j \in L^2(G) \), where \( j \in J \) and \( \Gamma_j \) are certain measure spaces. 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 hence eventually constitute the local and global structure of the wildfire spread.
Authors: Markvorsen, S. (Intern)
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Scopus rating (2011): SJR 1.792 SNIP 1.515 CiteScore 2.43
ISI indexed (2011): ISI indexed yes
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BFI (2009): BFI-level 1
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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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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 , 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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Authors: Kristiansen, K. U. (Intern)
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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.
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.
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 -nets.

General information
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Scopus rating (2014): SJR 0.635 SNIP 0.968 CiteScore 0.55
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Scopus rating (2011): SJR 0.781 SNIP 0.948 CiteScore 0.53
BFI (2010): BFI-level 1
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.

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Authors: Gimeno, V. (Ekstern), Markvorsen, S. (Intern)
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.

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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Université de La Rochelle, Inria Paris-Rocquencourt Research Centre, INRIA Sophia Antipolis
Authors: Benoît, E. (Ekstern), Brøns, M. (Intern), Desroches, M. (Ekstern), Krupa, M. (Ekstern)
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Scopus rating (2008): SJR 0.927 SNIP 1.209
Scopus rating (2007): SJR 0.855 SNIP 1.018
Scopus rating (2006): SJR 0.718 SNIP 0.988
Scopus rating (2005): SJR 0.467 SNIP 0.772
Scopus rating (2004): SJR 0.501 SNIP 0.756
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Web of Science (2003): Indexed yes
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 reserved.
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.

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Authors: Christensen, O. (Intern), Feichtinger, H. G. (Ekstern), Paukner, S. (Ekstern)
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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 $\text{GF}(q)$ 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 can in general not be improved. However, if the genus is large compared with $q$, the bound can be improved. Drinfeld and Vladut showed the asymptotic result:

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

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.

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**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.

**General information**

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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.

General information

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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Defence Research and Development Organisation, Indian Institute of Technology, Bombay
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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
Scopus rating (2012): SJR 0.965 SNIP 1.193 CiteScore 0.7
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.875 SNIP 0.986 CiteScore 0.66
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.875 SNIP 1.032
BFI (2009): BFI-level 1
Linear codes, Determinantal varieties, Generalized Hamming weight, Weight distribution

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
State: Published
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
Publication date: 2015

Host publication information
Title of host publication: Proceedings of the IEEE International Symposium on Information Theory (ISIT 2015)
Publisher: IEEE
ISBN (Print): 978-1-4673-7704-1
Main Research Area: Technical/natural sciences
Conference: IEEE International Symposium on Information Theory (ISIT 2015), Hong Kong, Hong Kong, 14/06/2015 - 14/06/2015
Linear complexity, Invariance, Groebner base, Correlatio, Arrays, Watermarking
DOI:
10.1109/ISIT.2015.7282946
Source: Findit
Source-ID: 276298993
Publication: Research - peer-review › Article in proceedings – Annual report year: 2015

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
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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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.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Inria Paris-Rocquencourt
Research Centre
Authors: Brøns, M. (Intern), Desroches, M. (Ekstern), Krupa, M. (Ekstern)
Pages: 71-79
Publication date: 2015
Main Research Area: Technical/natural sciences

Publication information
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.
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 \( \{E_{m,n}aT \}_{m,n \in \mathbb{Z}} \), 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
Publication date: 2015
Main Research Area: Technical/natural sciences

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
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
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 focused presentation of the R-duals of type I and III that can trigger the research on this.

