Report on the Copper Mountain Conference On Multigrid Methods

Copper Mountain, Colorado April 11-April 16, 1999

Summary of Project

The Copper Mountain Conference on Multigrid Methods was held on April 11-16, 1999. Over 100 mathematicians from all over the world attended the meeting. (See attached list of participants). The conference had two major themes: algebraic multigrid and parallel multigrid. During the five day meeting 69 talks on current research topics were presented as well as 3 tutorials preceding the reception on Sunday (see the Final Program which is located at the front of the attached Proceedings). Talks with similar content were organized into sessions. Session topics included:

Fluids
Multigrid and Multilevel Methods
Applications
PDE Reformulation
Inverse Problems
Special Methods
Decomposition Methods
Student Paper Winners
Parallel Multigrid
Parallel Algebraic Multigrid
FOSLS

Late evening sessions included a circus and an informal AMG open session. The circus had three talks including the Linz group demonstrating their program FEPP, which is a CAD based adaptive grid multidimensional finite element multigrid package that can handle industrial problems easily. During the AMG session there were many comments that said that algebraic multigrid works when problems have two features: locality and low dimensional local subspaces. There were also discussions on minor variants.

There were a number of talks highlighting that we are almost to the point that given part of a multilevel problem, the rest can be generated automatically at what is potentially an acceptable cost.

All encompassing (parallel) multilevel packages that generate problems, visualize the solutions, and can solve industrial strength problems have become a growth industry. There were talks describing a number of these packages.

DISCLAIMER

Holding a Student Paper Competition stimulated student participation in the Conference. Students were urged to submit a ten-page paper containing original research. A panel of judges made up of members of the Program Committee selected four winners. The winners were Shu-hua Chen, Jonathan Hu, Jonathan Rochez, and Roman Wienands.

A special effort was made to bring speakers to the conference and young researchers with fresh ideas. Below is a list of speakers who were encouraged to attend:

Achi Brandt
William Briggs
Zhiqiang Cai
Craig Douglas
Paul Frederickson
Van Henson
Jim Jones
Kirk Jordan
Duane Melson
Ulrich Ruede
Irad Yavneh

Technical information

On the first day of the conference each participant was provided with the Preliminary Proceedings that contained an abstract from each of the speakers. In an effort to reduce publication costs, each Proceedings paper was limited to two pages. Speakers were then urged to submit a journal quality version of the paper to the E.T.N.A.

Student Support

The Conference provided travel expenses for the four winners as well as lodging expense and registration fees. In addition, the conference provided lodging support and registration fees for a number of other students, women and minorities on a case by case basis. We made a special effort to attract women and minorities and young researchers by placing a special section for their attention in all announcements for the conference. All students who did pay their registration fees did so at a substantial reduction in cost.

Following is a list of students supported:
Dhavide Aruliah
Travis Austin
Alison Baker
Markus Berndt
Brian Blochle
Tim Chartier
Shu-hua Chen
Andrea Codd
Serge Goossens
Michael Griffin
Ronald Haynes
Jeff Heys
Jonathan Hu
Johannes Korsawe
Markus Kowarschik
Domenico Lahaye
Boris Lastdrager
Hugh MacMillan
Ali Namzifard
Ali Nesliturk
Michelle Pal
Stefan Reitzinger
Jonathan Rochez
Marc Schweitzer
Katina Warendorf
Roman Wienands
Grady Wright
Leonid Zhukov

1999 Copper Mountain Conference on Multigrid Methods
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Welcome to the Ninth Copper Mountain Conference On Multigrid Methods

This is your preliminary program with abstracts in alphabetical order according to the speaker's last name. This schedule may change so consult the information board outside of the meeting room.

Sunday April 11, 1999

Tutorial series on basic methods, algebraic multigrid, and parallel techniques.

9:00am-Noon	***William Briggs***	A Multigrid Tutorial
1:30pm-3:30pm	***Van Emden Henson***	An Algebraic Multigrid Tutorial
4:00pm-5:00pm	***Jim E. Jones***	A Parallel Multigrid Tutorial
7:00pm-9:00pm		***Cash bar and Light Buffet***

Village Square Conference facilities.

