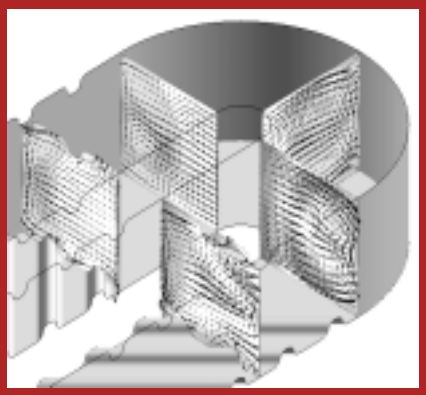
Michigan State University
College of Engineering

Presents
a short course on



Computational Fluid Dynamics
Theory and Applications

June 26-28, 2001

University Faculty Club
East Lansing, Michigan

Sponsored by

The Multiphysics Computational Research Laboratory of MSU's Automotive Research Experiment Station (ARES)

The Computational Fluid Dynamics (CFD) Laboratory of MSU's Department of Mechanical Engineering

A course for CFD practitioners and managers, who are serious about using CFD to obtain useful answers to realistic engineering problems.

MICHIGAN STATE
UNIVERSITY

This short course focuses on issues that affect accuracy and interpretation of CFD results; ability of CFD to impact design; and capability of CFD to break into new application areas. Topics addressed include grid generation, high-resolution schemes, turbulence modeling, large-eddy simulations, and computational aero-acoustics.

Day 1: June 26, 2001
9:00 am — 5:00 pm

Welcoming Remarks (R. Rosenberg)

Introductions (T. Shih)

Grid Generation (Z.J. Wang)
- Overview on Grid Generation
- Methods for Generating Unstructured Grids
  - Advancing Front
  - Delaunay Triangulation
  - Advancing Layers
- Adaptive Cartesian Grids
  - Projected Prismatic Grids for Viscous Flows
  - Dirty Geometry
  - Solution Adaptation

High-Resolution Schemes (B. van Leer)
- Why upwind differencing?
- Implementation for Nonlinear Conservation Laws
  - Riemann's Initial-Value Problem
  - Approximate Riemann Solvers (flux-vector splitting, flux-difference splitting, Hancock's scheme, limiters)
- Multidimensional Extensions
  - Rotated-Flux Formulas
  - Genuinely Multidimensional Schemes

Space-Time Coupled Methods (T. Shih)
- True Conservation in Space and Time
- Constraints and Implementation

Reception (MSU Engine Research Laboratory)

Day 2: June 27, 2001
8:30 am — 5:00 pm

Role of Experiments in CFD Simulations of IC Engine Components (H.J. Schock)
- Overview of Physics and Processes
- Experimental Methods and Uncertainties

Turbulence Modeling (G. Brereton)
- Overview of Theory and Methods
- Tools to Evaluate Models
- Guidelines

Workshop 1: Case Studies
- Engine Air Management (Habib Affes, Ford)
- Brake Cooling (Monirul Islam, GM)
- Water Management (Rolf Karlsson, GM)
- Underhood/Underbody Thermal and Front-End Air Flow (Sanjay Rastogi, GM)
- Engine Cooling System (K. Singh, DaimlerChrysler)
- Passenger Comfort (Clifton Stokes, GM)

Workshop 2: CFD-Code-Vendors Panel
- Adapco (John Deur)
- AEA (Brad Hutchinson)
- AVL (Ales Alajbegovic)
- FLUENT (Barb Hutchings)
- NUMECA (Charles Hirsch)

Future of Industrial CFD (Ch. Hirsch)
- Requirements of Industrial CFD
- Algorithms, Physical Models, and Grids
- Quality Assurance
- Multidisciplinary Application
- Design Optimization

Workshop 3: Academic, Government, and Industrial Panel
- Ron Bunker, General Electric CRD
- David Caughey, Cornell University
- John Foss, Michigan State University
- Boris Glezer, Optimized Turbine Solutions
- Ed Hernandez, Ford Motor Company
- James Johnson, General Motors Corporation
- Keith Meintjes, General Motors Corporation
- Lou Povinelli, NASA - Glenn Research Center
- Fred Shen, General Motors Corporation
- Richard Sun, DaimlerChrysler AG

Day 3: June 28, 2001
8:30 am — 5:00 pm

Computational Aeroacoustics (C. Tam)
- Overview of Physics
- Overview of Formulation and Methods
- Multiple-Size-Mesh Multiple-Time-Step DRP Scheme
- Simulation of Car Door Cavity Tones
- Simulation of Jet Screech Phenomenon

First-Principle Simulations of Turbulent Flows (F. Jaberi)
- Overview of Methods for Turbulent Flows
- Direct Numerical Simulations
- Fundamentals of Large-Eddy Simulations (filters, filtered equations, subgrid-scale models)
- Large-Eddy Simulations of Complex Flows

Instructors

Giles Brereton (Ph.D., Stanford University) joined Michigan State University as Associate Professor of Mechanical Engineering in 1997. Dr. Brereton conducts research in unsteady and turbulent fluid mechanics with applications ranging from IC engines to cardiovascular flows. In the area of turbulence modeling, he has specialized in the use of rapid-distortion approaches to model unsteady and non-equilibrium turbulent flows, in collaboration with industry and government laboratories.

