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# SYSTEM MODELING AND OPTIMIZATION

## **IFIP – The International Federation for Information Processing**

IFIP was founded in 1960 under the auspices of UNESCO, following the First World Computer Congress held in Paris the previous year. An umbrella organization for societies working in information processing, IFIP's aim is two-fold: to support information processing within its member countries and to encourage technology transfer to developing nations. As its mission statement clearly states,

*IFIP's mission is to be the leading, truly international, apolitical organization which encourages and assists in the development, exploitation and application of information technology for the benefit of all people.*

IFIP is a non-profitmaking organization, run almost solely by 2500 volunteers. It operates through a number of technical committees, which organize events and publications. IFIP's events range from an international congress to local seminars, but the most important are:

- The IFIP World Computer Congress, held every second year;
- Open conferences;
- Working conferences.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is small and by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is less rigorous and papers are subjected to extensive group discussion.

Publications arising from IFIP events vary. The papers presented at the IFIP World Computer Congress and at open conferences are published as conference proceedings, while the results of the working conferences are often published as collections of selected and edited papers.

Any national society whose primary activity is in information may apply to become a full member of IFIP, although full membership is restricted to one society per country. Full members are entitled to vote at the annual General Assembly, National societies preferring a less committed involvement may apply for associate or corresponding membership. Associate members enjoy the same benefits as full members, but without voting rights. Corresponding members are not represented in IFIP bodies. Affiliated membership is open to non-national societies, and individual and honorary membership schemes are also offered.

# SYSTEM MODELING AND OPTIMIZATION

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# Contents

Foreword	ix
Organizing Institutions	xi
Contributing Authors	xiii
<b>Toward a Mathematical Theory of Aeroelasticity</b>	<b>1</b>
<i>A.V. Balakrishnan</i>	
1 The Wing Model	3
2 The Aerodynamic Model	4
3 Time-Domain Formulation of Control Problem	14
<b>Uniform Cusp Property, Boundary Integral, and Compactness for Shape Optimization</b>	<b>25</b>
<i>Michel C. Delfour, Nicolas Doyon, Jean-Paul Zolésio</i>	
1 Preliminaries: Topologies on Families of Sets	26
2 Extension of the Uniform Cusp Property	27
3 Extended Uniform Cusp Property and Boundary Integral	30
4 Compactness under the Uniform Cusp Property and a Bound on the Perimeter	37
<b>Interior and Boundary Stabilization of Navier-Stokes Equations</b>	<b>41</b>
<i>Roberto Triggiani</i>	
1 Introduction	42
2 The Main Results	45
3 Introduction	48
4 Main Results (Case $d = 3$ )	54
<b>Matrix Rounding with Application to Digital Halftoning</b>	<b>59</b>
<i>Naoki Katoh</i>	
1 Introduction	59
2 Mathematical Programming Formulations	63
3 Geometric Families of Regions Defining Unimodular Hypergraphs	66
4 Algorithms for Computing the Optimal Rounding	67
5 Upper Bounds for the $L_p$ -Discrepancy	68
6 Application to Digital Halftoning	68
7 Global Roundings	69
8 Concluding Remarks	71

<b>Nonlinear Programming: Algorithms, Software, and Applications</b>	<b>73</b>
<i>Klaus Schittkowski, Christian Zillober</i>	
1 Sequential Quadratic Versus Sequential Convex Programming Methods	76
2 Very Large Scale Optimization by Sequential Convex Programming	84
3 Case Study: Horn Radiators for Satellite Communication	88
4 Case Study: Design of Surface Acoustic Wave Filters	93
5 Case Study: Optimal Control of an Acetylene Reactor	97
6 Case Study: Weight Reduction of a Cruise Ship	102
<b>Stochastic Modeling and Optimization of Complex Infrastructure Systems</b>	<b>109</b>
<i>P. Thoft-Christensen</i>	
1 Formulation of the Cost Optimization Problem	110
2 Bridge Networks	111
3 Estimation of Service Life of Infrastructures	112
4 Stochastic Modeling of Maintenance Strategies	114
5 Design of Long Bridges	115
6 Conclusions	120
<b>Feedback Robust Control for a Parabolic Variational Inequality</b>	<b>123</b>
<i>Vyacheslav Maksimov</i>	
1 Introduction	123
2 Statement of the Problem	124
3 The Algorithm for Solving Problem 1	127
4 The Algorithm for Solving Problem 2	131
<b>Tracking Control of Parabolic Systems</b>	<b>135</b>
<i>Luciano Pandolfi, Enrico Priola</i>	
1 Introduction and Preliminaries	135
2 The Tracking Problem	137
<b>Modeling of Topology Variations in Elasticity</b>	<b>147</b>
<i>Serguei A. Nazarov, Jan Sokolowski</i>	
1 Problem Formulation	148
2 Modeling of Singularly Perturbed Boundary Value Problem	150
3 Modeling with Self Adjoint Extensions	151
4 Modeling in Spaces with Separated Asymptotics	152
5 How to Determine the Model Parameters	153
6 Spectral Problems	156
<b>Factorization by Invariant Embedding of Elliptic Problems in a Circular Domain</b>	<b>159</b>
<i>J. Henry, B. Louro, M.C. Soares</i>	
1 Motivation	160
2 Formulation of the Problem and a Regularization Result	161
3 Factorization by Invariant Embedding	162

