

Preface

This book is the proceedings of the conference “Forum Math-for-Industry 2014,” for which the unifying theme was “Applications + Practical Conceptualization + Mathematics = fruitful Innovation.” This epigram encapsulates the dynamics of the process that takes an application through to an innovation. Industrial mathematics can be viewed as the causal engine that implements the epigram by taking an Application such as input and convolving it with a mixture of Practical Conceptualization and Mathematics to generate a fruitful Innovation as output.

In industrial mathematics, the questions spawned by real-world applications are what drive the resulting two-way interaction between a particular application and the associated mathematics that is utilized and developed, and that sometimes involves, quite unexpectedly, deeper aspects and new areas of mathematics than initially anticipated.

The plan for the talks at the forum was to illustrate various aspects of this two-way interaction between applications and the associated highlighting of how the practical conceptualization assists with the linking of the question that encapsulates the current application to the relevant mathematics. The organizers believe the plan was quite successful. Readers will find in this proceedings that the forum can actually be viewed as a way for unifying the two-way interaction between applications and mathematics.

In a mathematics-for-industry situation, although the application context and the desired innovation are notionally relatively clear, it takes time to identify the questions to be resolved. It is at this stage that conceptualization plays a key role through the generation of a plethora of possibilities of how to link various questions to the mathematics that will generate reliable and useful answers. In a way, one is reminded of this quotation from Edward David: “The importance of mathematics is not self-evident.”

It acknowledges the fact that the role of mathematics plays in solving real-world problems is often taken for granted. Circumspectly, using mathematics to solve real-world problems is similar to a sculptor working with mechanical devices to

chisel out one of the possible forms hidden in the block of wood or stone being carved. The one chosen is the result of the current subconscious conceptualization of the artist. That sculpturing could be viewed from this perspective can be found in Soseki Natsume's series of short stories "Ten Nights of Dreams" (*Yume-Juya*) in the Meiji Period (1868–1912). On the sixth night, the dreamer subconsciously visualizes Unkei, the famous Japanese twelfth-century sculptor (1150–1223), in the act of carving the two forbidding guardians of the Buddha Nio guarding the main gate of the Gokoku-ji Temple. Unkei is so absorbed in the carving, he is unaware of the noisy crowd gathered around him. The dreamer then visualizes that some onlookers theorize that the sculpture of the guardians is already hidden in the wood which Unkei is discovering rather than creating. The dreamer then concludes that he should also be able to find Nio in the wood and heads home to attempt it. Unfortunately, he is not able to find one. The dreamer thereby concludes that Nio is no longer in the wood of the Meiji Period.

The first Japanese Field Medallist Kunihiro Kodaira, in 1954, echoed this analogy in his remark that his theory of elliptic surfaces was not invented by him but was just sculptured, using paper and pencil, from the wood of mathematics where it was waiting to be discovered. The corresponding analogy for industrial mathematics, independent of the dynamics outside the context of the application being examined, is: "Answers to the questions that arise in an application are sculptured into reality using the tools of mathematics, which are thereby developed and sharpened by this process."

We would like to thank the participants of the forum, especially the members of the Scientific Board of the Forum. Without their cooperation and support, we would never have experienced the great excitement and success of the forum. Moreover, we would like to express our deep appreciation for the great help of the conference secretaries, especially Tsubura Imabayashi during the preparation and organization of the forum, and Chiemi Furutani for the proceedings.

Fukuoka, Japan
April 2015

Masato Wakayama
On behalf of the Organizing Committee
of the Forum Math-for-Industry 2014
and the Editorial Committee of the Proceedings

						
FMI2009	FMI2009	FMI2010	FMI2011	FMI2012	FMI2013	FMI2014
Tokyo	Fukuoka	Fukuoka	Honolulu	Fukuoka	Fukuoka	Fukuoka
Sep. 19-17	Nov. 9-13	Oct. 21-23	Oct. 24-28	Oct. 22-26	Nov. 4-8	Dec.27-31
The 1st Forum:Consortiu m Math For Industry	Casimir Force, Casimir Operators and the Riemann Hypothesis	Information Security, Visualization, and Inverse Problems, on the basis of Optimization Techniques	TSUNAMI - Mathematical Modelling- Using Mathematics for Natural Disaster Prediction, Recovery and Provision for the Future -	Information Recovery and Discovery	-The Impact of Applications on Mathematics-	-Applications + Practical Conceptualiza tion + Mathematics = fruitful Innovation-
  	  	  	  	  	  	

Forum "Math-for-Industry" 2014

Applications + Practical Conceptualization + Mathematics = fruitful Innovation

October 27(Mon) - 31(Fri), 2014

Venue: Nishijin Plaza, Kyushu University
2-16-23 Nishijin, Fukuoka City

Invited Speakers

Gary Froyland	University of New South Wales
Masahito Hasegawa	RIMS, Kyoto University
Hans-Christian Hege	Zuse-Institute Berlin (ZIB)
Thorsten Koch	TU Berlin / Zuse-Institute Berlin (ZIB)
Kerry Landman	The University of Melbourne
Vladimir Lorman	CNRS & Université Montpellier 2
Reinout Quispel	La Trobe University

