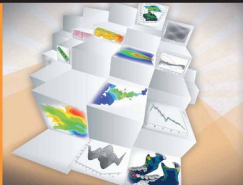


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Sxi

TransMath

Innovative Solutions from Mathematical Technology



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Preface

The book *TransMath: Innovative Solutions from Mathematical Technology* has been conceived as a powerful tool to spread and champion the transfer of mathematical knowledge and techniques to the industrial sector and society. This publication presents two technological maps, developed in the Consolider i-MATH CSD2006-00032 Project (Ministry of Science and Innovation – Government of Spain). Firstly, the i-MATH Map of Demand for Mathematical Technology (TransMATH Demand Map), with data obtained from a survey carried out with around 5,200 Spanish firms, details the level of knowledge, use and demand for mathematical technology in industry¹ in Spain. Secondly, the i-MATH Map of Supply of Mathematical Technology (TransMATH Supply Map) shows the experience acquired in technology transfer to business and industrial sectors by a broad representation of those Spanish mathematical research groups with greatest capacity and background in collaborating with industry.

The book is mainly addressed to those companies with innovation needs that could be met using mathematical technology. A complete list of successful industrial projects, developed by Spanish research groups, is therefore included to help readers determine the level of implementation and demand for mathematical technology in other companies and sectors of economic activity. Furthermore, it illustrates the benefits of using mathematical techniques to enhance innovation in industry.

In regards to professional readers, all information collected in this publication is classified by economic activity. Eleven sectors are considered in particular, as the majority of supply and demand for mathematical technology corresponds to companies belonging to these sectors: *Biomedicine & Health, Construction, Economics & Finance, Energy & Environment, Food, Information & Communication Technology (ICT), Logistics & Transport, Management & Tourism, Metal & Machinery, Public Administration, and Technical Services.*

¹ In this book the term “industry” is used in a broad sense of the word, to denote all kinds of business and commercial firms with economic activity and non-profit R&D organisations with activities outside the realm of education and academic research (including financial institutions, public administration and hospitals).

For readers interested in state of the art Spanish mathematical technology transferred to business and industrial sectors, two dedicated websites <http://www.math-in.net>, and <http://www.i-math.org/> provide further information.

Santiago de Compostela, January 2012

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Furthermore, the foundations of this book are built upon earlier editions of the publications *Investigadores en matemáticas para dar soluciones innovadoras (TransMATH Oferta)* and *Mapa i-MATH de demanda empresarial de tecnología matemática (TransMATH Demanda)*. The authors wish to thank all those who have contributed to these publications for their invaluable help in producing this book: Aureli Alabert, M^a Teresa Alonso, Alfredo Bermúdez de Castro, Javier Bullón, Laureano Escudero, M^a Jesús Frieiro, Jesús Gil, M^a José Ginzo, Andrés Gómez, Wenceslao González, Daniel Hernández, Mónica López, Félix Martínez, Jeff Palmer, Sophie Elizabeth Paton, Julio Rubio, M^a Teresa Seoane, Arturo Soto, Alba Souto and Giuseppe Viglialoro.

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The research project Ingenio Mathematica (i-MATH), an initiative financed by the Spanish Ministry of Education and Science, promoted a wide range of activities for the period 2006–2012 in order to improve the role of mathematical research in the Spanish sphere of science, technology and innovation, and increase the transfer of knowledge from Spanish mathematicians to business sectors. Specifically, two initiatives were developed in order to analyse the current state of mathematical technology transfer in Spain: the TransMATH Demand Map, which studies the knowledge, use and requirements for mathematical tools by Spanish companies, and the TransMATH Supply Map, which compiles both Spanish research groups' experience in technology transfer and the key mathematical services they currently offer.

1.1 Background

During the period 2006–2012 the mathematical community in Spain has contributed to a new global initiative aimed at promoting knowledge transfer from universities and public research bodies to industry. Thus, the year 2006 marked a turning point for industrial mathematics in Spain, with the launch of the project *Ingenio Mathematica*, known as i-MATH (<http://www.i-math.org/>). i-MATH was a CONSOLIDER singular research project for the period 2006–2012 in which a total of 350 research groups took part. It aimed to develop a complete activity research programme for Spanish mathematics, with the purpose of promoting and implementing strategic actions to increase – both qualitatively and quantitatively – Spain's mathematical presence at national and international levels.

In order to take this step, i-MATH has promoted several initiatives with a view to determining the current state of Spanish mathematics. These initiatives have provided a broad vision of current strengths and weaknesses, highlighting the need to act upon those areas in which mathematical community is not reaching its full potential, according to current economic development in the country. Furthermore, it has facilitated new progress in those areas and subjects where it already holds a significant or well-consolidated international position.

Two of these initiatives are put forward in this book. Firstly, Chap. 2 presents the main conclusions derived from the TransMATH Demand Map; a national prospectus on the level of knowledge, use, and demand for mathematical technology by industry. Secondly, Chap. 3 is devoted to the TransMATH Supply Map, which analyses the experience acquired in technology transfer to business and industrial sectors by the research groups belonging to the i-MATH project.

The purpose of mapping this technological supply and demand, and an outline of the subjects the maps cover, is described in the following article on the grant agreement that was signed with the Spanish Ministry of Science and Education to mark the start of the i-MATH project:

The design and annual update, together with the validation by an independent external committee, of a map showing the interactions and connections (both existing and potential) between mathematical research and technology transfer to the business and industrial sectors. The map will pay special attention to the detection of gaps in emerging fields, to the strengthening of existing fields, and to the identification of latent scientific-technological opportunities to be developed.

1.2

Mathematical technology in demand

For the drawing up of the TransMATH Demand Map, which was developed by CESGA Node (see <http://matematica.nodo.cesga.es/>) in collaboration with the i-MATH board of directors, a project was designed for detecting problems in industry for which mathematicians could provide complementary or fundamental tools to solve them, determine the demand for mathematical training, and define, where necessary, new research lines in mathematics aimed at solving these problems.

This project constitutes a highly ambitious, pioneering venture, unique in the field of mathematics, in which a survey has been carried out with around 6,716 companies of 10 employees or more, distributed throughout Spain and representing all industrial and business sectors. From this sample, a total of 5,176 companies from 10 activity sectors have been selected for this book, excluding the sectors where the use of mathematical technology is not intensive or there is no specific supply from the research groups considered. To achieve this, a panel of experts from the academic, business, and industrial sectors has provided their advice and expertise. Specialists in CAD, numerical simulation, statistics, operations research and other fields of mathematics have participated in this panel, all with experience in the transfer of technology to companies. In addition to experts in technological consultancy at CESGA Node, their counterparts in consultancy at the Department of Statistics and Operations Research from the Universidade de Santiago de Compostela have also taken part in the processing of acquired information for the most recent version of the Map.

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