Farhad Jaberi (Ph.D., State University of New York at Buffalo) joined Michigan State University as an Associate Professor of Mechanical Engineering in 2000. Dr. Jaberi conducts research in turbulent mixing and turbulent reacting flows by using direct and large-eddy simulations. During this past year, Dr. Jaberi received the prestigious Career Award from the National Science Foundation and the Young Investigator Award from the Office of Naval Research.

Charles Hirsch (Ph.D., Université Libre de Bruxelles) is Professor and Head of the Department of Fluid Mechanics at Vrije Universiteit Brussel. Also, he is President of NUMECA International. Dr. Hirsch has contributed very significantly to CFD. He edited 20 books, authored/co-authored 350 journal and conference papers, and wrote a two-volume definitive textbook on CFD. Dr. Hirsch is Editor-in-Chief of John Wiley's Series on Computational Methods in Applied Sciences and the European Editor of the International Journal of Computational Fluid Dynamics.

Bram van Leer (Ph.D., Leiden) is Professor of Aerospace Engineering at The University of Michigan. Dr. van Leer is internationally renowned for his very significant contributions to the fundamentals of CFD. He developed the concept of limiters that made possible non-oscillatory high-resolution schemes. He also developed a highly popular flux splitting that is differentiable across sonic lines. For his contributions, Dr. van Leer received the NASA Group Achievement Award and an Honorary Doctorate from Brussels' Free University. Dr. van Leer is a Fellow of AIAA.

Harold Schock (Ph.D., Michigan Technological University) is Professor of Mechanical Engineering and Director of Michigan State University's Automotive Research Experiment Station. Before joining MSU, he was Deputy Chief of the Turbine and Rotary Engine Branch and Head of the Intermittent Combustion Engine Technology Section at NASA – Lewis Research Center. Dr. Schock has conducted extensive research for the automotive industry, the general aviation aircraft industry, and government laboratories in developing and applying laser diagnostic techniques for IC engine in-cylinder flow fields.

Tom Shih (Ph.D., The University of Michigan) joined Michigan State University as Professor of Mechanical Engineering in 1998. Previously, he was a Research Engineer at NASA – Lewis Research Center, Associate Professor at the University of Florida, and Professor at Carnegie Mellon University. Dr. Shih has conducted extensive research for industry and government laboratories in developing and applying CFD to study a wide range of problems in propulsion and aerodynamics. Dr. Shih is a Fellow of ASME and an Associate Fellow of AIAA.

Christopher Tam (Ph.D., California Institute of Technology) is Robert O. Lawton Distinguished Professor at the Florida State University. Dr. Tam has conducted extensive research in aeroacoustics and computational aeroacoustics and is recognized internationally for them. For his very significant contributions, he received the AIAA Aeroacoustics Award. Dr. Tam is a Fellow of the American Physical Society, Acoustical Society of America, and AIAA.

Z.J. Wang (Ph.D., University of Glasgow) joined Michigan State University in 2000 as Associate Professor of Mechanical Engineering. Previously, he was at Oxford University and CFD Research Corporation. Dr. Wang has conducted extensive research in CFD with focus on algorithm development for grid generation and high-resolution schemes. For his contributions, he received a Bill Morton CFD Prize from Oxford University in 1995.

Registration Information

Short Course Fee

Short course fee is $1,000. This fee covers course material, continental breakfast, lunch, reception, and refreshments.

Registration

Mail, FAX, or e-mail registration form to Bobbie Slider (517-353-3995, slider@egr.msu.edu) or Jan Chappell (517-355-1789, chappe31@egr.msu.edu); FAX: 517-432-3341

Mailing Address: MSU Engine Research Laboratory, 3361 Hulett Road, Okemos, MI 48864

Lodging Information

A block of rooms have been reserved at the Candlewood Suites @ MSU, located next to the University Faculty Club (www.candlewoodsuites.com). Two types of suites are available: regular ($75) and one-bedroom ($95). All suites have kitchenettes, and the hotel has a grocery store. For reservation, please call 517-351-8181 and tell them that you are attending the CFD short course to get the discounted rates, which are guaranteed until May 14, 2001.

For additional information about the short course, please contact

Professor Tom I-P. Shih, CFD Laboratory, Dept. of Mechanical Engineering
Michigan State University, East Lansing, MI 48824-1226 (517-432-3658, tomshih@egr.msu.edu)

REGISTRATION FORM

Name: _____

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