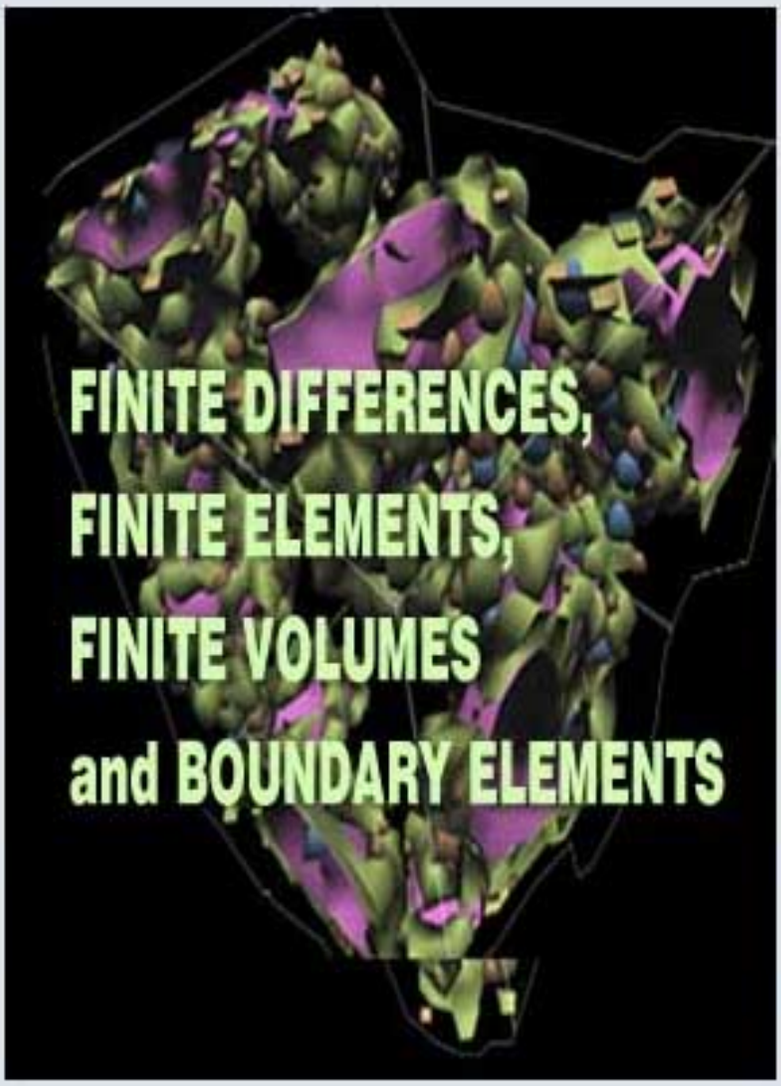

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1st WSEAS International Conference
on FINITE DIFFERENCES -
FINITE ELEMENTS - FINITE VOLUMES
- BOUNDARY ELEMENTS (F-and-B'08)

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Prof. Nikos E. Mastorakis, MIUE (ASEI),
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Malta, September 11-13, 2008

