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A. Di Bucchianico
R.M.M. Mattheij
M.A. Peletier
Editors

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Editors

A. Di Bucchianico
R.M.M. Mattheij
M.A. Peletier

Technische Universiteit Eindhoven
Department of Mathematics and
Computer Science
Postbus 513
5600 MB Eindhoven, The Netherlands

A.d.Bucchianico@tue.nl
R.M.M.Mattheij@tue.nl
M.A.Peletier@tue.nl

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Preface

In the autumn of 1985 ESMI (European Symposium on Mathematics in Industry), the predecessor of ECMI, took place in Amsterdam. During that meeting the ideas were born that eventually lead to the foundation of ECMI as we know it now. Many successful meetings followed this ‘ECMI-1985’ and during this period ECMI became a brand name for Industrial Mathematics. The adulthood of ECMI is apparent from the many things it has achieved since then, as a truly European institution devoted to promote Industrial Mathematics in education and research. It took nearly 20 years to have another ECMI meeting, the 13-th, held in the Netherlands again, now in Eindhoven, June 2004. During the preparations for this meeting we were joined by the European Network for Business and Industrial Statistics (ENBIS), an organisation with objectives similar to those of ECMI. It enlarged the scope of the meeting and opened up a number of opportunities for further co-operation. For one thing, ECMI-people have less tradition in employing theory and methods from Stochastics. Yet new challenges in Science and Industry increasingly cross borders between traditional mathematical areas. Multidisciplinarity applies to Industrial Mathematics as a whole and in fact Industrial Mathematics is multidisciplinary par excellence.

The Technische Universiteit Eindhoven (TU/e) is a relatively young university. Although not large, it recently came out as second in ranking of European Universities of Technology (see Third European Report on S&T Indicators 2003). Also the city of Eindhoven looks rather young, despite the fact that it has an old history. This modern face of the city is probably typical for the spirit here and, for that matter, in the larger region. Also the greater Eindhoven region does well as it ranks among the top three regions in Europe regarding technological and industrial innovation. The theme of this conference, Industrial Mathematics, is aptly fitting in with this. Indeed, nowadays Mathematics is generally accepted as a Technology, playing a crucial role in many branches of industrial activity, for optimising both processes and products.

Since Industrial Mathematics is a vast and diverse area, each ECMI conference chooses a number of (application) themes to focus on. This time they were Aerospace, Electronic Industry, Chemical Technology, Life Sciences, Materials, Geophysics, Financial Mathematics and Water flow. The majority of the subjects of the talks were on these topics indeed. In particular the talks of the invited speakers were related to these main themes. They delivered excellent lectures, most of which are reported in these proceedings. In alphabetical order the speakers were Søren Bisgaard (Amherst, MA), Rainer Helmig (Stuttgart), John Hinch (Cambridge), John Hunt (London), Chris Rogers (Cambridge), Cord Rossow (Braunschweig), Fabrizio Ruggeri (Milano), Wim Schoenmakers (Leuven), Bernard Schrefler (Padova), and Michael Waterman (Los Angeles, CA). Moreover there was a plenary talk by Sabine Zaglmayr, the winner of the Wacker price for the best thesis on Industrial Mathematics.

Organizing a meeting like this is a multi-person undertaking. During the last three years a dedicated group of people has devoted much of their time to making this event a success, eventually growing to quite a large number of persons who were actively involved in the lubrication of it all at the meeting. We are very grateful for their help. Special mention should be made of the help we received from our university congress bureau and our CASA secretariat. It goes without saying, however, that the actual success of this meeting was due to the participants. The conference was attended by some 400 people, from all continents, who altogether gave over 300 talks. There were excellent contributions by the invited speakers, a large number of high quality minisymposia, and many interesting contributed talks. All speakers were invited to submit a contribution to these proceedings, which therefore record the majority of the talks. We are most grateful to the many reviewers who helped us in the refereeing process.

At this place we would also like to thank the companies and institutions that participated in the exhibition, which was conducive to providing a proper atmosphere. We are particularly indebted to the many sponsors who made it possible to keep the fees quite moderate and yet have a nice social programme and affordable catering. The Local Organising Committee deserves special thanks for the many smaller and larger things that they have done. In particular I am personally very indebted to my two co-editors, Sandro Di Bucchianico and Mark Peletier. Their continuous enthusiasm, constructive ideas, as well as their skills in technical editing have proven invaluable. On behalf of all three of us I trust that these proceedings will be useful for all those who are interested in the use and the usefulness of Mathematics in Industry.

Bob Mattheij
Eindhoven, February 2005

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The MEGAFLOW Project – Numerical Flow Simulation for Aircraft

C.-C. Rossow, N. Kroll, and D. Schwamborn

[1] Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR) in the Helmholtz-Association
[2] Institute of Aerodynamics and Flow Technology D-38108 Braunschweig, Germany
cord.rossow@dlr.de, norbert.kroll@dlr.de

Summary. Some years ago the national CFD project MEGAFLOW was initiated in Germany, which combined many of the CFD development activities from DLR, universities and aircraft industry. Its goal was the development and validation of a dependable and efficient numerical tool for the aerodynamic simulation of complete aircraft which met the requirements of industrial implementations. The MEGAFLOW software system includes the block-structured Navier-Stokes code FLOWer and the unstructured Navier-Stokes code TAU. Both codes have reached a high level of maturity and they are intensively used by DLR and the German aerospace industry in the design process of new aircraft. Recently, the follow-on project MEGADESIGN was set up which focuses on the development and enhancement of efficient numerical methods for shape design and optimization. This paper highlights recent improvements and enhancements of the software. Its capability to predict viscous flows around complex industrial applications for transport aircraft design is demonstrated. First results concerning shape optimization are presented.

1 Introduction

Aerospace industry is increasingly relying on advanced numerical flow simulation tools in the early aircraft design phase. Today, computational fluid dynamics has matured to a point where it is widely accepted as an essential, complementary analysis tool to wind tunnel experiments and flight tests. Navier-Stokes methods have developed from specialized research techniques to practical engineering tools being used for a vast number of industrial problems on a routine basis [51]. Nevertheless, there is still a great need for improvement of numerical methods, because standards for simulation accuracy and efficiency are constantly rising in industrial applications. Moreover, it is crucial to reduce the response time for complex simulations, although the relevant geometries and underlying physical flow models are becoming increasingly complicated. In order to meet the requirements of German aircraft industry, the