Space Mapping and Beyond: Knowledge-Driven Microwave Design Optimization

Design closure exploiting electromagnetic (EM) solvers has become one of the fundamental design tools in contemporary microwave engineering. For many structures, adjustment of geometry and/or material parameters can only be done through repetitive EM simulations because analytical design formulas either do not exist or can only provide initial designs that need to be further refined. Unfortunately, EM-driven optimization is a challenging problem with the major bottleneck being a high computational cost of accurate simulation. This problem can be alleviated by using fast and yet reliable surrogate models that can replace the CPU-intensive EM-simulated structure of interest in the search for optimum design. The surrogate models exploiting physically-based low-fidelity models (e.g., circuit equivalents) can be particularly efficient: the knowledge about the structure under design embedded in such a low-fidelity model allows us to dramatically reduce the number of EM simulations necessary to find a satisfactory design. Here, we review the concept of knowledge-driven design as well as specific design techniques, including space mapping, simulation-based tuning, and various response correction methods. Discussion on open problems and perspectives of these methodologies is also included.

Space Mapping With Adaptive Response Correction for Microwave Design Optimization

Output space mapping is a technique introduced to enhance the robustness of the space-mapping optimization process in case the space-mapped coarse model cannot provide sufficient matching with the fine model. The technique often works very well; however, in some cases it fails. Especially in the microwave area where the typical model response (e.g., vertical bar S-21 vertical bar) is a highly nonlinear function of the free parameter (e.g., frequency), the output space-
mapping correction term may actually increase the mismatch between the surrogate and fine models for points other than the one at which the term was calculated, as in the surrogate model optimization process. In this paper, an adaptive response correction scheme is presented to work in conjunction with space-mapping optimization algorithms. This technique is designed to alleviate the difficulties of the standard output space mapping by adaptive adjustment of the response correction term according to the changes of the space-mapped coarse model response. Examples indicate the robustness of our approach.

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Editorial - surrogate modeling and space mapping for engineering optimization

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Quality assessment of coarse models and surrogates for space mapping optimization

One of the central issues in space mapping optimization is the quality of the underlying coarse models and surrogates. Whether a coarse model is sufficiently similar to the fine model may be critical to the performance of the space mapping optimization algorithm and a poor coarse model may result in lack of convergence. Although similarity requirements can be expressed with proper analytical conditions, it is difficult to verify such conditions beforehand for real-world engineering optimization problems. In this paper, we provide methods of assessing the quality of coarse/surrogate models. These methods can be used to predict whether a given model might be successfully used in space mapping optimization, to compare the quality of different coarse models, or to choose the proper type of space mapping which would be suitable to a given engineering design problem. Our quality estimation methods are derived from convergence results for space mapping algorithms. We provide illustrations and several practical application examples.

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Editorial introduction to the special issue on computational linear algebra and sparse matrix computations

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On the vehicle routing problem with time windows

The vehicle routing problem with time windows is concerned with the optimal routing of a fleet of vehicles between a depot and a number of customers that must be visited within a specified time interval, called a time window. The purpose of this thesis is to develop new and efficient solution techniques for solving the vehicle routing problem with time windows (VRPTW). The thesis consists of a section of introductory remarks and four independent papers.

The first paper 'Formulations and exact approaches for the vehicle routing problem with time windows' (Kallehauge, 2005, unpublished) is a review of the exact algorithms proposed in the last three decades for the solution of the vehicle routing problem with time windows. A detailed analysis of the formulations of the VRPTW is presented together with a review of the literature related to the different formulations. We present the two main lines of development in relation to the exact approaches for the VRPTW. One is concerned with the general decomposition approach and the solution to certain dual problems associated with the VRPTW. Another more recent direction is concerned with the analysis of the polyhedral structure of the VRPTW. We conclude by examining possible future lines of research in the area of the VRPTW.
In the second paper ‘Lagrangian duality applied to the vehicle routing problem with time windows’ (Kallehauge, Larsen, and Madsen, Computers & Operations Research, 33:1464-1487, 2006) we consider the Lagrangian relaxation of the constraint set requiring that each customer must be served by exactly one vehicle yielding a constrained shortest path subproblem. We present a stabilized cutting-plane algorithm within the framework of linear programming for solving the associated Lagrangian dual problem. This algorithm creates easier constrained shortest path subproblems because less negative cycles are introduced and it leads to faster multiplier convergence due to a stabilization of the dual variables. We have embedded the stabilized cutting-plane algorithm in a branch-and-bound search and introduce strong valid inequalities at the master problem level by Lagrangian relaxation. The result is a Lagrangian branch-and-price (LBCP) algorithm for the VRPTW. Making use of this acceleration strategy at the master problem level gives a significant speed-up compared to algorithms in the literature based on traditional column generation. We have solved two test problems introduced in 2001 by Gehring and Homberger with 400 and 1000 customers respectively, which to date are the largest problems ever solved to optimality. We have implemented the LBCP algorithm using the ABACUS open-source framework for solving mixed-integer linear-programs by branch, cut, and price.

In the third paper ‘Path inequalities for the vehicle routing problem with time windows’ (Kallehauge, Boland, and Madsen, 2005, submitted) we introduce a new formulation of the VRPTW involving only binary variables associated with the arcs in the underlying digraph. The new formulation is based on a formulation of the asymmetric traveling salesman problem with time windows and has the advantage of avoiding additional variables and linking constraints. In the new formulation of the VRPTW time windows are modeled using path inequalities. The path inequalities eliminate time and capacity infeasible paths. We present a new class of strengthened path inequalities based on polyhedral results obtained in the context of the asymmetric traveling salesman problem with replenishment arcs. We study the VRPTW polytope and determine the polytope dimension. We show that the lifted path inequalities are facet defining under certain assumptions. We also introduce precedence constraints in the context of the VRPTW. Computational experiments are performed with a branch-and-cut algorithm on the Solomon test problems with wide time windows. Based on results on 25-node problems the outcome is that the algorithm shows promising results compared to leading algorithms in the literature. In particular we report a solution to a previously unsolved 50-node Solomon test problem R208. The conclusion is therefore that the path formulation of the VRPTW is no longer the unchallenged winning strategy for solving the VRPTW.

The fourth and final paper ‘Vehicle routing problem with time windows’ (Kallehauge, Larsen, Madsen, and Solomon. In Desaulniers, Desrosiers, and Solomon, editors, Column generation, pages 67-98, Springer, New York, 2005) is a contribution to a book on column generation edited by G. Desaulniers, J. Desrosiers, and M. M. Solomon. The focus of the paper is on the VRPTW as one of the important applications of column generation in integer programming. We discuss the VRPTW in terms of its mathematical modeling, its structure and decomposition alternatives. We then present the master problem and the subproblem for the column generation approach, respectively. Next, we illustrate a branch-and-bound framework and address acceleration strategies used to increase the efficiency of branch-and-price methods. Then, we describe generalizations of the problem and report computational results for the classic Solomon test sets. Finally, we present our conclusions and discuss some open problems.

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This paper presents a comprehensive approach to engineering design optimization exploiting space mapping. The algorithms employ input space mapping and a new generalization of implicit space mapping to minimize the misalignment between the coarse and fine models of the optimized object over a region of interest. Output space mapping ensures the matching of responses and first-order derivatives between the mapped coarse model and the fine model at the current iteration point in the optimization process. We provide theoretical results that show the importance of the explicit use of sensitivity information to the convergence properties of our family of algorithms. Our algorithm is demonstrated on the optimization of a microstrip band-pass filter, a band-pass filter with double-coupled resonators and a seven-section impedance transformer. We describe the novel user-oriented software package SMF that implements the new family of space mapping optimization algorithms.

General information
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Interval methods: An introduction
This chapter contains selected papers presented at the Minisymposium on Interval Methods of the PARA'04 Workshop "State-of-the-Art in Scientific Computing". The emphasis of the workshop was on high-performance computing (HPC). The ongoing development of ever more advanced computers provides the potential for solving increasingly difficult computational problems. However, given the complexity of modern computer architectures, the task of realizing this potential needs careful attention. A main concern of HPC is the development of software that optimizes the performance of a given computer. An important characteristic of the computer performance in scientific computing is the accuracy of the Computation results. Often, we can estimate this accuracy by using traditional statistical techniques. However, in many practical situations, we do not know the probability distributions of different measurement, estimation, and/or roundoff errors, we only know estimates of the upper bounds on the corresponding measurement errors, i.e., we only know an interval of possible values of each such error. The papers from the following chapter contain the description of the corresponding "interval computation" techniques, and the applications of these techniques to various problems of scientific computing.

Non-linear Global Optimization using Interval Arithmetic and Constraint Propagation

PARA'04, State-of-the-art in scientific computing: LNCS Proceedings
This meeting in the series, the PARA'04 Workshop with the title "State of the Art in Scientific Computing", was held in Lyngby, Denmark, June 20-23, 2004. The PARA'04 Workshop was organized by Jack Dongarra from the University of
Space-Mapping-Based Interpolation for Engineering Optimization

We consider a simple and efficient space-mapping (SM) based interpolation scheme to work in conjunction with SM optimization algorithms. The technique is useful if the fine model (the one that is supposed to be optimized) is available only on a structured grid. It allows us to estimate the response of the fine model at off-grid points and, as a result, increases the effective resolution of the design variable domain search and improves the quality of the fine model solution found by the SM optimization algorithm. The proposed method requires little computational effort; in particular no additional fine model evaluations are necessary. Several examples that verify accuracy and robustness of our approach are provided.

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Scopus rating (2014): SJR 1.56 SNIP 2.417 CiteScore 3.37
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Space Mapping for Engineering Optimization

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Space mapping optimization algorithms for engineering design

A simple, efficient optimization algorithm based on space mapping (SM) is presented. It utilizes input SM to reduce the misalignment between the coarse and fine models of the optimized object over a region of interest, and output space mapping (OSM) to ensure matching of response and first-order derivatives between the mapped coarse model and the fine model at the current iteration point. We also consider an enhanced version in which the input SM coefficients are frequency dependent. The performance of our new algorithms is comparable with the recently published SMIS algorithm when applied to a benchmark problem. In comparison with SMIS, the models presented are simple and have a small number of parameters that need to be extracted. The new algorithm is applied to the optimization of coupled-line band-pass filter.

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Theoretical justification of space-mapping-based modeling utilizing a database and on-demand parameter extraction

We present a theoretical justification of a recently introduced surrogate modeling methodology based on space mapping that relies on an available data base and on-demand parameter extraction. Fine model data, the so-called base set, is assumed available in the region of interest. To evaluate the surrogate, we perform parameter extraction with weighting coefficients dependent on the distance between the point of interest and base points. We provide theoretical results showing that the new methodology can assure any accuracy that is required (provided the base set is dense enough), which is not the case for our benchmark space mapping modeling methodology. Illustrative examples emphasizing differences between modeling methodologies are provided.