General information

State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Acoustics Research Institute
Authors: Christensen, O. (Intern), Stoeva, D. (Ekstern)
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Publication date: 2015

Host publication information

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ISBN (Print): 978-1-4673-7353-1
Main Research Area: Technical/natural sciences
Conference: 11th International Conference on Sampling Theory and Applications, Washington DC, United States, 25/05/2015 - 25/05/2015
DOIs:
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Source: FindIt
Source-ID: 2287500296
Publication: Research - peer-review › Article in proceedings – Annual report year: 2015

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
Publication date: 2015
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
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
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, Sabanci 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

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

Electronic versions:
98099.pdf
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10.1137/140980995

Source: PublicationPreSubmission
Source-ID: 114011143
Publication: Research peer-review Journal article – Annual report year: 2015

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 $\epsilon \ll 1$ 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 Painlevé equation. The stable orbits of smallest amplitude that are obtained by these methods remain slightly further away from the slow manifold being distant by an order $\mathcal{O}(\epsilon^{1/3} \ln^{1/2} \ln \epsilon^{-1})$.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science , Mathematics
Authors: Kristiansen, K. U. (Intern)
Pages: 4561–4614
Publication date: 2015
Main Research Area: Technical/natural sciences
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 ($\hbar \to 0$) 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.
Regularization of Piecewise Smooth Two-Folds
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.
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. (Ekstern), 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., Kurtek, S., Turaga, P.
ISBN (Print): 1-901725-56-1
BFI conference series: British Machine Vision Conference (5000330)
Main Research Area: Technical/natural sciences
Workshop: 1st International Workshop on DIFFerential Geometry in Computer Vision for Analysis of Shapes, Images and Trajectories (DIFF-CV) 2015, Swansea, United Kingdom, 10/09/2015
Electronic versions:
DIFFCV2015.pdf

Links:
Source: PublicationPreSubmission
Source-ID: 118686065
Publication: Research - peer-review › Article in proceedings – Annual report year: 2015
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.
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.
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 $-93.2 \text{ cm}^{-1}$ 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–He$_2$ 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 $A(\ell)$, for $\ell = p^n$ 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

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Journal: Moscow Mathematical Journal
Volume: 15
Issue number: 1
ISSN (Print): 1609-3321
Ratings:
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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): 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
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.311 SNIP 1.323 CiteScore 0.65
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.701 SNIP 1.061 CiteScore 0.46
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.835 SNIP 1.118 CiteScore 0.55
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.326 SNIP 0.503 CiteScore 0.21
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**
State: Published
Organisations: IT Service, Department of Applied Mathematics and Computer Science, Image Analysis & Computer Graphics, Mathematics, Statistics and Data Analysis
Number of pages: 1
Publication date: 2015

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Title of host publication: Proceedings of SIGGRAPH Asia 2015 Posters
Publisher: Association for Computing Machinery
Article number: 40
ISBN (Print): 978-1-4503-3926-1
BFI conference series: International Conference on Computer Graphics and Interactive Techniques (5000583)
Main Research Area: Technical/natural sciences
Electronic versions: VirtualTable_abstract.pdf
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

**Publication information**
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Issue number: 6
Article number: 065503
ISSN (Print): 0169-5983
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 0.426 SNIP 0.67 CiteScore 0.74
Vortex breakdown, Flow topology, Moffatt eddies, Bioreactors, Axisymmetric flow

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5th International Symposium on Bifurcations and Instabilities in Fluid Dynamics (BIFD2013) Foreword

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Technion-Israel Institute of Technology, Tel Aviv University
Authors: Bar-Yoseph, P. Z. (Ekstern), Brøns, M. (Intern), Gelfgat, A. (Ekstern), Oron, A. (Ekstern)
Number of pages: 2
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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
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.