Mathematics and Computers
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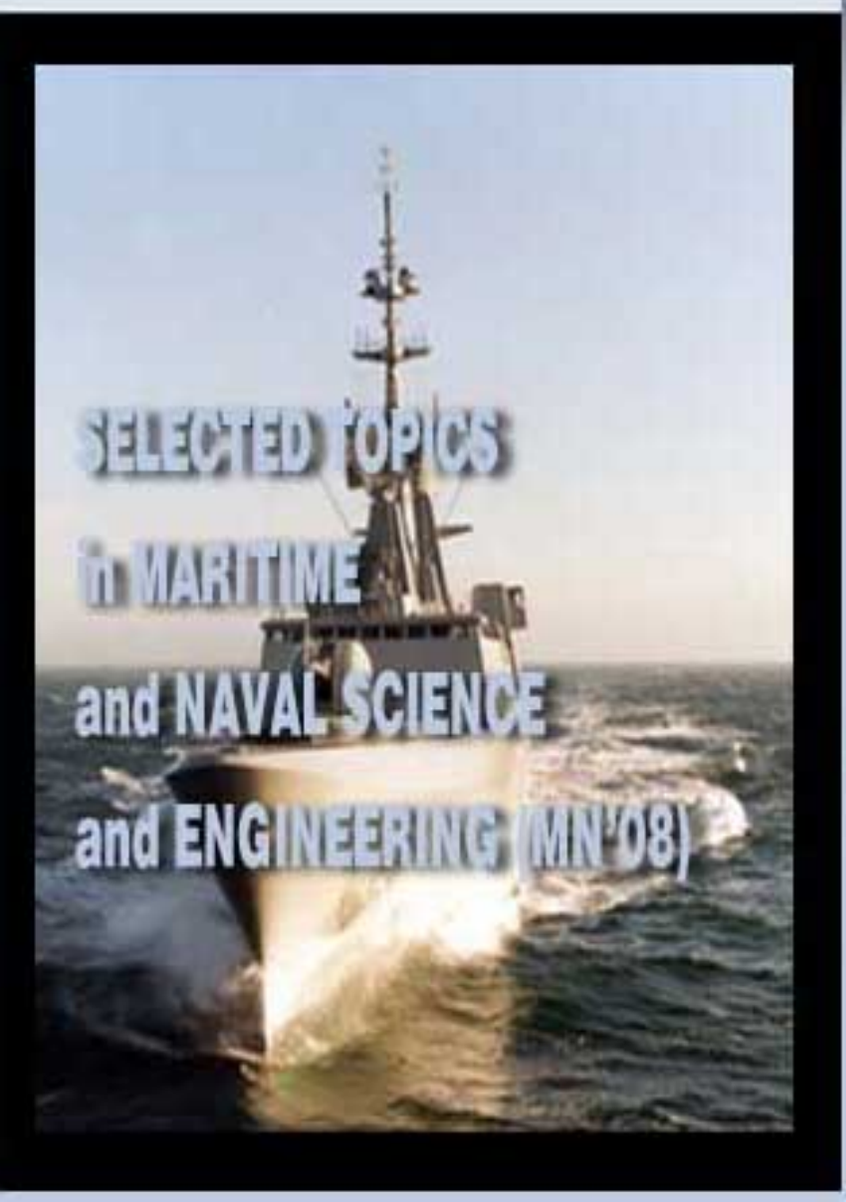
ISBN: 978-960-474-004-8
ISSN: 1790-2769



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Preface

This book contains the proceedings of the 1st WSEAS International Conference on FINITE DIFFERENCES - FINITE ELEMENTS - FINITE VOLUMES - BOUNDARY ELEMENTS (F-and-B'08), and the Proceedings of the 1st WSEAS International Conference on MARITIME and NAVAL SCIENCE and ENGINEERING (MN'08) which were held in Malta, September 11-13, 2008.

The friendliness and openness of the WSEAS conferences, adds to their ability to grow by constantly attracting young researchers. The WSEAS Conferences attract a large number of well-established and leading researchers in various areas of Science and Engineering as you can see from **http://www.wseas.org/reports**. Your feedback encourages the society to go ahead as you can see in **http://www.worldses.org/feedback.htm**

The contents of this Book are also published in the CD-ROM Proceedings of the Conference. Both will be sent to the WSEAS collaborating indices after the conference: **www.worldses.org/indexes**

In addition, papers of this book are permanently available to all the scientific community via the WSEAS E-Library.

Expanded and enhanced versions of papers published in this conference proceedings are also going to be considered for possible publication in one of the WSEAS journals that participate in the major International Scientific Indices (Elsevier, Scopus, EI, ACM, Compendex, INSPEC, CSA .... see: www.worldses.org/indexes) these papers must be of high-quality (break-through work) and a new round of a very strict review will follow. (No additional fee will be required for the publication of the extended version in a journal). WSEAS has also collaboration with several other international publishers and all these excellent papers of this volume could be further improved, could be extended and could be enhanced for possible additional evaluation in one of the editions of these international publishers.

Finally, we cordially thank all the people of WSEAS for their efforts to maintain the high scientific level of conferences, proceedings and journals.