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Enhanced surrogate models for statistical design exploiting space mapping technology

We present advances in microwave and RF device modeling exploiting Space Mapping (SM) technology. We propose new SM modeling formulations utilizing input mappings, output mappings, frequency scaling and quadratic approximations. Our aim is to enhance circuit models for statistical analysis and yield-driven design. We illustrate our results using a capacitively-loaded two-section impedance transformer, a single-resonator waveguide filter and a six-section H-plane waveguide filter.
On Characterization of Quadratic Splines

A quadratic spline is a differentiable piecewise quadratic function. Many problems in numerical analysis and optimization literature can be reformulated as unconstrained minimizations of quadratic splines. However, only special cases of quadratic splines are studied in the existing literature, and algorithms are developed on a case by case basis. There lacks an analytical representation of a general or even a convex quadratic spline. The current paper fills this gap by providing an analytical representation of a general quadratic spline. Furthermore, for convex quadratic spline, it is shown that the representation can be refined in a neighborhood of a non-degenerate point and a set of non-degenerate minimizers. Based on these characterizations, many existing algorithms for specific convex quadratic splines are also finite convergent for a general convex quadratic spline. Finally, we study the relationship between the convexity of a quadratic spline function and the monotonicity of the corresponding LCP problem. It is shown that, although both conditions lead to easy solvability of the problem, they are different in general.
Towards a Rigorous Formulation of the Space Mapping Technique for Engineering Design

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A Space-Mapping Interpolating Surrogate Algorithm for highly Optimized EM-Based Design of Microwave Devices

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Authors: Bandler, J. W. (Ekstern), Hailu, D. M. (Ekstern), Madsen, K. (Intern), Pedersen, F. (Intern)
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Convergence of Hybrid Space Mapping Algorithms
The space mapping technique is intended for optimization of engineering models which involve very expensive function evaluations. It may be considered a preprocessing method which often provides a very efficient initial phase of an optimization procedure. However, the ultimate rate of convergence may be poor, or the method may even fail to converge to a stationary point. We consider a convex combination of the space mapping technique with a classical optimization technique. The function to be optimized has the form $H \circ f$ where $H: \mathbb{R}^m \rightarrow \mathbb{R}^n$ is convex and $f: \mathbb{R}^n \rightarrow \mathbb{R}^m$ is smooth. Experience indicates that the combined method maintains the initial efficiency of the space mapping technique. We prove that the global convergence property of the classical technique is also maintained: The combined method provides convergence to the set of stationary points of $H \circ f$.

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Scopus rating (2011): SJR 0.472 SNIP 1.09 CiteScore 1.09
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Scopus rating (2010): SJR 0.388 SNIP 0.938
BFI (2009): BFI-level 1
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Scopus rating (2008): SJR 0.458 SNIP 1.112
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Web of Science (2007): Indexed yes
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The PARA workshops in the past have been devoted to parallel computing methods in science and technology. There have been seven PARA meetings to date: PARA'94, PARA'95 and PARA'96 in Lyngby, Denmark, PARA'98 in Umeå, Sweden, PARA'2000 in Bergen, Norway, PARA'02 in Espoo, Finland, and PARA'04 again in Lyngby, Denmark. The rst six meetings featured lectures in modern numerical algorithms, computer science, engineering, and industrial applications, all in the context of scientiﬁc parallel computing. This meeting in the series, the PARA'04 Workshop with the title State of the Art in Scientiﬁc Computing, was held in Lyngby, Denmark, June 20-23, 2004. The PARA'04 Workshop was organized by Jack Dongarra from the University of Tennessee and Oak Ridge National Laboratory, and Kaj Madsen and Jerzy Wasniewski from the Technical University of Denmark. The emphasis here was shifted to High-Performance Computing (HPC). The ongoing development of ever more advanced computers provides the potential for solving increasingly diʃcult computational problems. However, given the complexity of modern computer architectures, the task of realizing this potential needs careful attention. For example, the failure to exploit a computer's memory hierarchy can degrade performance badly. A main concern of HPC is the development of software that optimizes the performance of a given computer. The high cost of state-of-the-art computers can be prohibitive for many workplaces, especially if there is only an occasional need for HPC. A solution to this problem can be network computing, where remote computing facilities are exploited via the internet. PARA'04 featured invited talks, contributed talks, minisymposia, and software and hardware vendors. The rst day, June 20, was devoted to two parallel tutorials. The minisymposia and contributed talks during the main part of the Workshop, June 21-23, were scheduled in parallel sessions. All invited and contributed talks were
Recent trends in space mapping technology

We review recent trends in the art of Space Mapping (SM) technology for modeling and design of engineering devices and systems. The SM approach aims at achieving a satisfactory solution with a handful of computationally expensive so-called "fine" model evaluations. SM procedures iteratively update and optimize surrogates based on fast physically-based "coarse" models. Parameter extraction is an essential SM subproblem. It is used to align the surrogate (enhanced coarse model) with the fine model. Recent developments including TLM-based modeling and design using SM and the SM-based interpolating surrogates framework are discussed. Some practical applications are reviewed.

Robust C subroutines for non-linear optimization

This report presents a package of robust and easy-to-use C subroutines for solving unconstrained and constrained non-linear optimization problems. The intention is that the routines should use the currently best algorithms available. All routines have standardized calls, and the user does not have to worry about special parameters controlling the iterations. For convenience we include an option for numerical checking of the user's implementation of the gradient. Note that another report [3] presents a collection of robust subroutines for both unconstrained and constrained optimization but not requiring gradient information. The parameter lists for the subroutines in both collections are similar so it is easy to switch between the gradient and the non-gradient methods. All of the subroutine names in this report start with MI1. The corresponding names of the non-gradient subroutines are obtained by changing 1 to 0. The present report is a new and updated version of a previous report NI-91-03 with the same title, [16]. Both the previous and the present report describe a collection of subroutines, which have been translated from Fortran to C. The reason for writing the present report is that some of the C subroutines have been replaced by more effective and robust versions translated from the original Fortran subroutines to C by the Bandler Group, see [1]. Also the test examples have been modified to some extent. For a description of the original Fortran subroutines see the report [17]. The software changes are listed in Section 1.5.
Robust non-gradient C subroutines for non-linear optimization
This report presents a package of robust and easy-to-use C subroutines for solving unconstrained and constrained non-linear optimization problems, where gradient information is not required. The intention is that the routines should use the currently best algorithms available. All routines have standardized calls, and the user does not have to worry about special parameters controlling the iterations. For convenience we include an option for numerical checking of the user's implementation of the gradient. Note that another report [3] presents a collection of robust subroutines for both unconstrained and constrained optimization but requiring gradient information. The parameter lists for the subroutines in both collections are similar so it is easy to switch between the non-gradient and the gradient methods. All of the subroutine names in this report start with MI0. The corresponding names of the gradient subroutines are obtained by changing 0 to 1. The present report is a new and updated version of a previous report NI-91-04 with the title Non-gradient C Subroutines for Non-Linear Optimization, [16]. Both the previous and the present report describe a collection of subroutines, which have been translated from Fortran to C. The reason for writing the present report is that some of the C subroutines have been replaced by more effective and robust versions translated from the original Fortran subroutines to C by the Bandler Group, see [1]. Also the test examples have been modified to some extent. For a description of the original Fortran subroutines see the report [17]. The software changes are listed in Section 1.5.

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Brock, P. (Ekstern), Madsen, K. (Intern), Nielsen, H. B. (Intern)
Publication date: 2004

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
imm3400.pdf
imm3400.ps
Links:
Source: orbit
Source-ID: 154843
Publication: Research › Report – Annual report year: 2004

Selected numerical algorithms

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Dongarra, J. (Ekstern), Madsen, K. (Intern), Wasniewski, J. (Intern)
Pages: 349-351
Publication date: 2004
Main Research Area: Technical/natural sciences

Publication information
Journal: Future Generation Computer Systems
Volume: 20
Issue number: 3
ISSN (Print): 0167-739X
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
A powerful optimization algorithm that incorporates Space Mapping (SM) and the new Output Space Mapping (OSM) to yield highly optimized results in a handful of fine model evaluations is presented. The new method employs an SM-based interpolating surrogate (SMIS) framework that aims at matching the surrogate with the fine model locally. Accuracy and convergence properties are demonstrated using a seven-section capacitively-loaded impedance transformer. A highly optimized six-section H-plane waveguide filter design emerges after only four HFSS EM simulations, excluding necessary Jacobian estimations, using the new algorithm with sparse frequency sweeps.
Space Mapping: The State of the Art

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Bandler, J. W. (Ekstern), Cheng, Q. S. (Ekstern), Mohamed, A. S. (Ekstern), Bakr, M. H. (Ekstern), Madsen, K. (Intern), Søndergaard, J. (Intern)
Pages: 337-361
Publication date: 2004
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Transactions on Microwave Theory and Techniques
Volume: 52
Issue number: 1
ISSN (Print): 0018-9480
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.39 SJR 1.175 SNIP 1.914
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.159 SNIP 2.077 CiteScore 3.48
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.56 SNIP 2.417 CiteScore 3.37
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.705 SNIP 2.589 CiteScore 3.64
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.371 SNIP 2.043 CiteScore 2.89
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.223 SNIP 1.764 CiteScore 2.68
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.16 SNIP 1.774
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.687 SNIP 2.478
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.815 SNIP 2.243
Web of Science (2008): Indexed yes
Optimization using surrogate models - by the space mapping technique

Surrogate modelling and optimization techniques are intended for engineering design in the case where an expensive physical model is involved. This thesis provides a literature overview of the field of surrogate modelling and optimization. The space mapping technique is one such method for constructing and optimizing a surrogate model based on a cheap physical model. The space mapping surrogate is the cheap model composed with a parameter mapping, the so-called space mapping, connecting similar responses of the cheap and the expensive model. The thesis presents a theoretical study of the space mapping technique. Theoretical results are derived which characterize the space mapping under some ideal conditions. If these conditions are met, the solutions provided by the original space mapping technique are minimizers of the expensive model. However, in practice we cannot expect that these ideal conditions are satisfied. So hybrid methods, combining the space mapping technique with classical optimization methods, should be used if convergence to high accuracy is wanted. Approximation abilities of the space mapping surrogate are compared with those of a Taylor model of the expensive model. The space mapping surrogate has a lower approximation error for long steps. For short steps, however, the Taylor model of the expensive model is best, due to exact interpolation at the model origin. Five algorithms for space mapping optimization are presented and the numerical performance is evaluated. Three of the algorithms are hybrid algorithms. Convergence of a class of hybrid space mapping algorithms is proved.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Scientific Computing
Authors: Søndergaard, J. (Intern), Madsen, K. (Intern), Nielsen, H. B. (Intern)
Publication date: May 2003