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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
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Journal: SIAM Journal on Applied Dynamical Systems
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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
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.306 SNIP 1.34 CiteScore 1.85
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.221 SNIP 1.486 CiteScore 1.77
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.494 SNIP 1.41 CiteScore 1.91
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
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
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Scopus rating (2014): SJR 0.318 SNIP 1.091 CiteScore 0.43
Scopus rating (2013): SJR 0.261 SNIP 1.592 CiteScore 0.47
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Electronic versions:
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Publication: Research - peer-review › Journal article – 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 two-parameter 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

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Scopus rating (2015): SJR 1.423 SNIP 1.533 CiteScore 3.06
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.235 SNIP 1.73 CiteScore 3.07
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Scopus rating (2013): SJR 1.214 SNIP 1.638 CiteScore 2.85
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.9 SNIP 1.938 CiteScore 2.83
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Constant Gaussian curvature surfaces in the 3-sphere via loop groups
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 $K\neq 0$, 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 $0<K<1$.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Hokkaido University, Yamagata University
Authors: Brander, D. (Intern), Inoguchi, J. (Ekstern), Kobayashi, S. (Ekstern)
Pages: 281-303
Publication date: 2014
Main Research Area: Technical/natural sciences

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BFI (2018): BFI-level 1
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BFI (2017): BFI-level 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)
Pages: 57-71
Publication date: 2014
Main Research Area: Technical/natural sciences
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.

General information

State: Published
Organisations: Department of Photonics Engineering, Department of Applied Mathematics and Computer Science, Mathematics, University of Southern Denmark
Authors: Lassen, B. (Ekstern), Willatzen, M. (Intern), Gravesen, J. (Intern)
Pages: 409-435
Publication date: 2014
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.
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).

General information
State: Published
Organisations: Department of Applied Chemistry, Department of Applied Mathematics and Computer Science, Mathematics
Authors: Christensen, O. (Intern)
Pages: 219-234
Publication date: 2014

Host publication information
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Publisher: Springer
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.

General information
State: Published
Organisations: Department of Applied Chemistry, 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: 235-243
Publication date: 2014

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∞(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 parameters.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, National University of Singapore
Authors: Christensen, O. (Intern), Goh, S. S. (Ekstern)
Pages: 198-214
Publication date: 2014
Main Research Area: Technical/natural sciences
Galois towers over non-prime finite fields

In this paper we construct Galois towers with good asymptotic properties over any non-prime finite field \( F_\ell \); i.e., we construct sequences of function fields \( N=(N_1\subset N_2\subset \cdots) \) over \( F_\ell \) 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.

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: 163-179
Publication date: 2014
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Journal: Acta Arithmetica
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Ratings:
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
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
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.921 SNIP 1.11 CiteScore 0.56
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.725 SNIP 0.935 CiteScore 0.5
ISI indexed (2013): ISI indexed yes
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BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.779 SNIP 1.016 CiteScore 0.49
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.72 SNIP 1.1 CiteScore 0.48
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1 SNIP 1.218
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.812 SNIP 1.101
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.926 SNIP 1.026
Scopus rating (2007): SJR 0.734 SNIP 0.942
Scopus rating (2006): SJR 0.85 SNIP 0.991
Scopus rating (2005): SJR 0.862 SNIP 1.04
Scopus rating (2004): SJR 1.029 SNIP 1.221
Scopus rating (2003): SJR 1.123 SNIP 1.266
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.

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.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Scientific Computing, Mathematics, SINTEF Information and Communication Technology, Delft University of Technology
Authors: Dang Manh, N. (Ekstern), Evgrafov, A. (Intern), Gravesen, J. (Intern), Lahaye, D. (Ekstern)
Pages: 1416-1433
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Main Research Area: Technical/natural sciences

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Scopus rating (2014): SJR 0.29 SNIP 0.693 CiteScore 0.63
Web of Science (2014): Indexed yes
Scopus rating (2013): SJR 0.202 SNIP 0.53 CiteScore 0.55
ISI indexed (2013): ISI indexed yes
Scopus rating (2012): SJR 0.21 SNIP 0.513 CiteScore 0.5
ISI indexed (2012): ISI indexed yes
Scopus rating (2011): SJR 0.214 SNIP 0.708 CiteScore 0.5
ISI indexed (2011): ISI indexed yes
Scopus rating (2010): SJR 0.235 SNIP 0.83
Scopus rating (2009): SJR 0.245 SNIP 0.817
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.298 SNIP 0.858
Scopus rating (2007): SJR 0.266 SNIP 0.453
Scopus rating (2006): SJR 0.301 SNIP 0.676
Scopus rating (2005): SJR 0.22 SNIP 0.54
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.253 SNIP 0.734
Scopus rating (2003): SJR 0.283 SNIP 0.387
Scopus rating (2002): SJR 0.24 SNIP 0.562
Scopus rating (2001): SJR 0.224 SNIP 0.454
Scopus rating (2000): SJR 0.227 SNIP 0.82
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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.