Friday, April 16

Session 14

Topic: *Parallel and Algebraic Methods*	*Session Chair:* *Jim E. Jones*	
8:00am	Michael Kuhn	A Unifying Software Concept for Several Parallelization Techniques
8:25am	Gundolf Haase	Parallel AMG for Non-overlapping Domain Decomposition
8:50am	Stefan Reitzinger	Algebraic Multigrid Methods Based on Element Stiffness Matrices
9:15am	Ping Wang	Parallel Computation of 3D, Time dependent, Thermal Convective Flows
9:40am		*Coffee Break*

Session 15

Topic: *Decomposition Methods*	*Session Chair:* *Panayot Vassilevski*	
10:10am	Susanne Brenner	Lower Bounds for Nonoverlapping Domain Decomposition Methods
10:35am	Serge Goossens	Two-Level Algorithms for Overlapping Composite Mesh Difference Methods
11:00am	Thomas Huckle	Multigrid Preconditioning and Toeplitz Matrices
11:25am	David Keyes	Newton-Krylov Methods with Multilevel Preconditioning: Algorithm-Architecture Trade-offs in the Number of Levels
11:50am	Maria Sosonkina	Distributed Multilevel Schur Complement Preconditioning of General Sparse Linear Systems
12:15pm	Roman Wienands	Fourier Analysis of GMRES(m) Preconditioned by Multigrid

Wednesday April 14

Session 7

Topic: *Parallel Algebraic Methods*	*Session Chair:* *Jim E. Jones*	
8:00am	Ulrike Yang	Coarse-Grid Selection for Parallel Algebraic Multigrid
8:25am	Arnold Krechel	Parallel Algebraic Multigrid
8:50am	Marc Schweitzer	Three Parallelization Strategies for AMG
9:15am	Dimitri Mavriplis	A Highly Scalable Unstructured Agglomeration Multigrid Algorithm for Viscous Turbulent Flows
9:40am		*Coffee Break*

Session 8

Topic: *Parallel Techniques*	*Session Chair:* *Jim E. Jones*	
10:10am	Colin Aro	Implicit Mechanical Modeling in ALE3D
10:35am	Craig Douglas	Accelerating ADI Methods on Parallel Processors including Multigrid with ADI as the Smoother
11:00am	Paul Frederickson	Recent Results on PUMG
11:25am	Ignacio Llorente	Smoothing Properties for Plane Smoothers for Multiblock Grids
11:50am	William Mitchell	Approaches to Parallel Multigrid with the Full Domain Partition

Session 9

Topic: *PDE Reformulations*	*Session Chair:* *Kirk Jordan*	
4:30pm	Travis Austin	Multigrid Ideas in FOSLS Neutron Transport Theory
4:55pm	Markus Berndt	Multigrid for FOSLS on the Discontinuous Coefficient Problem with Singular Basis Functions
5:20pm	Zhiqiang Cai	Least Squares for the Perturbed Stokes Equations and the Reissner-Mindlin Plate
5:45pm	Andrea Codd	Steady-State Elasticity-Fluid Coupled Systems
6:10pm	Johannes Korsawe	FAS Multilevel Methods for Nonlinear Least- Squares Finite Element Computations
6:35pm	Irad Yavneh	Towards Automatic Differential Preconditioning and Variable Transformations for PDE Systems
7:30pm		*Cash Bar and Banquet* *Victoria B Room in the Pavilion*

Tuesday, April 13

Session 4

Topic:	*Session Chair:*	
Algebraic Methods	***Van Emden Henson***	
8:00am	Yousef Saad	ARMS: an Algebraic Recursive Multilevel Solver for General Sparse Linear Systems
8:25am	Serguei Sokol	Applying Multi-Coarse Correction with Suboptimal Operators to CFD Problems
8:50am	Ray Tuminaro	ML: A Multilevel Framework for Parallel Unstructured Grid Computations
9:15am	Jun Zhang	A Multilevel Block ILU Preconditioning Technique for Solving General Sparse Linear Systems
9:40am		***Coffee Break***