1st WSEAS International Conference on FINITE DIFFERENCES - FINITE ELEMENTS - FINITE VOLUMES - BOUNDARY ELEMENTS (F-and-B'08)

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1st WSEAS International Conference on MARITIME and NAVAL SCIENCE and ENGINEERING (MN'08)

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Plenary Lecture I

Parallel Processing in Finite Element Programs for Engineering Applications

Associate Professor Ion Cârstea
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ROMANIA

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Abstract: The physical systems have the mathematical models a set of partial-derivatives equations and only in some particular assumptions we approximate them by lumped-parameter models. Although a tremendous variety of parallel numerical methods have been proposed for simulation of these systems, the most invented parallel computational strategies are largely based on the finite element (FE) and multigrid methods. The programs for the simulation of the distributed-parameter systems have an inherent parallelism when finite element method (FEM) method is used.

In many engineering applications in the area of field computation, the numerical models are based on FEM. The finite element programs have a modular form in accordance with the stages of the method: pre-processing, solution (processing) and post-processing.

The technique of dividing a large physical system into a system of components is very old and is still used extensively. In this way different components are designed in parallel by different groups of researchers or companies. It is obviously that this traditional approach can be used with parallel computers if the FEM is used for numerical models.

In this lecture we present several parallel computational strategies for the FE applications. The fact that the finite element method is central to many modern engineering simulations constitutes a real motivation for its consideration in this presentation. Another motivation is based upon some of the algorithmic issues raised by the FE method in comparison with other methods like the difference finite methods. The FE method can handle discrete meshes with an irregular or complicated distribution of points. The matrix of linear equation coefficients has not a regular, predictable structure characteristic of the finite difference method.

Another main motivation to consider the FEM is the existence of a large amount of software developed for conventional computers based on it. The justification of this large amount of software products in this area consists in the facility with which the FEM can be used to handle many physical problems described by partial differential derivatives equations.

As target examples we present practical problems from electrical engineering using coupled models. Motivations for these models are justified. Many areas of electrical engineering require the solution of problem in which the electromagnetic field equations are coupled to other partial differential equations, such as those describing thermal field, fluid flow or stress behaviour. These phenomena are described by equations that are coupled. The coupling between the fields is a natural phenomenon and only in a simplified approach the field analysis can be treated as independent problem.

As a parallel implementation of the FE programs, the domain decomposition method is presented. The domain decomposition is guided by physical considerations. Parallelism is obviously in every stage of the FE program and these parallelism facets we present in our lecture. Finally we discuss about the implementation aspects of the domain decomposition approach in the context of our target examples.

Brief Biography of the Speaker: The speaker is an Assoc. Professor at the Computer Engineering and Communications Department, Faculty of Automatics, Computers and Electronics, University of Craiova, Romania.

He has a BSc and MSc in Automatics from the University of Craiova, Romania. He has a Ph.D. in Automatics from the University of Ploiesti, Romania. Also, he has a BSc and MSc in Mathematics from the Natural Sciences Faculty, University of Craiova, Romania.

He was director of the research projects supported by international grants at University of Houston (USA)- 6 months (Fulbright Grant), at the University of Coimbra, Portugal – 9 months (NATO grant), at the Polytechnics of Milano, Italy- 4 months (a CNR-NATO grant). In 2004 he was invited at the Mathematics Department, University of Trento, Italy, for 2 months.

Ion Cârstea published 10 books in the area of programming languages, advanced computers and CAD of the electromagnetic devices. He is the co-author of the book FINITE ELEMENTS in WSEAS Press, 2007.

He is the author of more than 130 papers in revues, scientific journals and international conference proceedings. He is a reviewer for several WSEAS International Conferences and was a member in many international scientific committees. In the year 2007, he was Plenary speaker and chair at the WSEAS Conferences from Arcachon (France) and Venice (Italy).

His research interests include parallel algorithms for numerical simulation of the distributed-parameter systems, software products for coupled and inverse problems in engineering, domain decomposition method in the context of the finite element method.

Author Index
F-and-B, MN 2008


978-968-474-884-8