EM-based surrogate modeling and design exploiting implicit, frequency and output space mappings

General information
State: Published
EM-based optimization exploiting partial space mapping and exact sensitivities

We present a family of robust techniques for exploiting sensitivities in electromagnetic (EM)-based circuit optimization through space mapping (SM) technology. We utilize derivative information for parameter extractions and mapping updates. We exploit a partial SM (PSM) concept, where a reduced set of parameters is sufficient for parameter extraction optimization. It reflects the idea of tuning and execution time is reduced. Upfront gradients of both EM (fine) model and coarse surrogates can initialize possible mapping approximations. We introduce several effective approaches for updating the mapping during the optimization iterations. Examples include the classical Rosenbrock function, modified to illustrate the approach, a two-section transmission-line 10:1 impedance transformer and a microstrip bandstop filter with open stubs.
EM-Based Optimization Exploiting Partial Space Mapping and Exact Sensitivities

We present a family of robust techniques for exploiting sensitivities in EM-based circuit optimization through Space Mapping (SM). We utilize derivative information for parameter extractions and mapping updates. We exploit a Partial Space Mapping (PSM) concept where a reduced set of parameters is sufficient for parameter extraction optimization. Upfront gradients of both EM (fine) model and coarse surrogates can initialize possible mapping approximations. Illustrations include a two-section 10:1 impedance transformer and a microstrip bandstop filter.

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Bandler, J. W. (Ekstern), Mohamed, A. S. (Ekstern), Bakr, M. H. (Ekstern), Madsen, K. (Intern), Søndergaard, J. (Intern)
Pages: 2101-2104
Publication date: 2002

Host publication information
Title of host publication: 2002 IEEE MTT-S International Microwave Symposium
Volume: 1-3
Publisher: IEEE
ISBN (Print): 0-7803-7239-5
Introduction to Interval Analysis

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Caprani, O. (Ekstern), Madsen, K. (Intern), Nielsen, H. B. (Intern)
Publication date: 2002

Publication information
Original language: English
Main Research Area: Technical/natural sciences
interval integration, roots of functions, global optimization, interval analysis
Electronic versions:
imm1462.pdf
Links:
Source: orbit
Source-ID: 201102
Publication: Education › Compendium/lecture notes – Annual report year: 2002

Parallel branch-and-bound attraction based methods for global optimization

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Zilinskas, J. (Ekstern)
Pages: 175-187
Publication date: 2002

Host publication information
Title of host publication: Stochastic and Global optimization
Publisher: Kluwer
ISBN (Print): 1402004842
Main Research Area: Technical/natural sciences
Links:
Source: orbit
Source-ID: 58271
Publication: Research - peer-review › Book chapter – Annual report year: 2002

Robust Subroutines for Non-Linear Optimization

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Nielsen, H. B. (Intern), Søndergaard, J. (Intern)
Publication date: 2002
Supplementary Notes for Course 02611 Optimization and Data Fitting

General Information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Nielsen, H. B. (Intern)
Publication date: 2002

An Introduction to the Space Mapping Technique

General Information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Bakr, M. H. (Ekstern), Bandler, J. W. (Ekstern), Madsen, K. (Intern), Søndergaard, J. (Intern)
Pages: 369-384
Publication date: 2001
Main Research Area: Technical/natural sciences

Journal: Optimization and Engineering
Volume: 2
Issue number: 4
ISSN (Print): 1389-4420
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 0.481 SNIP 0.737 CiteScore 1.28
   BFI (2015): BFI-level 1
   Scopus rating (2015): SJR 0.709 SNIP 1.244 CiteScore 1.46
   BFI (2014): BFI-level 1
   Scopus rating (2014): SJR 0.628 SNIP 1.305 CiteScore 1.74
   BFI (2013): BFI-level 1
   Scopus rating (2013): SJR 0.456 SNIP 1.427 CiteScore 1.59
   ISI indexed (2013): ISI indexed yes
   BFI (2012): BFI-level 1
   Scopus rating (2012): SJR 0.459 SNIP 1.17 CiteScore 1.07
   ISI indexed (2012): ISI indexed yes
   BFI (2011): BFI-level 1
Surrogate Modelling and Space Mapping for Engineering Optimization

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Bandler, J. W. (Ekstern), Madsen, K. (Intern)
Pages: 367-368
Publication date: 2001
Main Research Area: Technical/natural sciences

Publication information
Journal: Optimization and Engineering
Volume: 2
Issue number: 4
ISSN (Print): 1389-4420
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 0.481 SNIP 0.737 CiteScore 1.28
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.709 SNIP 1.244 CiteScore 1.46
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.628 SNIP 1.305 CiteScore 1.74
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.456 SNIP 1.427 CiteScore 1.59
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.459 SNIP 1.17 CiteScore 1.07
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.472 SNIP 1.09 CiteScore 1.09
ISI indexed (2011): ISI indexed yes
Evaluating Performance of Attraction based Subdivision Methods for Global Optimization

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Zilinskas, J. (Ekstern)
Pages: 38-42
Publication date: 2000

Host publication information
Title of host publication: 2‘nd International Conference on Simulation, Gaming, Training and Business Process Reengineering in Operations
Main Research Area: Technical/natural sciences
Conference: 2‘nd International Conference on Simulation, Gaming, Training and Business Process Reengineering in Operations, 01/01/2000
global optimization, branch-and-bound.
Source: orbit
Source-ID: 176502
Publication: Research - peer-review › Article in proceedings – Annual report year: 2000

Frequency-Space Mapping Optimization of Microwave Circuits Exploiting Surrogate Models

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Bakr, M. H. (Ekstern), Bandler, J. W. (Ekstern), Rayas-Sánchez, J. E. (Ekstern), Madsen, K. (Intern), Søndergaard, J. (Intern)
Pages: 1785-1788
Publication date: 2000

Host publication information
Title of host publication: IEEE MTT-S International Microwave Symposium
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 176451
Publication: Research - peer-review › Article in proceedings – Annual report year: 2000

Repræsentation, kalkulation og beslutning| under økonomisk usikkerhed

General information
Review of the Space Mapping Approach to Engineering Optimization and Modeling

We review the Space Mapping (SM) concept and its applications in engineering optimization and modeling. The aim of SM is to avoid computationally expensive calculations encountered in simulating an engineering system. The existence of less accurate but fast physically-based models is exploited. SM drives the optimization iterates of the time-intensive model using the fast model. Several algorithms have been developed for SM optimization, including the original SM algorithm, Aggressive Space Mapping (ASM), Trust Region Aggressive Space Mapping (TRASM) and Hybrid Aggressive Space Mapping (HASM). An essential subproblem of any SM based optimization algorithm is parameter extraction. The uniqueness of this optimization subproblem has been crucial to the success of SM optimization. Different approaches to enhance the uniqueness are reviewed. We also discuss new developments in Space Mapping-based Modeling (SMM). These include Space Derivative Mapping (SDM), Generalized Space Mapping (GSM) and Space Mapping-based Neuromodeling (SMN). Finally, we address open points for research and future development.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Bakr, M. H. (Ekstern), Bandler, J. W. (Ekstern), Madsen, K. (Intern), Rayas-Sánchez, J. E. (Ekstern), Søndergaard, J. (Intern)
Pages: 241-276
Publication date: 2000
Main Research Area: Technical/natural sciences

Publication information
Journal: Optimization and Engineering
Volume: 1
Issue number: 3
ISSN (Print): 1389-4420
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 0.481 SNIP 0.737 CiteScore 1.28
- BFI (2015): BFI-level 1
- Scopus rating (2015): SJR 0.709 SNIP 1.244 CiteScore 1.46
- BFI (2014): BFI-level 1
- Scopus rating (2014): SJR 0.628 SNIP 1.305 CiteScore 1.74
- BFI (2013): BFI-level 1
- Scopus rating (2013): SJR 0.456 SNIP 1.427 CiteScore 1.59
- ISI indexed (2013): ISI indexed yes
- BFI (2012): BFI-level 1
- Scopus rating (2012): SJR 0.459 SNIP 1.17 CiteScore 1.07
- ISI indexed (2012): ISI indexed yes
- BFI (2011): BFI-level 1
Short-term prediction of wind farm electricity production

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling, Mathematical Statistics
Authors: Madsen, K. (Intern), Nielsen, T. S. (Intern), Nielsen, H. A. O. 3. (Intern), Landberg, L. (Ekstern)
Publication date: 2000

Host publication information
Title of host publication: European Congress on Computational Methods in Applied Sciences and Engineering
Place of publication: Barcelona
Main Research Area: Technical/natural sciences
Conference: European Congress on Computational Methods in Applied Sciences and Engineering, Barcelona, 01/01/2000
Source: orbit
Source-ID: 176385
Publication: Research - peer-review › Journal article – Annual report year: 2000

Space Mapping Optimization of Microwave Circuits Exploiting Surrogate Models
A powerful new space-mapping (SM) optimization algorithm is presented in this paper. It draws upon recent developments in both surrogate model-based optimization and modeling of microwave devices, SM optimization is formulated as a general optimization problem of a surrogate model. This model is a convex combination of a mapped coarse model and a linearized fine model. It exploits, in a novel way, a linear frequency-sensitive mapping. During the optimization iterates, the coarse and fine models are simulated at different sets of frequencies. This approach is shown to be especially powerful if a significant response shift exists. The algorithm is illustrated through the design of a capacitively loaded 10:1 impedance transformer and a double-folded stub filter. A high-temperature superconducting filter is also designed using decoupled frequency and SMs.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Bakr, M. H. (Ekstern), Bandler, J. W. (Ekstern), Madsen, K. (Intern), Søndergaard, J. (Intern)
Pages: 2297-2306
Publication date: 2000
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Transaction on Microwave Theory and Techniques
Volume: 48
Issue number: 12
ISSN (Print): 0018-9480
Ratings:
A Finite Continuation Algorithm for Bound Constrained Quadratic Programming

The dual of the strictly convex quadratic programming problem with unit bounds is posed as a linear $\ell_1$ minimization problem with quadratic terms. A smooth approximation to the linear $\ell_1$ function is used to obtain a parametric family of piecewise-quadratic approximation problems. The unique path generated by the minimizers of these problems yields the solution to the original problem for finite values of the approximation parameter. Thus, a finite continuation algorithm is
designed. Results of extensive computational experiments are reported.