4	Sketch of the Proof of Theorem 2	164
5	Factorization by Invariant Embedding: Dual Case	166
6	Sketch of the Proof of Theorem 7	168
7	Final Remarks	170
<b>On Identifiability of Linear Infinite-Dimensional Systems</b>		<b>171</b>
<i>Yury Orlov</i>		
1	Basic Definitions	172
2	Identifiability Analysis	174
<b>An Inverse Problem For the Telegraph Equation</b>		<b>177</b>
<i>A.B. Kurzhanski, M.M. Sorokina</i>		
1	The Telegraph Equation and the Estimation Problem	178
2	Some Properties of the Telegraph Equation	180
3	Observability	181
4	The Filtering Equations	184
5	The Duality of Optimal Control and Observation problems	187
<b>Solvability and Numerical Solution of Variational Data Assimilation Problems</b>		<b>191</b>
<i>Victor Shutyaev</i>		
1	Statement of Data Assimilation Problem	191
2	Linear Data Assimilation Problem	193
3	Solvability of Nonlinear Problem	196
4	Iterative Algorithms	198
<b>Existence of Solutions to Evolution Second Order Hemivariational Inequalities with Multivalued Damping</b>		<b>203</b>
<i>Zdzisław Denkowski, Stanisław Migórski</i>		
1	Motivation	205
2	Preliminaries	207
3	Existence Theorem	210
<b>Probabilistic Investigation on Dynamic Response of Deck Slabs of Highway Bridges</b>		<b>217</b>
<i>Chul-Woo Kim, Mitsuo Kawatani</i>		
1	Governing Equations of Bridge-Vehicle Interaction System	218
2	Model Description	221
3	Simulation of Impact Factor	224
4	Concluding Remarks	227
<b>Optimal Maintenance for Bridge Considering Earthquake Effects</b>		<b>229</b>
<i>Hitoshi Furuta, Kazuhiro Koyama</i>		
1	Earthquake Occurrence Probability in Service Time	230
2	Analysis of Required Yield Strength Spectrum	231
3	Reliability Analysis of Steel Bridge Pier	233
4	Life-Cycle Cost Considering Earthquake Effects	236
5	Conclusion	237

**Uniform Decay Rates of Solutions to a Nonlinear Wave Equation with Boundary Condition of Memory Type 239**

*Marcelo M. Cavalcanti, Valéria N. Domingos Cavalcanti, Mauro L. Santos*

1	Notations and Main Results	243
2	Exponential Decay	246
3	Polynomial Rate of Decay	251

**Bayesian Deconvolution of Functions in RKHS using MCMC Techniques 257**

*Gianluigi Pillonetto, Bradley M. Bell*

1	Introduction	257
2	Preliminaries	258
3	Statement of the Estimation Problem	261
4	MCMC Deconvolution Algorithms in RKHS	263
5	Numerical Experiments	265
6	Conclusions	266
	Appendix: Proof of Theorem 6	267

**Modeling Stochastic Hybrid Systems 269**

*Mrinal K. Ghosh, Arunabha Bagchi*

1	Stochastic Hybrid Model I	271
2	Stochastic Hybrid Model II	275
3	Conclusion	279

**Mathematical Models and State Observation of the Glucose-Insulin Homeostasis 281**

*A. De Gaetano, D. Di Martino, A. Germani, C. Manes*

1	Asymptotic State Observers	283
2	The Minimal Model	285
3	The Fisher Model	288
4	Glucose Feedback Model	291
5	Conclusions and Future Developments	293

**Convergence Estimates of POD-Galerkin Methods for Parabolic Problems 295**

*Thibault Henri, Jean-Pierre Yvon*

1	Principle of Proper Orthogonal Decomposition (POD)	296
2	Problem Formulation	298
3	Estimates of the Error of POD-Approximation in a Regular Case	299
4	Choosing the Order of Approximation	303
5	Conclusion	305

# Foreword

This volume comprises selected papers from the 21st Conference on System Modeling and Optimization that took place from July 21st to July 25th, 2003, in Sophia Antipolis, France. This event is part of a series of conferences that meet every other year and bring together the seventh Technical Committee of the International Federation for Information Processing (IFIP). It has been co-organized by three institutions: Institut National de Recherche en Informatique et Automatique (INRIA), Pôle Universitaire Léonard de Vinci and Ecole des Mines de Paris. It was chaired by Jean-Paul Zolésio and co-chaired by John Cagnol.