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Organisations: Mathematics, Department of Applied Mathematics and Computer Science, Department of Chemical and Biochemical Engineering, Center for BioProcess Engineering
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Web of Science (2018): Indexed yes
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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
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Scopus rating (2013): SJR 1.325 SNIP 1.678 CiteScore 3.62
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.409 SNIP 1.732 CiteScore 3.2
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.35 SNIP 1.64 CiteScore 3.48
ISI indexed (2011): ISI indexed yes
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)
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Journal: Computers & Fluids
Volume: 91
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Web of Science (2018): Indexed yes
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Web of Science (2017): Indexed Yes
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
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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)
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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
Scopus rating (2002): SJR 2.581 SNIP 2.172
Scopus rating (2001): SJR 1.45 SNIP 3.321
Scopus rating (2000): SJR 1.76 SNIP 2.277
Scopus rating (1999): SJR 1.375 SNIP 1.854
Original language: English
Entire functions, Trigonometric polynomials, Partition of unity, Dual frame pairs, Gabor systems, Tight frames
DOIs:
10.1016/j.acha.2014.03.005
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

Publication information
Journal: Canadian Mathematical Bulletin
Volume: 57
Issue number: 2
ISSN (Print): 0008-4395
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 0.513 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
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.669 SNIP 0.742
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.587 SNIP 0.812
Scopus rating (2006): SJR 0.502 SNIP 0.6
Scopus rating (2005): SJR 0.499 SNIP 0.565
Scopus rating (2004): SJR 0.677 SNIP 1.077
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)
Pages: 38-46
Publication date: 2014
Main Research Area: Technical/natural sciences

Publication information
Journal: Discrete Mathematics
Volume: 325
ISSN (Print): 0012-365X
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 0.72 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
Scopus rating (2012): SJR 0.965 SNIP 1.193 CiteScore 0.7
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.875 SNIP 0.986 CiteScore 0.66
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.875 SNIP 1.032
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
Scopus rating (2016): CiteScore 1.09 SJR 0.64 SNIP 1.393
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.604 SNIP 1.095 CiteScore 0.82
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.73 SNIP 1.441 CiteScore 0.99
Web of Science (2014): Indexed yes
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

Publication information
Journal: Designs, Codes and Cryptography
Volume: 76
Issue number: 1
ISSN (Print): 0925-1022
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
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.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Scientific Computing, Johannes Kepler University of Linz
Authors: Gravesen, J. (Intern), Evgrafov, A. (Intern), Nguyen, D. (Ekstern), Nørtoft, P. (Intern)
Number of pages: 189
Publication date: 2014

Host publication information
Title of host publication: Mathematical Methods for Curves and Surfaces: 8th International Conference, MMCS 2012, Oslo, Norway, June 28 – July 3, 2012, Revised Selected Papers
Publisher: Springer
ISBN (Print): 978-3-642-54381-4
ISBN (Electronic): 978-3-642-54382-1

Series: Lecture Notes in Computer Science
Volume: 8177
ISSN: 0302-9743
BFI conference series: Curves and Surfaces (5010494)
Main Research Area: Technical/natural sciences
Conference: 8th International Conference on Mathematical Methods for Curves and Surfaces (MMCS 2012), Oslo, Norway, 28/06/2012 - 28/06/2012
Electronic versions:
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Source: dtu
Source-ID: n:oai:DTIC-ART:inspec/434688061::38102
Publication: Research - peer-review › Article in proceedings – Annual report year: 2014

