Series Editors' Foreword

The topics of control engineering and signal processing continue to flourish and develop. In common with general scientific investigation, new ideas, concepts and interpretations emerge quite spontaneously and these are then discussed, used, discarded or subsumed into the prevailing subject paradigm. Sometimes these innovative concepts coalesce into a new sub-discipline within the broad subject tapestry of control and signal processing. This preliminary battle between old and new usually takes place at conferences, through the Internet and in the journals of the discipline. After a little more maturity has been acquired by the new concepts then archival publication as a scientific or engineering monograph may occur.

A new concept in control and signal processing is known to have arrived when sufficient material has evolved for the topic to be taught as a specialised tutorial workshop or as a course to undergraduate, graduate or industrial engineers. *Advanced Textbooks in Control and Signal Processing* is designed as a vehicle for the systematic presentation of course material for both popular and innovative topics in the discipline. It is hoped that prospective authors will welcome the opportunity to publish a structured and systematic presentation of some of the newer emerging control and signal processing technologies.

Parallel computing brings together computing science and applications in both control and signal processing. The aim is fast, efficient, accurate real-time computing that can be used in time-critical algorithms that might be needed in such diverse fields as robotics, aerospace control systems and supply chain management in commerce. Computing using parallel processors is thus an implementational technology which enables the use of advanced control and data processing algorithms in demanding technological applications.

In this textbook, Drs. Tokhi, Hossain and Shaheed present a systematic introduction to the parallel computing field with special emphasis on its applications to control and signal processing. After a broad introductory chapter, the authors have chapters on parallel architectures, performance metrics, parallel programming and algorithms. The last two chapters of the book report on the hardware features of parallel computers as available to users and finally examine a set of typical control and signal processing applications. Performance metrics are given for the use of different parallel computing environments to run the various algorithms developed earlier in the textbook. This comprehensive textbook development of parallel computing with applications in control and signal processing can be used either as an advanced course textbook, a self-learning text or even a reference text for many of the specialist terms used in parallel computing. As such it is a versatile addition to the *Advanced Textbooks in Control and Signal Processing* series.

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Preface

The computing performance demands in modern real-time signal processing and control applications are increasing at a rapid pace. These impose hard limits on requirements of computational capabilities and processing speed, which are most often not met by traditional computing methods. Parallel processing offers the potential for solving problems of this nature by devising suitable parallel computing methods. One of the main issues in this process is the partitioning of an application into tasks and the mapping of these tasks onto the processing elements (PEs). It is often noticed that the resulting parallel architecture does not offer the desired performance due to a mismatch between the computational requirements of the tasks and the computing capabilities of the PEs. This book aims at presenting a principled introduction to the design and development of real-time parallel architectures and computing methods on the basis of the interrelation between algorithms and architectures. This involves an exploration of the nature and computing requirements of typical algorithms commonly encountered in signal processing and control applications and an investigation into the nature and computational capabilities of sequential and parallel high-performance processors. The strategy adopted thus allows identification and, in turn, exploitation of the computational capabilities of processors for suitable task-to-processor matching. In addition to worked examples and end of chapter exercises, the book provides case studies demonstrating theoretical concepts within a practical setting and framework.

The material presented in this book has largely been derived from the research work carried out by the authors over several years. Accordingly, there have been several other colleagues and students involved in this process. These have included Professor Peter J. Fleming and Dr Daniela N. Ramos-Hernandez (University of Sheffield, UK), Dr Abul K. M. Azad (Northern Illinois University, USA), Michael J. Baxter (University of Wales Bangor, UK), Margarida M. Moura and Dr Graca Ruano (University of Algarve, Portugal), Professor Gurvinder S. Virk (University of Leeds, UK), Benjamin Chan (Sheffield Hallam University, UK), Upama Kabir (University of Dhaka, Bangladesh). The authors are indebted to the support and encouragement of their families; their patience and understanding during this project have been crucial to its successful completion. The authors would like also to acknowledge the enthusiastic encouragement and support of Professor Michael

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