Special Volume on Combinatorial Scientific Computing

Dedicated to Alan George on the occasion of his sixtieth birthday

Although scientific computing is traditionally considered to be the province of differential equations and linear algebra, combinatorial and geometric algorithms have for long played a significant role in the solution of many scientific computing problems. Some early examples include graph models and algorithms for factoring sparse matrices, and graph coloring for estimating sparse Jacobians and Hessians, while more recently combinatorial ideas have been used to compute preconditioners for sparse iterative methods. Concepts such as elimination trees and elimination DAGs (directed acyclic graphs), matchings, edge and vertex colorings, graph embeddings, spectral graph theory, hypergraphs, matroids, etc., have been employed in scientific computing during the past thirty years. The moniker, combinatorial scientific computing (CSC), was coined recently to describe this area of research in which combinatorial mathematics and algorithms are used to solve the problems of scientific computing.

This special volume of the Electronic Transactions on Numerical Analysis devoted to combinatorial scientific computing, is dedicated to Professor Alan George of the University of Waterloo, one of the intellectual forefathers of the CSC community, on the occasion of his sixtieth birthday. A biographical sketch and an appreciation of Alan's contributions to CSC are included in a tribute in this special volume.

This volume is being published subsequent to the First SIAM Workshop on Combinatorial Scientific Computing (CSC04), which was organized in San Francisco on Feb 27 and 28, 2004. In bringing the CSC research community together for the first time under this banner, the workshop helped to highlight the common aesthetic, mathematical, and algorithmic methodologies underlying various problems in CSC. The members of the CSC04 Organizing committee were John Gilbert, Bruce Hendrickson, Alex Pothen, Horst Simon, and Sivan Toledo. The program and abstracts of talks from the CSC04 workshop are available at `www.cs.odu.edu/~pothen/CSC/CSC04`. A report on the CSC04 workshop was published in SIAM News, Volume 37, Number 10, December 2004 (available electronically at `www.siam.org/siamnews/12-04/CSC.htm`).

The nine papers included in this volume are representative of the themes of combinatorial scientific computing that are currently on the research frontier. Among these are: issues associated with sparse matrix computations, such as dataflow models, organizing memory accesses to enhance locality, and reducing communication costs in parallel computations; elucidation of the techniques of support theory used in matrix splitting; graph elimination models used in automatic differentiation; and dynamic scheduling of irregular computations. These articles were reviewed according to the rigorous standards of ETNA. We thank the authors who submitted their papers, and the reviewers who provided their informative reviews in a timely manner, enabling us to produce this special volume. We trust that these articles will spur further progress in CSC.

Guest Editors for the special volume
John Gilbert, University of California, Santa Barbara
Bruce Hendrickson, Sandia National Laboratories
Suely Oliveira, University of Iowa
Alex Pothen, Old Dominion University
Sivan Toledo, Tel Aviv University