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
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.461 SNIP 1.805
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.474 SNIP 1.578
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.812 SNIP 2.444
Web of Science (2006): 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
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
Rotation reversal in a 1D turbulence spreading model

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.
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.
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
ISSN (Print): 1050-6926
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 0.95 SJR 1.537 SNIP 1.211
BFI (2015): BFI-level 2
Differential geometry, Integrable systems, Timelike CMC surfaces, Singularities, Constant mean curvature

Electronic versions:
timelikeCMCsingularities.pdf

DOIs:
10.1007/s12220-013-9389-6

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

**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 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. By including the self-induced velocity on the vortex filament by a 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 parameters.

**General information**

State: Published
Organisations: Department of Applied Mathematics and Computer Science , Mathematics
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 plasmaperformance 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.

General information
State: Published
Organisations: Department of Physics, Plasma Physics and Fusion Energy, Department of Applied Mathematics and Computer Science, Mathematics
Number of pages: 1
Publication date: 2014

Host publication information
Title of host publication: Abstract Book - DTU Sustain Conference 2014
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Main Research Area: Technical/natural sciences
Conference: DTU Sustain Conference 2014, Lyngby, Denmark, 17/12/2014 - 17/12/2014
Publication: Research - peer-review » Conference abstract in proceedings – Annual report year: 2014

Vorticity generation and conservation for two-dimensional interfaces and boundaries
The generation, redistribution and, importantly, conservation of vorticity and circulation is studied for incompressible Newtonian fluids in planar and axisymmetric geometries. A generalised formulation of the vorticity at the interface between two fluids for both no-slip and stress-free conditions is presented. Illustrative examples are provided for planar Couette flow, Poiseuille flow, the spin-up of a circular cylinder, and a cylinder below a free surface. For the last example, it is shown that, although large imbalances between positive and negative vorticity appear in the wake, the balance is found in the vortex sheet representing the stress-free surface.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Monash University, Aix Marseille Universite
Authors: Brøns, M. (Intern), Thompson, M. C. (Ekstern), Leweke, T. (Ekstern), Hourigan, K. (Ekstern)
Pages: 63-93
Publication date: 2014
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Fluid Mechanics
Volume: 758
ISSN (Print): 0022-1120
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
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.731 SNIP 1.88 CiteScore 2.47
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.165 SNIP 2.023 CiteScore 2.72
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.29 SNIP 2.163
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.563 SNIP 1.891
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 2.691 SNIP 2.073
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.417 SNIP 1.975
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 2.641 SNIP 2.181
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.836 SNIP 2.107
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.411 SNIP 2.196
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 2.896 SNIP 2.059
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 3.042 SNIP 2.205
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 3.783 SNIP 2.518
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 3.66 SNIP 2.242
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 1.928 SNIP 1.95
Original language: English
General fluid mechanics, Vortex flows, Vortex interactions
DOIs:
10.1017/jfm.2014.520
Source: Findit
Source-ID: 273961026
Publication: Research - peer-review › Journal article – Annual report year: 2015
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

Publication information
Journal: Physics of Plasmas
Volume: 20
Issue number: 10
ISSN (Print): 1070-664X
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 1.08 SJR 0.702 SNIP 0.685
Web of Science (2016): Indexed yes
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

Publication information
Journal: Designs, Codes and Cryptography
Volume: 66
Issue number: 1-3
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
Scopus rating (2016): CiteScore 1.09 SJR 0.64 SNIP 1.393
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.604 SNIP 1.095 CiteScore 0.82
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.73 SNIP 1.441 CiteScore 0.99
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.788 SNIP 1.447 CiteScore 0.92
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.849 SNIP 1.519 CiteScore 0.98
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.964 SNIP 1.309 CiteScore 1.08
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.864 SNIP 1.094
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.878 SNIP 1.324
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.836 SNIP 1.095
Scopus rating (2007): SJR 0.724 SNIP 1.114
Scopus rating (2006): SJR 0.807 SNIP 1.093
Scopus rating (2005): SJR 0.673 SNIP 1.277
Scopus rating (2004): SJR 0.915 SNIP 1.258
Web of Science (2004): Indexed yes
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 \( \{T_k g\}_{k \in \mathbb{Z}} \) 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.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Universidad De Granada, Universitat Jaume I
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Main Research Area: Technical/natural sciences
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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.