**General information**

State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Nielsen, H. B. (Intern), Pinar, M. C. (Ekstern)
Pages: 62-83
Publication date: 1999
Main Research Area: Technical/natural sciences

**Publication information**

Journal: SIAM Journal on Optimization
Volume: 9
Issue number: 1
ISSN (Print): 1052-6234
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.22 SJR 2.902 SNIP 2.237
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 3.388 SNIP 2.373 CiteScore 3.32
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.851 SNIP 2.513 CiteScore 2.98
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.267 SNIP 2.701 CiteScore 3.44
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.529 SNIP 2.773 CiteScore 3.05
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.339 SNIP 2.217 CiteScore 2.4
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.361 SNIP 2.324
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 3.011 SNIP 2.144
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.316 SNIP 2.178
Scopus rating (2007): SJR 2.759 SNIP 2.183
Scopus rating (2006): SJR 2.118 SNIP 2.312
Scopus rating (2005): SJR 3.127 SNIP 2.721
Scopus rating (2004): SJR 4.01 SNIP 3.038
Scopus rating (2003): SJR 3.371 SNIP 2.613
Scopus rating (2002): SJR 4.011 SNIP 2.519
Scopus rating (2001): SJR 2.73 SNIP 1.375
Scopus rating (2000): SJR 3.727 SNIP 1.904
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 4.258 SNIP 2.381
Original language: English
Links:
http://www2.imm.dtu.dk/pubdb/p.php?416
Source: orbit
Source-ID: 199703
A Hybrid Aggressive Space Mapping Algorithm for EM Optimization

We propose a novel hybrid aggressive space-mapping (HASM) optimization algorithm. HASM exploits both the trust-region aggressive space-mapping (TRASM) strategy and direct optimization. Severe differences between the coarse and fine models and nonuniqueness of the parameter extraction procedure may cause the TRASM algorithm to be trapped in local minima. The HASM algorithm is based on a novel lemma that enables smooth switching from the TRASM optimization to direct optimization if the TRASM algorithm is not converging. It also enables switching back from direct optimization to the TRASM algorithm in a smooth way. The uniqueness of the extraction step is improved by utilizing a good starting point. The algorithm does not assume that the final space-mapped design is the true optimal design and is robust against severe misalignment between the coarse and fine models. The examples include a seven-section waveguide transformer, the design of a H-plane waveguide filter, and a double-folded stub filter.

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Bakr, M. H. (Ekstern), Bandler, J. W. (Ekstern), Georgieva, N. (Ekstern), Madsen, K. (Intern)
Pages: 2440-2449
Publication date: 1999
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES
Volume: MTT-47
Issue number: 12
ISSN (Print): 0018-9480
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.39 SJR 1.175 SNIP 1.914
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.159 SNIP 2.077 CiteScore 3.48
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.56 SNIP 2.417 CiteScore 3.37
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.705 SNIP 2.589 CiteScore 3.64
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.371 SNIP 2.043 CiteScore 2.89
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.223 SNIP 1.764 CiteScore 2.68
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.16 SNIP 1.774
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.687 SNIP 2.478
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.815 SNIP 2.243
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.584 SNIP 2.888
A Hybrid Aggressive Space Mapping Algorithm for EM Optimization

We present a novel, Hybrid Aggressive Space Mapping (HASM) optimization algorithm. HASM is a hybrid approach exploiting both the Trust Region Aggressive Space Mapping (TRASM) algorithm and direct optimization. It does not assume that the final space-mapped design is the true optimal design and is robust against severe misalignment between the coarse and the fine models. The algorithm is based on a novel lemma that enables smooth switching from the TRASM optimization to direct optimization and vice versa, The new algorithm has been tested on several microwave filters and transformers.

Bound constrained quadratic programming via piecewise

We consider the strictly convex quadratic programming problem with bounded variables. A dual problem is derived using Lagrange duality. The dual problem is the minimization of an unconstrained, piecewise quadratic function. It involves a lower bound of $\lambda_1$, the smallest eigenvalue of a symmetric, positive definite matrix, and is solved by Newton iteration with line search. The paper describes the algorithm and its implementation including estimation of $\lambda_1$, how to get a good starting point for the iteration, and up- and downdating of Cholesky factorization. Results of extensive testing and comparison with other methods for constrained QP are given.
Initialization and Optimization of Deformable Models

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Jensen, R. F. (Intern), Carstensen, J. M. (Intern), Madsen, K. (Intern)
Pages: 295-302
Publication date: 1999

Host publication information
Title of host publication: Proceedings from The 11th Scandinavian Conference on Image Analysis
Main Research Area: Technical/natural sciences
Conference: 11th Scandinavian Conference on Image Analysis (SCIA), Kangerlussuaq, Greenland, 07/06/1999 - 07/06/1999
Source: orbit
Source-ID: 172454
Publication: Research - peer-review › Article in proceedings – Annual report year: 1999

Methods for Non-Linear Least Squares Problems

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Nielsen, H. B. (Intern), Tingleff, O. (Ekstern)
Number of pages: 56
Publication date: 1999

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Links:
http://www2.imm.dtu.dk/pubdb/p.php?660
Source: orbit
Source-ID: 201122
Publication: Education › Compendium/lecture notes – Annual report year: 1999

Optimization with constraints

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Nielsen, H. B. (Intern), Tingleff, O. (Intern)
Number of pages: 74
Publication date: 1999

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 172494
Publication: Research - peer-review › Book – Annual report year: 1999

Quantitative Measurement of Changes in Retinal Vessel Diameter in Ocular Fundus Images

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Torsana A/S, Copenhagen University Hospital
Authors: Pedersen, L. (Intern), Grunkin, M. (Ekstern), Ersbøll, B. K. (Intern), Madsen, K. (Intern), Larsen, M. (Ekstern), Christoffersen, N. (Ekstern), Skands, U. (Ekstern)
Pages: 439-446
Publication date: 1999

Host publication information
Title of host publication: Proceedings from The 11th Scandinavian Conference on Image Analysis
A C++ Programme for Global Optimization

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Zertchaninov, S. (Ekstern)
Publication date: 1998

Publication information
Publisher: IMM Publications
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 200970
Publication: Research - peer-review › Report – Annual report year: 1998

An Almost Embarrassingly Parallel Interval Global Optimization Method

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Caprani, O. (Ekstern)
Pages: 15-18
Publication date: 1998

Host publication information
Title of host publication: Interval '98
Place of publication: Nanjing, China
Main Research Area: Technical/natural sciences
Conference: Interval '98, 01/01/1998
Source: orbit
Source-ID: 170431
Publication: Research - peer-review › Article in proceedings – Annual report year: 1998


General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Zertchaninov, S. (Ekstern)
Number of pages: 19
Publication date: 1998

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 170500
Publication: Research - peer-review › Report – Annual report year: 1998

A Trust Region Aggressive Space Mapping Algorithm for EM
A robust new algorithm for electromagnetic (EM) optimization of microwave circuits is presented. The algorithm (TRASM) integrates a trust region methodology with the aggressive space mapping (ASM). The trust region ensures that each iteration results in improved alignment between the coarse and fine models needed to execute ASM. The parameter extraction step is a crucial part of the ASM technique. The nonuniqueness of this step may result in the divergence of the technique. To improve the uniqueness of the extraction phase, we developed a recursive multipoint parameter extraction.
This suggested step exploits all the available EM simulations for improving the uniqueness of parameter extraction. The new algorithm was successfully used to design a number of microwave circuits. Examples include the EM optimization of a double-folded stub filter and of a high-temperature superconducting (HTS) filter using Sonnet's em. The proposed algorithm was also used to design two-section, three-section, and seven-section waveguide transformers exploiting Maxwell Eminence. The design of a three-section waveguide transformer with rounded corners was carried out using HP HFSS. We show how the mapping can be used to carry out Monte Carlo analysis using only coarse model simulations.
A Trust Region Aggressive Space Mapping Algorithm for EM Optimization

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Bakr, M. (Ekstern), Bandler, J. (Ekstern), Biernacki, R. (Ekstern), Chen, S. (Ekstern)
Pages: 1759-1762
Publication date: 1998

Host publication information
Title of host publication: Microwave Symp. Digest
Place of publication: Baltimore, U.S.A.
Main Research Area: Technical/natural sciences
Conference: IEEE MTT-S Int. Microwave Symp, 01/01/1998
Source: orbit
Source-ID: 170430
Publication: Research - peer-review › Article in proceedings – Annual report year: 1998

The Trust Region Aggressive Space Mapping Technique

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Bakr, M. (Ekstern), Bandler, J. (Ekstern), Biernacki, R. (Ekstern), Chen, S. (Ekstern)
Pages: 2412-2425
Publication date: 1998
Main Research Area: Technical/natural sciences

Publication information
Journal: Theory, Implementation and Examples
Original language: English
Source: orbit
Source-ID: 170423
Publication: Research - peer-review › Journal article – Annual report year: 1998

The Trust Region Aggressive Space Mapping Technique: Theory, Implementation and Examples

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Bakr, M. (Ekstern), Bandler, J. (Ekstern), Biernacki, R. (Ekstern), Chen, S. (Ekstern)
Number of pages: 30
Publication date: 1998

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Automatic validation of numerical solutions

This thesis is concerned with "Automatic Validation of Numerical Solutions". The basic theory of interval analysis and self-validating methods is introduced. The mean value enclosure is applied to discrete mappings for obtaining narrow enclosures of the iterates when applying these mappings with intervals as initial values. A modification of the mean value enclosure of discrete mappings is considered, namely the extended mean value enclosure which in most cases leads to even better enclosures. These methods have previously been described in connection with discretizing solutions of ordinary differential equations, but in this thesis, we describe how to use the methods for enclosing iterates of discrete mappings, and then later use them for discretizing solutions of ordinary differential equations. The theory of automatic differentiation is introduced, and three methods for obtaining derivatives are described: The forward, the backward, and the Taylor expansion methods. The three methods have been implemented in the C++ program packages FADBAD/TADIFF. Some examples showing how to use the three methods are presented. A feature of FADBAD/TADIFF not present in other automatic differentiation packages is the possibility to combine the three methods in an extremely flexible way. We examine some applications where this flexibility is very useful. A method for Taylor expanding solutions of ordinary differential equations is presented, and a method for obtaining interval enclosures of the truncation errors incurred, when truncating these Taylor series expansions is described. By combining the forward method and the Taylor expansion method, it is possible to implement the (extended) mean value enclosure of a truncated Taylor series expansion with enclosures of the truncation errors. A C++ program package ADIODES, using this method has been developed. (ADIODES is an abbreviation of "Automatic Differentiation Interval Ordinary Differential Equation Solver"). ADIODES is used to prove existence and uniqueness of periodic solutions to specific ordinary differential equations occurring in dynamical systems theory. These proofs of existence and uniqueness are difficult or impossible to obtain using other known methods. Also, a method for solving boundary value problems is described. Finally a method for enclosing solutions to a class of integral equations is described. This method is based on the mean value enclosure of an integral operator and uses interval Bernstein polynomials for enclosing the solution. Two numerical examples are given, using two orders of approximation and using different numbers of discretization points.

