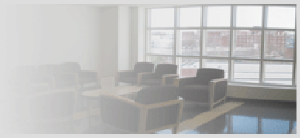
Center for Scientific Computation And Mathematical Modeling

University of Maryland, College Park



A Program Announcement

"Fast Multipole Method, Tree-Code and Related Approximate Algorithms. Trading Exactness for Efficiency"

April 19 - 30, 2004

Organizers: Ramani Duraiswami, Björn Engquist, Dennis Healy, Eitan Tadmor, Peter Teuben

Invited Participants

Rick Beatson
University of Canterbury Institute
Gregory Beylkin
University of Colorado
Shiyi Chen
John Hopkins University
Weng Chew
University of Illinois
Ronald Coifman
Yale University
Walter Dehnen
Astrophysical of Institutes potsdam
Ramani Duraiswami
University of Maryland
Alan Edelman
MIT
Björn Engquist
Princeton University
Alexander Gray
Carnegie Mellon University
Leslie Greengard
Courant Institute – NYU
Michael Griebel
Institut für Angewandte Mathematik
Nail Gumerov
University of Maryland
Dennis Healy
University of Maryland
Atsushi Kawai
University of Toyko
Robert Krasny
University of Michigan
Qing Liu
Duke University
Eric Michielssen
University of Illinois
David Mount
University of Maryland
Derek Richardson
University of Maryland
Vladimir Rokhlin
Yale University
Eitan Tadmor
University of Maryland
Peter Teuben
University of Maryland
Yen-Hsi Tsai
Princeton University
Stephen Wandzura
Hughes Research Laboratories

SCIENTIFIC BACKGROUND. A two-week program on the Fast Multipole Method (FMM), Tree-code and related algorithms will be conducted at the newly established Center for Scientific Computation And Mathematical Modeling (CSCAMM) at the University of Maryland, College Park.

The FMM algorithm allows the $O(N^2)$ matrix-vector product of particular dense matrices to be evaluated approximately – up to a specified precision, in O(N) or O(Nlog N) operations. Coupled with advances in iterative methods for the solution of linear systems, the gain in efficiency and memory achieved by these algorithms can be very significant, and enable the use of more sophisticated modeling approaches that, while known to be better, may have been discarded as computationally infeasible in the past.
FMM and Tree-code algorithms have been developed for astrophysical many-body problems, for bio-molecular force-field computations, for solution of the Laplace and Poisson equations in applications such as fluid mechanics, for the solution of acoustical scattering (the Helmholtz equation), and electromagnetic scattering (Maxwell's equations).
FMM algorithms have also been developed for the solution of interpolation problems in one to four dimensions, for performing non uniform Fourier transforms, for performing fast summations of Gaussians and of other radial-basis functions.
The O(NlogN) Tree-code has meant big improvements in simulation (disk) galaxies especially when special geometries cannot be taken advantage of. Multipole expansions combined with treecode enable O(N) codes, which in turn meant larger number of particles can be achieved, which is essential to resolve the 3D structure of flat galaxies, especially in the case of interactions.

WORKSHOP 1 – Tutorials (April 19- 23)
The first week will be devoted to introductory, hands-on, graduate level tutorial lectures on fast approximate methods and their applications.
Ramani Duraiswami and Nail Gumerov: ***Fast Multipole Methods: Fundamentals and Applications***
Dennis Healy: ***A Survey***
Peter Teuben : ***NEMO Stellar Dynamics Toolbox Hands-on***

WORKSHOP 2 - Trading Exactness for Efficiency (April 26-30)
The workshop will be devoted to a research symposium with the goal of trying to elucidate the research directions being taken by various groups. There will be talks by a select group of invited participants. A goal of this second workshop will be the publication of a set of papers based on these talks.

GOALS. With such an impressive breadth of applications, there is a need for a focused activity of the widely-spread research community on algorithmic details and the translation of results from one application area to another. One of the goals of this two-weeks workshop is to provide a forum for such an exchange.

Another goal is to address common difficulties and raise open questions drawn from the various research communities. These include but are not limited to development of efficient translation operators, development of data-structures for efficient implementation, establishing optimal versions of the algorithms, extensions to higher dimensions, new application areas, and more.

Finally, the aim is to establish connections with related areas of scientific computation and applied mathematics. These include developing efficient O(N) preconditioners (suitable for use with the FMM), other algorithms that trade exactness for complexity, the non-uniform fast fourier transform, multiresolution methods and others.

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And Mathematical Modeling (CSCAMM)
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CSCAMM is part of the College of Computer, Mathematical and Physical Sciences

UNIVERSITY OF MARYLAND

A limited number of openings are available. To apply please RSVP at www.cscamm.umd.edu/programs/fam04/rsvp.htm
ADDITIONAL INFORMATION is posted at www.cscamm.umd.edu/programs/fam04 email: fam04@cscamm.umd.edu

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