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Korea Advanced Institute of Science & Technology, Yeungnam University
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Journal: Applied and Computational Harmonic Analysis
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Web of Science (2018): Indexed yes
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.
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
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
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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
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Scopus rating (2013): CiteScore 2.64
ISI indexed (2013): ISI indexed yes
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ISI indexed (2012): ISI indexed yes
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Scopus rating (2011): CiteScore 2.87
ISI indexed (2011): ISI indexed yes
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BFI (2010): BFI-level 1
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
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BFI (2008): BFI-level 1
Web of Science (2008): Indexed yes
Web of Science (2007): Indexed yes
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Web of Science (2004): Indexed yes
Web of Science (2003): Indexed yes
Web of Science (2002): Indexed yes
Web of Science (2001): 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.
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.

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Authors: Nielsen, J. S. R. (Intern), Beelen, P. (Intern), Høholdt, T. (Intern)
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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
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 0.645 SNIP 1 CiteScore 1.53
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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
Scopus rating (2011): SJR 0.692 SNIP 1.123 CiteScore 1.78
ISI indexed (2011): ISI indexed yes
BFI (2010): 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.

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Authors: Nielsen, J. S. R. (Intern), Zeh, A. (Ekstern)
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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
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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.
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 applied to certain wavelet frames.
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 dynamics 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-C2H2 van der Waals complex

A refined CCSD(T) intermolecular potential energy surface is developed for the He-C2H2 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
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Santiago de Compostela, Utah State University
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Web of Science (2017): Indexed yes
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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
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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
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.127 SNIP 0.956
Regularity of Dual Gabor Windows

General information
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Korea Advanced Institute of Science & Technology, Yeungnam University
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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
Scopus rating (2004): SJR 0.533 SNIP 1.007
Scopus rating (2003): SJR 0.36 SNIP 0.56
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.

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Organisations: Department of Micro- and Nanotechnology, Theoretical Biophysics, Department of Applied Mathematics
and Computer Science, Mathematics
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.11 SJR 1.201 SNIP 1.092
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.414 SNIP 1.131 CiteScore 3.32
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.545 SNIP 1.141 CiteScore 3.54
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.74 SNIP 1.147 CiteScore 3.94
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.945 SNIP 1.142 CiteScore 4.15
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, \( u \cdot \nabla \omega = 0 \), 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 R2. 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
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Organisations: Department of Applied Mathematics and Computer Science, Mathematics, Technische Universität Berlin
Authors: Kutyniok, G. (Ekstern), Lemvig, J. (Intern), Lim, W. (Ekstern)
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Beneath the Wheel - Greenwood Engineering

This is the report from the 54th European Study Group with 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
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A characterization of spheres, circles and cardioids

General information
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Publication information
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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
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BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.577 SNIP 0.679 CiteScore 0.42
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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
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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
Scopus rating (2002): SJR 0.849 SNIP 0.856
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.6 SNIP 0.744
Scopus rating (2000): SJR 0.862 SNIP 1.032
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 $f:S^2 \rightarrow g$ 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

On the topology of spaces of holomorphic maps

On the topology of spaces of holomorphic maps
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

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Authors: Gravesen, J. (Intern)
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Main Research Area: Technical/natural sciences

Publication information

Journal: Annals of Global Analysis and Geometry
Volume: 7
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.
WHITNEY O-INFINITY-TOPOLOGIES AND THE BAIRE PROPERTY