IFIP is a multinational federation of professional and technical organizations concerned with information processing. The Federation is organized into the IFIP Council, the Executive Board, and the Technical Assembly. The Technical Assembly is divided into eleven Technical Committees of which TC 7 is one. The TC 7 on system modeling and optimization aims to provide an international clearing house for computational, as well as related theoretical, aspects of optimization problems in diverse areas and to share computing experience gained on specific applications. It also aims to promote the development of important high-level theory to meet the needs of complex optimization problems and establish appropriate cooperation with the International Mathematics Union and similar organizations. In addition, IFIP fosters interdisciplinary activity on optimization problems spanning the various areas such as Economics, including Business Administration and Management, Biomedicine, Meteorology, etc. in cooperation with associated international bodies. The technical committee is composed of seven working groups and is chaired by Irena Lasiecka. It was founded by A.V. Balakrishnan, J.L. Lions and M. Marchuk.

System modeling and optimization are two disciplines arising from many spheres of scientific activities. Their fields include, but are not limited to: bioscience, environmental science, optimal design, transport and telecommunications, control in electromagnetics, image analysis,

multi-physics systems that are coupled by moving interfaces, free boundary problems, non cylindrical evolution control, etc... The emergence of smart materials allows the existence of new actuators and new configurations, and thus we are required to revisit many classical settings. For example, the dynamical systems involved are often non autonomous. The uncertainty in the modeling and the robustness (or the lack thereof) results in stochastic modeling. In addition, intrinsic geometry is increasing in control theory since the boundaries are moving and minimal regularity is sought. The coupling of fluid and structural mechanics leads to the superposition of Eulerian and Lagrangian representations. The coupling of several physical models such as fluid (wind, blood, solar flux,...), structures (elastic shell, elasto-plastic crash, airfoils, arteries,...), electromagnetism (antennas, dynamical frequency assignments, nerves and heart control), thermal effects (rheology, boundary conditions, damping,...), acoustics (supersonic plane, sound control, helicopter cabin noise reduction...), and chemical effects (climate, pollution, ionisation,...) lead to hierarchical modeling associated with multiscale control theory and computation. Optimization and optimal control of such systems include inverse problems and topological identification analysis for applications to non destructive control such as cracks and surface identifications. Many of these problems lead to non linear, non quadratic control problems.

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The editors would also like to thank Michel Cosnard, head of INRIA-Sophia Antipolis who made possible the organization of the conference and Yves Laboureur head of the Sophia-Antipolis branch of the Ecole des Mines for hosting the conference.

Finally, the chair and co-chair would like to thank their wives Monique and Bethany for their support and help during the organization of the conference.

John Cagnol and Jean-Paul Zolésio

# Organizing Institutions

INRIA, the National Institute for Research in Computer Science and Control, was created in 1967 at Rocquencourt near Paris. INRIA is a public scientific and technological establishment under the joint supervision of the Research Ministry and the Ministry of Economy, Treasury and Industry. INRIA's mission is to be a world player, a research institute at the heart of the information society. INRIA aims to network skills and talents from the fields of information and computer science and technology from the entire French research system. This network allows scientific excellence to be used for technological progress, for creating employment, and prosperity and for finding renewed applications in response to socio-economic needs. Its decentralized organization (six research units), small autonomous teams, and regular evaluation enable INRIA to develop partnerships with 95 research projects shared with universities, Grandes Ecoles and research organizations.

Pôle Universitaire Léonard de Vinci is a private university founded in 1995, and located in Paris La Défense, France. It includes an accredited engineering school with several departments: Scientific Computation, Computer Science, Financial Engineering and Computational Mechanics. These programs have received very positive feedback from the industry.

The Ecole des Mines de Paris was founded in 1783 by Louis XVI. It was originally a mining school. The exploitation and processing of raw materials formed the basis of the development of Europe's economy. The art of mining in particular was one area in which scientific thinking had to be applied. Naturally, the focus of the School closely followed industrial development and the Ecole des Mines now studies, develops and teaches a wide range of sciences and techniques of value to engineers, including economic and social sciences. Today the Ecole des Mines de Paris is split into four locations: Paris, Fontainebleau, Evry and Sophia Antipolis.

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