Ernesto G. Birgin	University of São Paulo
Daniel Braak	University of Augsburg
Íñigo L. Egusquiza	University of the Basque Country, Bilbao
Farid Melgani	University of Trento
Robert Norman	RMIT University
Konrad Polthier	Freie Universität Berlin
Enrique Solano	University of the Basque Country, Bilbao
Akira Takada	Asahi Glass Co., Ltd.
Roger C. E. Tan	National University of Singapore

Kenichi Arai	NTT Communication Science Laboratories
Zainal Abdul Aziz	Universiti Teknologi Malaysia
Troy Farrell	Queensland University of Technology
Luke Fullard	Massey University
Arnab Ganguly	University of Louisville
Sachiko Ishida	Meiji University
Shinsaku Kiyomoto	KDDI R&D Laboratories, Inc.
Akira Ohata	Toyota Motor Corporation
Takashi Sasaki	Yokogawa Electric Corporation
Toshinao Yoshida	Bank of Japan

Alexandra Hogan	Australian National University
Keita Iida	Tohoku University
Yasuaki Kobayashi	Hokkaido University
Lucas Lamata	University of the Basque Country, Bilbao
Mikel Sanz	University of the Basque Country, Bilbao
Eriko Shinkawa	Graduate School of Mathematics, Kyushu University

Organizing Committee

Bob Anderssen	CSIRO, Australia
Philip Broadbridge	La Trobe University
Yasuhide Fukumoto	IMI
Kenji Kajiwara	IMI
Tsuyoshi Takagi	IMI
Eugeny Verbitsky	Leiden University / University of Groningen
Masato Wakayama	IMI, Chair

Supported by

Institute of Mathematics for Industry, Kyushu University

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Forum "Math-for-Industry" 2014					
<i>Applications + Practical Conceptualization + Mathematics = fruitful Innovation</i>					
October 27 to 31, 2014, Nishijin Plaza, Fukuoka, Japan					
October 27, 2014		October 28, 2014		October 29, 2014	
Registration		Registration		Registration	
9:00	Opening Ceremony				
	Thorsten Koch TU Berlin / Zuse Institute Berlin (ZIB)				
10:00 - 10:30	Mixed-Integer Nonlinear Programs for Gas Network Optimization	9:45 - 10:30	Kerry Landman University of Melbourne An Interaction with Biologists: Insights into Development and Disease	9:45 - 10:30	Gary Froyland University of New South Wales Dynamical Systems Approaches to Analysing Transport in Geophysical Fluid Flow
10:35 - 11:30	Kenichi Arai NTT Communication Science Laboratories Synchronization of Semiconductor Lasers for Secret Key Distribution	10:40 - 11:15	Arbab Ganguly University of Louisville Modeling Biochemical Reaction Systems with Markov Chains	10:40 - 11:15	Akira Takada Asahi Glass Co., Ltd. Mathematical Modeling of Inorganic Glass Materials
11:35 - 12:10	Zainal Abdul Aziz Universiti Teknologi Malaysia UTM-CIAM: Transformation and Beyond Malaysian Mathematics for Industry	11:20 - 12:05	Daniel Braak University of Augsburg Analytical Solutions of Basic Models in Quantum Optics	11:20 - 12:05	Akira Ohata BMW Motor Corporation Boundary Model Identification for Automotive Engine Controls
	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
13:40 - 14:30	Vladimir Lorman CNRS & Université Montpellier 2 Group Theory Methods in Virology: Laxoid Density Wave Approach	13:35 - 14:20	Enrique Solano University of the Balearic Country, Spain Quantum Simulations and Quantum Technologies	13:35 - 14:20	Reinout Quispel La Trobe University Geometric Numerical Integration of Differential Equations and its Applications
14:35 - 15:20	Ernesto G. Birgin University of São Paulo Applications of Nonlinear Programming to Packing Problems	14:25 - 15:20	Young Researcher Session Alexandra Hogan A Medal for Nonlinear Integral Viscosity Transmutation Katala India Research to Construct a Mathematical Theory that can Compare Stochastic Cellular Processes Yasuaki Kobayashi Mathematical Modeling for Epistemic Structure	14:30 - 15:20	Íñigo L. Egusquiza University of the Basque Country, Spain Beyond Adiabatic: Effective Hamiltonians and Singular Perturbation
	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK
15:40 - 16:15	Sachiko Ishida Meiji University Origami Evolution from Mathematics to Engineering	15:35 - 18:00 Poster Session	15:30 - 16:00	APCMI Launch Ceremony "The Importance and Future of APCMI!"	15:10 - 15:55 Konrad Polthier Freie Universität Berlin Reliable Computing in Geometry Processing and CAD
16:20 - 16:55	Troy Farrell Queensland University of Technology Mathematics for Industry: A Mining and Resources Case Study	16:05 - 17:00	Poster Session Voting	15:45 - 16:00	Poster Session Award Ceremony
	Wakayama Party (Drinks & Souvenirs)	18:00	Sangput Hitachi (Fukuoka New Branch)		
		PHOTO	PHOTO	PHOTO	EXCURSION
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Applications + Practical Conceptualization +
Mathematics = fruitful Innovation
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