Algorithms for non-linear M-estimation

In non-linear regression, the least squares method is most often used. Since this estimator is highly sensitive to outliers in the data, alternatives have become increasingly popular during the last decades. We present algorithms for non-linear M-estimation. A trust region approach is used, where a sequence of estimation problems for linearized models is solved. In the testing we apply four estimators to ten non-linear data fitting problems. The test problems are also solved by the Generalized Levenberg-Marquardt method and standard optimization BFGS method. It turns out that the new method is in general more reliable and efficient.
Bound constrained quadratic programming via piecewise quadratic functions.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Bilkent University
Authors: Madsen, K. (Intern), Nielsen, H. B. (Intern), Pinar, M. (Ekstern)
Number of pages: 18
Publication date: 1997

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 168604
Existence test for asynchronous interval iterations

In the search for regions that contain fixed points of a real function of several variables, tests based on interval calculations can be used to establish existence or non-existence of fixed points in regions that are examined in the course of the search. The search can e.g. be performed as a synchronous (sequential) interval iteration: In each iteration step all components of the iterate are calculated based on the previous iterate. In this case it is straightforward to base simple interval existence and non-existence tests on the calculations done in each step of the iteration. The search can also be performed as an asynchronous (parallel) iteration: Only a few components are changed in each step and this calculation is in general based on components from different previous iterates. For the asynchronous iteration it turns out that simple tests of existence and non-existence can be based on the componentwise calculations done in the course of the iteration. These componentwised tests are useful for parallel implementation of the search, since the tests can then be performed local to each processor and only when a test is unsuccessful do a processor communicate this result to other processors.

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Caprani, O. (Ekstern), Stauning, O. (Intern)
Pages: 259-268
Publication date: 1997
Main Research Area: Technical/natural sciences

Publication information
Journal: Reliable Computing
Volume: 3
ISSN (Print): 1573-1340
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.175 SNIP 0.756 CiteScore 0.5
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.137 SNIP 0.464 CiteScore 0.35
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.204 SNIP 0.42 CiteScore 0.33
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.165 SNIP 0.474 CiteScore 0.38
ISI indexed (2013): ISI indexed no
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.141 SNIP 0.725 CiteScore 0.3
ISI indexed (2012): ISI indexed no
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.16 SNIP 0.113 CiteScore 0.2
ISI indexed (2011): ISI indexed no
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.295 SNIP 2.508
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.217 SNIP 1.426
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.214 SNIP 1.272
Scopus rating (2007): SJR 0.563 SNIP 1.713
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.607 SNIP 1.297
Scopus rating (2005): SJR 0.431 SNIP 0.816
Scopus rating (2004): SJR 0.461 SNIP 1.2
Scopus rating (2003): SJR 0.447 SNIP 0.788
Scopus rating (2002): SJR 0.506 SNIP 0.934
Scopus rating (2001): SJR 0.307 SNIP 1.148
A New Finite Continuation Algorithm for Linear Programming

We describe a new finite continuation algorithm for linear programming. The dual of the linear programming problem with unit lower and upper bounds is formulated as an $\ell_1$ minimization problem augmented with the addition of a linear term. This nondifferentiable problem is approximated by a smooth problem. It is shown that the minimizers of the smooth problem define a family of piecewise-linear paths as a function of a smoothing parameter. Based on this property, a finite algorithm that traces these paths to arrive at an optimal solution of the linear program is developed. The smooth problems are solved by a Newton-type algorithm. Preliminary numerical results indicate that the new algorithm is promising.

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling, Bilkent University
Authors: Madsen, K. (Intern), Nielsen, H. B. (Intern), Pinar, M. (Ekstern)
Pages: 600-616
Publication date: 1996
Main Research Area: Technical/natural sciences

Publication information
Journal: SIAM J. Optimization
Volume: 6
Issue number: 3
ISSN (Print): 1052-6234
Ratings:
Enclosing Solutions of Integral Equations

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), NA NA NA Caprani, O. (Ekstern), Stauning, O. (Intern)
Number of pages: 19
Publication date: 1996

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 170219
Publication: Research - peer-review › Report – Annual report year: 1996

Existence test for asynchonous interval iteration

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), NA NA NA Caprani, O. (Ekstern), Stauning, O. (Intern)
Pages: 30-31
Publication date: 1996

Host publication information
Title of host publication: Proceedings of Interval '96
Place of publication: Wurzburg
Main Research Area: Technical/natural sciences
Conference: Interval '96 Wurzburg, Germany, 01/01/1996
Source: orbit
Source-ID: 170218
Publication: Research - peer-review › Article in proceedings – Annual report year: 1996

Filter Model of Reduced-Rank Noise Reduction

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Pages: 379-387
Publication date: 1996

Host publication information
Title of host publication: Applied Parallel Computing
Publisher: Springer
Main Research Area: Technical/natural sciences
Conference: Applied Parallel Computing, Berlin, 01/01/1996
Source: orbit
Source-ID: 200456
Publication: Research › Article in proceedings – Annual report year: 1996

Second Scandinavian Workshop on Linear Programming Extended abstracts of invited papers

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Nielsen, H. B. (Intern)
Number of pages: 52
Publication date: 1996
Selvevaluering af datalogiuddannelsen på DTU

General information
State: Published
Organisations: Department of Information Technology, Department of Informatics and Mathematical Modeling, Technical University of Denmark
Authors: Bruun, E. (ed.) (Intern), Bruun, E. (Intern), Hoffmann, T. (Ekstern), Husmark, E. (Ekstern), Madsen, K. (Intern), Rischel, H. (Intern), Smidsgaard, H. (Intern), Staunstrup, J. (Intern)
Publication date: 1996

Publication Information
Original language: Danish
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 166460
Publication: Research - peer-review › Report – Annual report year: 1996

Aggressive Space Mapping for Electromagnetic Design

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Bandler, J. W. (Ekstern), Biernacki, R. M. (Ekstern), Chen, S. H. (Ekstern), Madsen, K. (Intern)
Pages: 1455-1458
Publication date: 1995

Host publication information
Title of host publication: IEEE MTT-S Int. Microwave Symp. Digest
Main Research Area: Technical/natural sciences
Conference: IEEE MTT-S Int. Microwave Symp. Digest, 01/01/1995
non-linear optimization, engineering design
Source: orbit
Source-ID: 199958
Publication: Research - peer-review › Article in proceedings – Annual report year: 1995

Applied Parallel Computing: Computations in Physics, Chemistry and Engineering Science

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Dongarra, J. (ed.) (Ekstern), Madsen, K. (ed.) (Intern), Wasniewski, J. (ed.) (Intern)
Publication date: 1995

Publication information
Publisher: Springer
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 200598
Publication: Research - peer-review › Book – Annual report year: 1995
Electromagnetic Optimization Exploiting Aggressive Space Mapping

We propose a significantly improved space mapping (SM) strategy for electromagnetic (EM) optimization. Instead of waiting for upfront EM analyses at several base points, our new approach aggressively exploits every available EM analysis, producing dramatic results right from the first step. We establish a relationship between the novel SM optimization and the quasi-Newton iteration for solving a system of nonlinear equations. Approximations to the matrix of first-order derivatives are updated by the classic Broyden formula. A high-temperature superconducting microstrip filter design solution emerges after only six EM simulations with sparse frequency sweeps. Furthermore, less CPU effort is required to optimize the filter than is required by one single detailed frequency sweep. We also extend the SM concept to the parameter extraction phase, overcoming severely misaligned responses induced by inadequate empirical models. This novel concept should have a significant impact on parameter extraction of devices.

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Bandler, J. W. (Ekstern), Biernacki, R. (Ekstern), Chen, S. (Ekstern), Hemmers, R. (Ekstern), Madsen, K. (Intern)
Pages: 2874-2882
Publication date: 1995
Main Research Area: Technical/natural sciences

Publication information
Volume: MTT-43
Issue number: 12
ISSN (Print): 0018-9480
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.39 SJR 1.175 SNIP 1.914
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.159 SNIP 2.077 CiteScore 3.48
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.56 SNIP 2.417 CiteScore 3.37
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.705 SNIP 2.589 CiteScore 3.64
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.371 SNIP 2.043 CiteScore 2.89
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.223 SNIP 1.764 CiteScore 2.68
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.16 SNIP 1.774
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.687 SNIP 2.478
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.815 SNIP 2.243
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.584 SNIP 2.888
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 2.435 SNIP 2.826
Enclosing Solutions of Integral Equations

State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Caprani, O. (Ekstern), Madsen, K. (Intern), Stauning, O. (Intern)
Pages: 45-51
Publication date: 1995
Main Research Area: Technical/natural sciences

Publication information
Journal: International Journal of Reliable Computing
Original language: English
integral equations, interval analysis
Links:
http://www2.imm.dtu.dk/pubdb/p.php?1495
Source: orbit
Source-ID: 199531
Publication: Research - peer-review › Journal article – Annual report year: 1995

Implementation of QR up- and downdating on a massively parallel computer
We describe an implementation of QR up- and downdating on a massively parallel computer (the Connection Machine CM-200) and show that the algorithm maps well onto the computer. In particular, we show how the use of corrected semi-normal equations for downdating can be efficiently implemented. We also illustrate the use of our algorithms in a new LP algorithm.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Scientific Computing
Authors: Bendtsen, C. (Intern), Hansen, P. C. (Ekstern), Madsen, K. (Intern), Nielsen, H. B. (Intern), Pinar, M. C. (Ekstern)
Pages: 49-61
Publication date: 1995
Main Research Area: Technical/natural sciences

Publication information
Journal: Parallel Computing
Volume: 21
Issue number: 1
ISSN (Print): 0167-8191
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
A Parallel Method for Linear Interval Equations

**General information**
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Toft, O. (Ekstern)
Pages: 81-105
Publication date: 1994
Main Research Area: Technical/natural sciences

**Publication information**
Journal: Interval Computations
Volume: 3
Original language: English

Links:
Source: orbit
Source-ID: 199496
Publication: Research - peer-review › Journal article – Annual report year: 1995
New Characterizations of Solutions to Overdetermined Systems of Linear Equations

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Nielsen, H. B. (Intern), Pinar, M. C. (Ekstern)
Pages: 159-166
Publication date: 1994
Main Research Area: Technical/natural sciences

