PARALLEL AND DISTRIBUTED PROCESSING FOR COMPUTATIONAL MECHANICS: SYSTEMS AND TOOLS

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Edited by
B.H.V. Topping

SAXE-COBURG PUBLICATIONS
EDINBURGH

published 1999 by
Saxe-Coburg Publications
10 Saxe-Coburg Place
Edinburgh, EH3 5BR, UK

Saxe-Coburg Publications is an imprint of Civil-Comp Ltd

ISBN 1-874672-03-2

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Cover Image: Transonic flow around a Dassault Falcon aircraft showing contours of density, stream ribbons and mesh partitions.
Courtesy of E.A. Turner-Smith, Department of Civil Engineering, University of Wales, Swansea.

Printed in Great Britain by Bell & Bain Ltd, Glasgow

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Preface

The First Euro-Conference on Parallel and Distributed Computing was held in Lochinver, Scotland between 26 April and 1 May 1997. This Euro-Conference was supported by the European Commisson Training and Mobility of Researchers Programme under contract no: ERBMMACT960072 with Civil-Comp Limited. As well as the lectures published in this book, a number of research presentations were made at the First Euro-Conference. The texts of these presentations are published in "Advances in Computational Mechanics with Parallel and Distributed Processing", Edited by B.H.V. Topping, Civil-Comp Press, Edinburgh, ISBN 0-948749-47-4, 1997.

The lectures in this book include both review chapters and descriptions of a body of work from well established researchers in the field. In the first chapter, the general field of parallel and distributed computing is reviewed and the main research and development tasks discussed. Chapter 2 provides an introduction to the MPI standard and describes how parallel programs may be written using the message passing paradigm. In Chapter 3 CAPTools, a computer system developed for automating the parallelisation of FORTRAN codes, is discussed. In Chapters 4, 5, 6 and 7 aspects of pre-processing for parallel finite element analysis are explained. This includes mesh generation and mesh partitioning to ensure load balancing and minimum interprocessor communication during the parallel finite element analysis.

In Chapter 8 issues in the parallelisation of multiphysics codes are described. Chapters 9, 10, 11, 12 and 13 discuss parallel solution techniques for computational mechanics. In Chapters 14 and 15 the application of parallel techniques to simulation in the automotive industry is illustrated. Chapter 16 and 17 consider the parallelisation of fluid flow problems.

The use of parallel processing in design and optimization is introduced Chapters 18 and 19. In the the first of these chapters, genetic algorithms and evolution strategies are compared. In the second, the parallelisation of evolution strategies and their application to engineering design problems are outlined. In Chapter 20, dynamic load-balancing techniques are reviewed. These techniques are required when the parallel computation becomes unbalanced during an analysis. This occurs because of changes in computational load, resulting in the original static partitioning becoming inefficient.

I am grateful for the valued help of many people in the organisation of the First Euro-Conference. In particular, I should like to thank Dr P. Jimack and Dr

L. Laemmer for their advice. My thanks are also due to all at Civil-Comp Ltd for their help and perseverance in the realisation of this conference, particularly Dr Martin Sales and Szandra Koves. The assistance of members of the Structural Engineering Computational Technology Research Group at Heriot-Watt University, Edinburgh is gratefully acknowledged, particularly János Sziveri, Colin Seal, Peter Iványi and Biao Cheng.

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