Session 5

Topic:	*Session Chair:*	
Algebraic Methods	***Van Emden Henson***	
10:10am	John Ruge	Algebraic Multigrid Applied to Multi-Body Elasticity Problems with Interface Constraints
10:35am	Petr Vanek	Smoothed Aggregation Multilevel Methods and Their Convergence Analysis
11:00am	Jan Mandel	Fast Computation of Energy Minimal Coarse Basis Functions by Smoothing and Projection
11:25am	Marian Brezina	Smoothed Aggregation-Based Black-Box Iterative Solver
11:50am	Herve Guillard	A Petrov Galerkin Smoothed Aggregation Method
12:15pm	Rudolph Lorentz	Total Reduction Revisited

Session 6

Topic:	*Session Chair:*	
Fluids	***Irad Yavneh***	
4:30pm	Michael Pernice	Hybrid Solvers for the Steady State Incompressible Navier-Stokes Equations
4:55pm	William Rider	A Serendipitous Recovery of Linear Scaling
5:20pm	Jonathan Rochez	A Multigrid Strategy for Accelerating Steady-State Computations of Waves Propagating with Curvature Dependent Speeds
5:45pm	Carol Woodward	Comparison of Parallel Newton-Krylov-Multigrid Solvers for Variably Saturated Flow Problems
6:10pm	Shu-hua Chen	The Application of the Multigrid Method in a Nonhydrostatic Atmospheric Model

		Algebraic Methods Bull Session
7:30 p.m.	***Moderator:***	***Van Emden Henson***
		Open discussion on algebraic methods. Everyone is welcome to talk and/or listen.

Monday, April 12

Session 1

Topic:	*Session Chair:*	
Algebraic Methods	***Van Emden Henson***	
8:00am	Achi Brandt	MG Re-Examined
8:25am	Mark Adams	Heuristics for the Automatic Construction of Coarse Grids in Multigrid Solvers for Finite Element Problems in Solid Mechanics
8:50am	Michael Bader	An Algebraic Multigrid Method with Fixed Coarse Grid Selection for Convection Diffusion Equations
9:15am	Tim Chartier	Algebraic Multigrid Based on Element Interpolation (AMGe): Coarsening and the AMGe Measure
9:40am	Mike DeLong	Recent Results with Algebraic Multilevel Methods for ASCI Problems
10:05am		***Coffee Break***

Session 2

Topic:	*Session Chair:*	
Algebraic Methods	***Van Emden Henson***	
10:35am	Joel Dendy	Some Aspects of Multigrid for Mixed Discretizations
11:00am	Michael Griebel	Algebraic Multi-Grid for Coupled Systems of PDEs
11:25am	Jim E. Jones	Algebraic Multigrid Methods Based on Element Agglomeration
11:50am	Domenico Lahaye	On the Use of Algebraic Multigrid in an Electromagnetic Systems Simulation Package
12:15pm	Jens-Dominik Muller	Coarsening 3-D Hybrid Meshes for Multrigrid Methods

Session 3

Topic:	*Session Chair:*	
Fluids	***Duane Melson***	
4:30pm	Scott Fulton	Performance of a Self-Adaptive Multigrid Algorithm
4:55pm	Klaus Johannsen	Robust Multigrid Methods for Convection Diffusion Problems with Closed Characteristics
5:20pm	David Kay	A Multigrid Preconditioner for the Steady State Navier-Stokes Equations
5:45pm	Boris Lastdrager	The Sparse-Grid Combination Technique for a Time-Dependent Advection Problem
6:10pm	Marius Paraschivoiu	Multi-Level Full Potential and Euler Formulation for Transonic Flows

Circus	*Circus Chair*	
7:30 p.m.	***Craig Douglas***	Everyone is welcome to talk and/or listen. The program will be determined at the start by polling the participants