Publication information
Journal: Operations Research Letters
Volume: 16
Issue number: 3
ISSN (Print): 0167-6377
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 0.841 SNIP 0.942 CiteScore 1.13
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 0.658 SNIP 0.744 CiteScore 0.72
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 0.959 SNIP 0.988 CiteScore 0.99
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 0.823 SNIP 1.167 CiteScore 1
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 0.856 SNIP 0.954 CiteScore 0.85
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.932 SNIP 1.073 CiteScore 0.96
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.183 SNIP 1.041
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 0.963 SNIP 1.231
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.286 SNIP 1.398
Scopus rating (2007): SJR 1.101 SNIP 1.191
Scopus rating (2006): SJR 1.037 SNIP 1.407
Scopus rating (2005): SJR 0.755 SNIP 1.184
Scopus rating (2004): SJR 0.753 SNIP 1.178
Scopus rating (2003): SJR 0.594 SNIP 0.745
Scopus rating (2002): SJR 0.765 SNIP 1.087
Scopus rating (2001): SJR 1.059 SNIP 1.083
Scopus rating (2000): SJR 1.029 SNIP 1.247
Scopus rating (1999): SJR 0.623 SNIP 0.796
Original language: English
Links:
Parallel Interval Methods for Perturbed Linear Systems

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Toft, O. (Ekstern)
Pages: 358-362
Publication date: 1994

Host publication information
Title of host publication: Lecture Notes in Scientific Computing: Parallel Scientific Computing
Main Research Area: Technical/natural sciences
Links:
http://www2.imm.dtu.dk/pubdb/p.php?1496
Source: orbit
Source-ID: 200648
Publication: Research - peer-review » Book chapter – Annual report year: 1994

Programming for Sparse Minimax Optimization
We present an algorithm for nonlinear minimax optimization which is well suited for large and sparse problems. The method is based on trust regions and sequential linear programming. On each iteration, a linear minimax problem is solved for a basic step. If necessary, this is followed by the determination of a minimum norm corrective step based on a first-order Taylor approximation. No Hessian information needs to be stored. Global convergence is proved. This new method has been extensively tested and compared with other methods, including two well known codes for nonlinear programming. The numerical tests indicate that in many cases the new method can find the solution in just as few iterations as methods based on approximate second-order information. The tests also show that for some problems the corrective steps give much faster convergence than for similar methods which do not employ such steps

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Jonasson, K. (Ekstern), Madsen, K. (Intern)
Pages: 372-388
Publication date: 1994
Main Research Area: Technical/natural sciences

Publication information
Journal: BIT
Volume: 34
Issue number: 3
Original language: English
Links:
http://www2.imm.dtu.dk/pubdb/p.php?695
Source: orbit
Source-ID: 199642
Publication: Research - peer-review » Journal article – Annual report year: 1994

The Huber concept in device modeling, circuit diagnosis and design centering
We present exciting applications of the Huber concept in circuit modeling and optimization. By combining the desirable properties of the l1 and l2 norms, the Huber function is robust against gross errors and smooth w.r.t. small variations in the data. We extend the Huber concept by introducing a one-sided Huber function tailored to design optimization with upper and lower specifications. We demonstrate the advantages of Huber optimization in the presence of faults, large and small measurement errors, bad starting points and statistical uncertainties. Circuit applications include parameter identification, design optimization, statistical modeling, analog fault location and yield optimization

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
A Finite Smoothing Algorithm for Linear L1 Estimation

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Nielsen, H. B. (Intern)
Pages: 223-235
Publication date: 1993
Main Research Area: Technical/natural sciences

Publication information
Journal: SIAM J. on Optimization
Volume: 3
ISSN (Print): 1052-6234
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.22 SJR 2.902 SNIP 2.237
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 3.388 SNIP 2.373 CiteScore 3.32
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.851 SNIP 2.513 CiteScore 2.98
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.267 SNIP 2.701 CiteScore 3.44
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.529 SNIP 2.773 CiteScore 3.05
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.339 SNIP 2.217 CiteScore 2.4
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.361 SNIP 2.324
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 3.011 SNIP 2.144
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.316 SNIP 2.178
Scopus rating (2007): SJR 2.759 SNIP 2.183
Scopus rating (2006): SJR 2.118 SNIP 2.312
Scopus rating (2005): SJR 3.127 SNIP 2.721
A Projected Conjugate Gradient Method for Sparse Minimax Problems.
A new method for nonlinear minimax problems is presented. The method is of the trust region type and based on sequential linear programming. It is a first order method that only uses first derivatives and does not approximate Hessians. The new method is well suited for large sparse problems as it only requires that software for sparse linear programming and a sparse symmetric positive definite equation solver are available. On each iteration a special linear/quadratic model of the function is minimized, but contrary to the usual practice in trust region methods the quadratic model is only defined on a one dimensional path from the current iterate to the boundary of the trust region. Conjugate gradients are used to define this path. One iteration involves one LP subproblem and requires three function evaluations and one gradient evaluation. Promising numerical results obtained with the method are presented. In fact, we find that the number of iterations required is comparable to that of state-of-the-art quasi-Newton codes.

Huber Optimization of Circuits: A Robust Approach
The authors introduce an approach to robust circuit optimization using Huber functions, both two-sided and one-sided. They compare Huber optimization with $l_1$, $l_2$, and minimax methods in the presence of faults, large and small measurement errors, bad starting points, and statistical uncertainties. They demonstrate FET statistical modeling, multiplexer optimization, analog fault location, and data fitting. They extend the Huber concept by introducing a one-sided Huber function for large-scale optimization. For large-scale problems, the designer often attempts, by intuition, a preliminary optimization by selecting a small number of dominant variables. It is demonstrated, through multiplexer optimization, that the one-sided Huber function can be more effective and efficient than minimax in overcoming a bad starting point.

General Information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Jonasson, K. (Ekstern)
Pages: 304-311
Publication date: 1993

Host publication Information
Title of host publication: Proc. Symp. on Applied Mathematical Programming and Modelling, |Budapest.
Main Research Area: Technical/natural sciences
sparse problems, minimax optimization
Source: orbit
Source-ID: 200216
Publication: Research - peer-review › Article in proceedings – Annual report year: 1993

General Information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Bandler, J. W. (Ekstern), Biernacki, R. (Ekstern), Chen, S. (Ekstern), Gao, L. (Ekstern), Madsen, K. (Intern)
Pages: 2279-2287
Publication date: 1993
Main Research Area: Technical/natural sciences

Publication information
Volume: MTT-41
Issue number: 12
Robustizing Circuit Optimization using Huber Functions.
The authors introduce a novel approach to 'robustizing' microwave circuit optimization using Huber functions, both two-sided and one-sided. They compare Huber optimization with $l_1$, $l_2$, and minimax methods in the presence of faults, large and small measurement errors, bad starting points, and statistical uncertainties. They demonstrate FET statistical modeling, multiplexer optimization, analog fault location, and data fitting. They extend the Huber concept by introducing a 'one-sided' Huber function for large-scale optimization. For large-scale problems, the designer often attempts, by intuition, a preliminary optimization by selecting a small number of dominant variables. It is demonstrated, through multiplexer optimization, that the one-sided Huber function can be more effective and efficient than minimax in overcoming a bad starting point.

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Bandler, J. W. (Ekstern), Biernacki, R. M. (Ekstern), Chen, S. H. (Ekstern), Gao, L. (Ekstern), Madsen, K. (Intern)
Pages: 1009-1012
Publication date: 1993

Host publication information
Title of host publication: IEEE MTT Trans. Microwave Symp. Digest
Main Research Area: Technical/natural sciences
Conference: IEEE MTT Trans. Microwave Symp. Digest, 01/01/1993
Publication: Research - peer-review › Article in proceedings – Annual report year: 1993

Use of a Real-Valued Local Minimum in Parallel Global Optimization

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Caprani, O. (Ekstern), Godthåb, B. (Ekstern), Madsen, K. (Intern)
Pages: 71-82
Publication date: 1993
Main Research Area: Technical/natural sciences

Publication information
Journal: Interval Computations
Volume: 2
Original language: English
Source: orbit
Source-ID: 199532
Publication: Research - peer-review › Journal article – Annual report year: 1993

A Continuation Method for Linear Estimation.

General information
State: Published
Organisations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Nielsen, H. B. (Intern), Dodge, Y. (ed.) (Ekstern)
Pages: 371-377
Publication date: 1992

Host publication information
Title of host publication: Statistical Analysis and Related Methods
Publisher: North-Holland
Main Research Area: Technical/natural sciences
Conference: 2nd Int. Conf. On Stat. Data Analysis based on the L1-norm and Related Methods, Neuchatel, 01/01/1992
Publication: Research - peer-review › Article in proceedings – Annual report year: 1992
Parallel Algorithms for Global Optimization.

General information
State: Published
Organizations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Henriksen, T. (Ekstern), Madsen, K. (Intern)
Pages: 88-95
Publication date: 1992
Main Research Area: Technical/natural sciences

Publication information
Journal: Interval Computations
Volume: 3
Issue number: 5
Original language: English
Links:
Source: orbit
Source-ID: 199627
Publication: Research - peer-review › Journal article – Annual report year: 1992

Robust Algorithms for Non-Linear Estimation.

General information
State: Published
Organizations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Madsen, K. (Intern), Ekblom, H. (Ekstern), Dodge, Y. (ed.) (Ekstern)
Pages: 327-335
Publication date: 1992

Host publication information
Title of host publication: Statistical Analysis and Related Methods
Publisher: North-Holland
Main Research Area: Technical/natural sciences
Conference: Statistical Analysis and Related Methods, 01/01/1992
non-linear estimation, robust estimation
Source: orbit
Source-ID: 200219
Publication: Research - peer-review › Article in proceedings – Annual report year: 1992

Optimization of Pipe Networks
The paper treats a piping system, where the layout of the network is given but the diameters of the pipes should be chosen among a small number of different values. The cost of realizing the system should be minimized while keeping the energy heads at the nodes above some lower limits. A new algorithm using successive linear programming is presented. The performance of the algorithm is illustrated by optimizing a network with 201 pipes and 172 nodes. It is concluded that the new algorithm seems to be very efficient and stable, and that it always finds a solution with a cost near the best possible

General information
State: Published
Organizations: Scientific Computing, Department of Informatics and Mathematical Modeling
Authors: Hansen, C. T. (Ekstern), Madsen, K. (Intern), Nielsen, H. B. (Intern)
Pages: 45-58
Publication date: 1991
Main Research Area: Technical/natural sciences

Publication information
Journal: Mathematical Programming
Volume: 52
Issue number: 1
ISSN (Print): 0025-5610
Ratings:
BFI (2018): BFI-level 2
Finite Algorithms for Robust Linear Regression

The Huber M-estimator for robust linear regression is analyzed. Newton type methods for solution of the problem are defined and analyzed, and finite convergence is proved. Numerical experiments with a large number of test problems demonstrate efficiency and indicate that this kind of approach may be useful also in solving the l/sub 1 / problem.
Algorithms for worst-case tolerance optimization

New algorithms are presented for the solution of optimum tolerance assignment problems. The problems considered are defined mathematically as a worst-case problem (WCP), a fixed tolerance problem (FTP), and a variable tolerance problem (VTP). The basic optimization problem without tolerances is denoted the zero tolerance problem (ZTP). For solution of the WCP we suggest application of interval arithmetic and also alternative methods. For solution of the FTP an algorithm is suggested which is conceptually similar to algorithms previously developed by the authors for the ZTP. Finally, the VTP is solved by a double-iterative algorithm in which the inner iteration is performed by the FTP-algorithm. The application of the algorithm is demonstrated by means of relatively simple numerical examples. Basic properties, such as convergence properties, are displayed based on the examples.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling
Authors: Schjær-Jacobsen, H. (Intern), Madsen, K. (Intern)
Pages: 775-783
Publication date: 1979
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Transactions on Circuits and Systems
Volume: 26
Issue number: 9
ISSN (Print): 0098-4094
Ratings:
BFI (2008): BFI-level 2
Original language: English
Electronic versions:
Schjaer.pdf
DOIs:
10.1109/TCS.1979.1084700

Bibliographical note
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Source: orbit
Source-ID: 267003
Publication: Research - peer-review › Journal article – Annual report year: 1979

Algorithms for worst case tolerance optimization

General information
State: Published
Organisations: Center for Bachelor of Engineering Studies
Authors: Madsen, K. (Intern), Schjær-Jacobsen, H. (Intern)
Publication date: 1978

Publication information
Original language: English
Main Research Area: Technical/natural sciences

Bibliographical note
Report NI-78-05
Linearly constrained minimax optimization

We present an algorithm for nonlinear minimax optimization subject to linear equality and inequality constraints which requires first order partial derivatives. The algorithm is based on successive linear approximations to the functions defining the problem. The resulting linear subproblems are solved in the minimax sense subject to the linear constraints. This ensures a feasible-point algorithm. Further, we introduce local bounds on the solutions of the linear subproblems, the bounds being adjusted automatically, depending on the quality of the linear approximations. It is proved that the algorithm will always converge to the set of stationary points of the problem, a stationary point being defined in terms of the generalized gradients of the minimax objective function. It is further proved that, under mild regularity conditions, the algorithm is identical to a quadratically convergent Newton iteration in its final stages. We demonstrate the performance of the algorithm by solving a number of numerical examples with up to 50 variables, 163 functions, and 25 constraints. We have also implemented a version of the algorithm which is particularly suited for the solution of restricted approximation problems.
Minimax optimization subject to linear constraints

General information
State: Published
Organisations: Center for Bachelor of Engineering Studies
Authors: Madsen, K. (Intern), Schjær-Jacobsen, H. (Intern)
Pages: T489-T491
Publication date: 1978
Main Research Area: Technical/natural sciences

Publication information
Journal: Zeitschrift fuer Angewandte Mathematik und Mechanik
Volume: 58
Issue number: 7
ISSN (Print): 0044-2267
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 1.23 SJR 0.558 SNIP 0.911
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.586 SNIP 1.147 CiteScore 1.06
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.597 SNIP 1.167 CiteScore 1.01
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.618 SNIP 1.158 CiteScore 1
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
New algorithms for worst case tolerance optimization

General information
State: Published
Organisations: Center for Bachelor of Engineering Studies
Authors: Madsen, K. (Intern), Schjær-Jacobsen, H. (Intern)
Pages: 681-685
Publication date: 1978

Host publication information
Title of host publication: Proceedings of the 1978 IEEE International Symposium on Circuits and Systems
Main Research Area: Technical/natural sciences
Publication: Research - peer-review › Article in proceedings – Annual report year: 1978

Constrained minimax optimization

General information
State: Published
Organisations: Center for Bachelor of Engineering Studies
Authors: Madsen, K. (Intern), Schjær-Jacobsen, H. (Intern)
Publication date: 1977

Publication information
Original language: English
Main Research Area: Technical/natural sciences

Bibliographical note
Report NI-77-03
Publication: Research - peer-review › Report – Annual report year: 1977
FORTRAN subroutines for nonlinear optimization subject to linear constraints

General information
State: Published
Organisations: Center for Bachelor of Engineering Studies
Authors: Madsen, K. (Intern), Schjær-Jacobsen, H. (Intern)
Publication date: 1977

Publication information
Original language: English
Main Research Area: Technical/natural sciences

Bibliographical note
Report NI-77-07
Publication: Research - peer-review › Report – Annual report year: 1977

Linearly constrained minimax optimization of circuits and systems

General information
State: Published
Organisations: Center for Bachelor of Engineering Studies
Authors: Madsen, K. (Intern), Schjær-Jacobsen, H. (Intern)
Pages: 47-52
Publication date: 1977

Host publication information
Title of host publication: Proceedings of the IEEE Conference on Computer Aided-Design of Electronic and Microwave Circuits and Systems
Main Research Area: Technical/natural sciences
Publication: Research - peer-review › Article in proceedings – Annual report year: 1977

FORTRAN subroutines for minimax solution of non-linear bounds on the variables

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Center for Bachelor of Engineering Studies
Authors: Madsen, K. (Intern), Schjær-Jacobsen, H. (Intern)
Publication date: 1976

Publication information
Original language: English
Main Research Area: Technical/natural sciences

Bibliographical note
Report NI-76-16
Publication: Research - peer-review › Report – Annual report year: 1976

Gradient and non-gradient algorithms for minimax optimization with parameter bounds

General information
State: Published
Organisations: Center for Bachelor of Engineering Studies
Authors: Madsen, K. (Intern), Schjær-Jacobsen, H. (Intern)
Publication date: 1976

Publication information
Original language: English
Main Research Area: Technical/natural sciences

Bibliographical note
Report NI-76-17
Linearly constrained minimax optimization of circuits and systems

General information
State: Published
Organisations: Center for Bachelor of Engineering Studies
Authors: Schjær-Jacobsen, H. (Intern), Madsen, K. (Intern)
Publication date: 1976

Publication information
Original language: English
Main Research Area: Technical/natural sciences

Bibliographical note
Report NI-76-19
Publication date: 1976
Main Research Area: Technical/natural sciences

Singularities in minimax optimization of networks
A theoretical treatment of singularities in nonlinear minimax optimization problems, which allows for a classification in regular and singular problems, is presented. A theorem for determining a singularity that is present in a given problem is formulated. A group of problems often used in the literature to test nonlinear minimax algorithms, i.e., minimax design of multisection quarter-wave transformers, is shown to exhibit singularities and the reason for this is pointed out. Based on the theoretical results presented an algorithm for nonlinear minimax optimization is developed. The new algorithm maintains the quadratic convergence property of a recent algorithm by Madsen et al. when applied to regular problems and it is demonstrated to significantly improve the final convergence on singular problems.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Center for Bachelor of Engineering Studies
Authors: Madsen, K. (Intern), Schjær-Jacobsen, H. (Intern)
Pages: 456-460
Publication date: 1976
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Transactions on Circuits and Systems
Volume: 23
Issue number: 7
ISSN (Print): 0098-4094
Ratings:
BFI (2008): BFI-level 2
Original language: English
Electronic versions:
Jacob.pdf
DOIs:
10.1109/TCS.1976.1084240

Bibliographical note
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Source: orbit
Source-ID: 266759
Publication: Research - peer-review › Journal article – Annual report year: 1976

Singularities in minimax optimization of networks

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Center for Bachelor of Engineering Studies
Authors: Madsen, K. (Intern), Schjær-Jacobsen, H. (Intern)
Pages: 94-97
Publication date: 1976
Synthesis of nonuniformly spaced arrays using a general nonlinear minimax optimisation method

Antenna patterns can be synthesized using a new nonlinear minimax optimization method with sure convergence properties. Not requiring derivatives, the proposed method is general and easy to use so that it might be applied to a wide variety of nonlinear synthesis problems for which analytical solutions are not known. To test the algorithm a group of test problems for which exact analytical solutions are known has been considered, namely, optimization of Dolph-Chebyshev arrays by spacing variation. The method is further applied to find the element positions in nonuniformly spaced linear arrays with uniform excitation that produce minimized (equal) sidelobe levels, and comparisons are made with conventional Dolph-Chebyshev arrays.
Automated minimax design of networks

A new gradient algorithm for the solution of nonlinear minimax problems has been developed. The algorithm is well suited for automated minimax design of networks and it is very simple to use. It compares favorably with recent minimax and leastpth algorithms. General convergence problems related to minimax design of networks are discussed. Finally, minimax design of equalization networks for reflectiontype microwave amplifiers is carried out by means of the proposed algorithm.

General information
State:Published
Organisations:Department of Informatics and Mathematical Modeling, Center for Bachelor of Engineering Studies, Technical University of Denmark
Authors:Madsen, K. (Intern), Schjær-Jacobsen, H. (Intern), Voldby, J. (Ekstern)
Pages:791-796
Publication date:1975
Main Research Area:Technical/natural sciences

Publication information
Journal:IEEE Transactions on Circuits and Systems
Volume:22
Issue number:10
ISSN (Print):0018-9286
Ratings:
BFI (2008): BFI-level 2
Original language:English
Electronic versions:
Voldby.pdf

Bibliographical note
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Source:orbit
Source-ID:266758
Publication:Research - peer-review › Journal article – Annual report year: 1976
Efficient Minimax Design of Networks without Using Derivatives

A new minimax network optimization algorithm not requiring derivatives has been developed. It is based on successive
linear approximations to the nonlinear functions defining the problem. Adequate modeling of distributed parameter
circuits for optimization purposes often involves parasitic, etc., which makes the gradient computation by the adjoint network
method or related methods rather complicated, and often numerical errors are introduced in the gradients. Consequently,
the algorithm is found to be of particular relevance in optimum design of practical microwave networks. The relative
advantages of the proposed algorithm are established by comparison with known gradient and nongradient algorithms
based on optimization of cascaded transmission-line transformers. The relevance to microwave filter design is
demonstrated by an example which represents an improvement of analytical filter design results. Finally, optimum broad-
band design of a practical coaxial transferred-electron reflection-type amplifier is carried out by means of the proposed
method. The results are supported by experimental verification.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Department of Electromagnetic Systems, Center
for Bachelor of Engineering Studies, Department of Photonics Engineering
Authors: Madsen, K. (Intern), Nielsen, N. O. (Ekstern), Schjær-Jacobsen, H. (Intern), Thrane, L. (Ekstern)
Pages: 803-809
Publication date: 1975
Main Research Area: Technical/natural sciences

Publication information
Journal: IEEE Transactions on Microwave Theory and Techniques
Volume: 23
Issue number: 10
ISSN (Print): 0018-9480
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
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2016): CiteScore 3.39 SJR 1.175 SNIP 1.914
Web of Science (2016): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2015): SJR 1.159 SNIP 2.077 CiteScore 3.48
Web of Science (2015): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2014): SJR 1.56 SNIP 2.417 CiteScore 3.37
BFI (2012): BFI-level 2
Scopus rating (2013): SJR 1.705 SNIP 2.589 CiteScore 3.64
ISI indexed (2013): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2012): SJR 1.371 SNIP 2.043 CiteScore 2.89
ISI indexed (2012): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2011): SJR 1.223 SNIP 1.764 CiteScore 2.68
ISI indexed (2011): ISI indexed yes
BFI (2009): BFI-level 2
Scopus rating (2010): SJR 1.16 SNIP 1.774
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.687 SNIP 2.478
Web of Science (2009): Indexed yes
BFJ (2008): BFI-level 2
Scopus rating (2008): SJR 1.815 SNIP 2.243
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.584 SNIP 2.888
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 2.435 SNIP 2.826
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.286 SNIP 3.098
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.304 SNIP 2.586
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 2.401 SNIP 2.521
Scopus rating (2002): SJR 2.396 SNIP 2.307
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 2.106 SNIP 2.152
Scopus rating (2000): SJR 1.684 SNIP 1.648
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 1.681 SNIP 2.305
Original language: English
Electronic versions:
Madsen.pdf
DOIs:
10.1109/TMTT.1975.1128686

Bibliographical note
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Source: orbit
Source-ID: 266524
Publication: Research - peer-review › Journal article – Annual report year: 1975

FORTRAN subroutines for non-linear minimax optimization

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Center for Bachelor of Engineering Studies
Authors: Madsen, K. (Intern), Schjær-Jacobsen, H. (Intern)
Publication date: 1975

Publication information
Original language: English
Main Research Area: Technical/natural sciences

Bibliographical note
Publication: Research - peer-review › Report – Annual report year: 1975

Projects:

Ikke-differentiabel optimering i heltalsprogrammering
Department of Transport
Period: 01/08/2000 → 22/05/2006
Number of participants: 7
Phd Student:
Kallehauge, Brian (Intern)
Supervisor:
Larsen, Jesper (Intern)
Madsen, Kaj (Intern)
Main Supervisor:
Madsen, Oli B.G. (Intern)
Examiner:
Nielsen, Otto Anker (Intern)
Lübbecke, Marco (Ekstern)
Pisinger, David (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Ikke-lineær optimering ved anvendelse af surrogatmodeller
Department of Informatics and Mathematical Modeling
Period: 01/02/2000 → 20/05/2003
Number of participants: 7
Phd Student:
Søndergaard, Jacob (Intern)
Supervisor:
Frandsen, Poul Erik (Ekstern)
Nielsen, Hans Bruun (Intern)
Main Supervisor:
Madsen, Kaj (Intern)
Examiner:
Hansen, Per Christian (Intern)
Ravn, Hans V. (Intern)
Vicente, Luís Nunes (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

Signal and Image Processing for Telemedicine (SITE).
Project No. 3135. The rapid development in sensor technology, signal processing methods and parallel computing technology has enabled the physical realization of complex mathematical models in a diversity of scientific and industrial areas. This beginning interdisciplinary convergence of methodologies in science and technology has already had an impact on several industries and is emerging in medical imaging and more generally in telemedicine. It seems very likely that bringing together specialists from the mentioned areas could further boost the development of medical information processing in Denmark. Such considerations also head to incorporating the disciplines signal processing, scientific computing, and image analysis in the Department of Mathematical Modelling (IMM) together with applied mathematical physics, numerical analysis, operations research, and statistics. Furthermore, there has been established a close cooperation between scientist from DTU and several departments from different hospitals and university clinics.

Department of Informatics and Mathematical Modeling
Period: 01/07/1999 → 30/06/2003
Number of participants: 9
Project participant:
Madsen, Kaj (Intern)
Hansen, Per Christian (Intern)
Ersbøll, Bjarne Kjær (Intern)
Carstensen, Jens Michael (Intern)
Larsen, Jan (Intern)
Sørensen, John Aasted (Intern)
Sigurdsson, Sigurdur (Intern)
Project Manager, organisational:
Conradsen, Knut (Intern)
**Storskala inversionsalgoritmer**

Department of Informatics and Mathematical Modeling  
Period: 01/12/1998 → 20/01/2003  
Number of participants: 8  
Phd Student:  
Berglund, Eva Ann-Charlotte (Intern)  
Supervisor:  
Bendtsen, Claus (Intern)  
Jacobsen, Bo Holm (Ekstern)  
Madsen, Kaj (Intern)  
Main Supervisor:  
Hansen, Per Christian (Intern)  
Examiner:  
Nielsen, Hans Bruun (Intern)  
Mosegaard, Klaus (Intern)  
Rojas Larrazabal, Marielba de la Caridad (Intern)  

**Financing sources**  
Source: Internal funding (public)  
Name of research programme: Samarbejdsaftalefinans  
Project: PhD

**Guest List at IMM - 1997.**  

Department of Informatics and Mathematical Modeling  
Period: 01/01/1997 → 31/12/1997  
Number of participants: 1  
Project Manager, organisational:  
Madsen, Kaj (Intern)

**Guest list of IMM - 1996.**  

Department of Informatics and Mathematical Modeling  
Period: 01/01/1996 → 31/12/1996  
Number of participants: 1  
Project Manager, organisational:
**Linear and Quadratic Programming**

A new type of method has been developed for positive definite problems. It is based on solving a dual problem which is an unconstrained minimization of a piecewise quadratic function. Finite convergence has been proved and an efficient implementation has been made.

Department of Informatics and Mathematical Modeling

Period: 01/01/1996 → …

Number of participants: 5

Project participant:

Madsen, Kaj (Intern)
Pinar, Mustafa (Ekstern)
Chen, Bintong (Ekstern)
Edlund, Ove (Ekstern)

Project Manager, organisational:

Nielsen, Hans Bruun (Intern)

**Financing sources**

Source: Unknown

Name of research programme: Ukendt

Amount: 288,000.00 Danish Kroner

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**EPOS: Efficient Parallel algorithms for Optimization and Simulation**

The goal is to develop efficient and reliable parallel algorithms that can utilize supercomputers for solving large-scale optimization and simulation problems.

Department of Informatics and Mathematical Modeling

Fluid Mechanics

Department of Mechanical Engineering

UNI-C

Period: 03/02/1995 → …

Number of participants: 10

Project participant:

Clausen, Jens (Intern)
Barker, Vincent A. (Intern)
Hansen, Per Christian (Intern)
Madsen, Oli B.G. (Intern)
Nielsen, Hans Bruun (Intern)
Thomsen, Per Grove (Intern)
Sørensen, Jens Nørkær (Intern)
Wasniewski, Jerzy (Ekstern)

Other:

Caprani, Ole (Ekstern)

Project Manager, organisational:

Madsen, Kaj (Intern)

**Financing sources**

Source: Unknown

Name of research programme: Ukendt

Amount: 5,758,000.00 Danish Kroner

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**Surrogate Modelling for Engineering Optimization**

Design optimization of computationally expensive engineering devices and systems through fast, inexpensive surrogate models. Based on corresponding response evaluations a mapping between the expensive system and the inexpensive model is approximated and used in the optimization of the expensive system.
Selv-validerende computerbaserede beregningsmetoder for funktionalanalysen (med særlig henblik på anvendelsemulighederne)

Department of Informatics and Mathematical Modeling
Number of participants: 5
Phd Student:
Stauning, Ole (Intern)
Supervisor:
Knudsen, Carsten (Intern)
Skelboe, Stig (Ekstern)
Main Supervisor:
Madsen, Kaj (Intern)
Examiner:
Skelboe, Stig (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-Su Stipendium, Eksperiment
Project: PhD

Error Bounds for Differential Equations
Methods for the solution of integral equations and ordinary differential equations, with automatic determination of error bounds which are guaranteed to enclose the exact solution. Interval analysis is used. The methods are applied to prove the existence of periodic solutions to certain differential equations occurring in dynamic systems theory.

Department of Informatics and Mathematical Modeling
Period: 01/08/1994 → 31/12/1997
Number of participants: 2
Project participant:
Stauning, Ole (Intern)
Project Manager, organisational:
Madsen, Kaj (Intern)

Space mapping for engineering optimization
The space mapping technique is intended for optimization of engineering models which involve very expensive function evaluations. It is assumed that two different models of the same physical system are available: Besides the expensive model of primary interest (denoted the fine model), access to a cheaper (coarse) model is assumed which may be less accurate. The main idea of the space mapping technique is to use the coarse model to gain information about the fine model, and to apply this in the search for an optimal solution of the latter. Thus the technique iteratively establishes a mapping between the parameters of the two models which relate similar model responses. Having this mapping, most of the model evaluations can be directed to the fast coarse model. In many cases this technique quickly provides an approximate optimal solution to the fine model that is sufficiently accurate for engineering purposes. Thus the space mapping technique may be considered a preprocessing technique that perhaps must be succeeded by use of classical optimization techniques.

Department of Informatics and Mathematical Modeling
Department of Civil Engineering
McMaster University
Global optimization
A new method for global optimization is being developed. It is based on the same principles as the well established interval branch-and-bound method but without so severe limitations on the objective function. It only needs to be a smooth function (i.e. twice differentiable), calculated by a "black box" procedure. Stochastic methods, like simulated annealing and genetic algorithms also are used as sources of inspiration. Parallel processing is applied.

Department of Informatics and Mathematical Modeling
Period: 01/08/1990 → …
Number of participants: 5
Project participant:
Stauning, Ole (Intern)
Zerchaninov, Serguei (Ekstern)
Zilinskas, Antanas (Ekstern)
Zilinskas, Julius (Ekstern)
Project Manager, organisational:
Madsen, Kaj (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 0.00 Danish Kroner

Applications of parameter estimation
Software for robust modelling of electromagnetic circuits is developed in collaboration with "Optimization Systems Associates", Canada.

Department of Informatics and Mathematical Modeling
TICRA
Period: 01/08/1979 → …
Number of participants: 4
Project participant:
Frandsen, Poul Erik (Ekstern)
Other:
Biernacki, Radek (Ekstern)
Bandler, John W. (Ekstern)
Project Manager, organisational:
Madsen, Kaj (Intern)