SIAM CONFERENCE ON NUMERICAL COMBUSTION
March 9–11, 1987

Conducted with the cosponsorship of INRIA and SMAI

Holiday Inn — Golden Gateway • San Francisco, California

- Detonation Physics and High Speed Flows
- Computation of Turbulent Combustion
- Combustion Engineering
- Asymptotics and Numerical Experiments
- Adaptive Gridding
- Role of Asymptotics
- Complex Chemical Kinetics
- Use of the Supercomputer
- Multidimensional Moving Boundary Problems
**Invited Presentations**

**Monday, March 9, 8:30 AM**

**Invited Presentation 1**

**Numerical Computation of Turbulent Combustion**

The probability density function (pdf) method is a statistical approach to solving the equations governing turbulent combustion. The method has been applied successfully in several applications recently. The speaker will discuss the case of a one-point joint pdf of the fluid velocity and composition. Closed form solutions are available in this case for convection and reaction. But even in this highly simplified situation, the joint pdf contains seven independent variables and the standard numerical methods are impractical and have to be replaced by Monte Carlo methods for the determination of the pdf. The speaker will show the results of calculations for both premixed and diffusion flames to show the attributes of the method.

Stephen B. Pope
Cornell University

**Tuesday, March 10, 8:30 AM**

**Invited Presentation 3**

**Physical Processes in Combustion Engineering that Require Advanced Numerical Treatment**

Industrial researchers routinely are confronted with complex processes and problems that can be elucidated by the application of numerical and analytical techniques. Examples will be discussed from the fields of two-phase flows and combustion. An effort will be made to identify specific topics that require the development of advanced numerical techniques or even a reexamination of the constitutive equations.

Frediano V. Bracco
Princeton University

**Tuesday, March 10, 9:15 AM**

**Invited Presentation 4**

**The Use of Analytical Knowledge and Adaptive Gridding in Combustion Problems**

It has long been recognized that a priori knowledge of the solution is helpful, and often essential, in numerical computations. Regions in which the solution changes very rapidly must be anticipated or identified, and the grid locally adjusted to provide the required accuracy in those regions. There has been a lack of emphasis on the need for adaptive numerical methods and the proper response of the methods to the asymptotic parameters causing interior boundary regions and scaling problems.

James M. Hyman
Los Alamos National Laboratory

**Wednesday, March 11, 8:30 AM**

**Invited Presentation 5**

**Numerical Solution of Moving Boundary Problems in Combustion Theory**

Flames are often thin. If it is known where they go and how they behave, reasonable understanding of the combustion field can be obtained. Such flames define moving boundaries, separating unburnt gas from burnt gas, or fuel from oxidizer.

Combustion theory has long used this approximation. Finding the Response of a given combustion system often requires that the reaction zone be tracked as part of the solution of a nonlinear moving boundary problem. Front tracking in one dimension is understood but the best methods are not widely known to the user community. For multidimensional problems, front tracking methods are only now being developed. The speaker will discuss problems in combustion theory that help define the state-of-the-art in numerical front tracking and provide a good testing ground for these methods.

James G.lim
Courant Institute of Mathematical Sciences
New York University
Wednesday, March 11, 9:15 AM
Invited Presentation 6
Using Asymptotics to Define Numerical Experiments in Combustion
In defining a numerical problem one can try to include everything that is likely to be of physical importance, or one can “model”, deliberately discarding ingredients in order to better understand the effect of those that are kept. The first approach is necessary if the goal is to obtain numbers that must be compared with the physical world. The second is of great value when the goal is physical understanding.
Asymptotics can be used to define interesting models of combustion. In some cases the result of the asymptotics is a field equation, a simple paradigm for the “exact” equations. The Kuramoto-Sivashinsky equation is an example. In other cases, the asymptotics suggests approximations that lead to great simplification. For example, flame sheet models can be useful even when there is no formal asymptotic justification for them.
John D. Buckmaster
University of Illinois, Urbana and University of Washington, Seattle

Minisymposia
1. Detonation Physics and High Speed Flows
   Andrew Majda
   Princeton University
2. Computation of Systems with Complex Chemical Kinetics
   Robert J. Kee
   Sandia National Laboratories
   Livermore, CA
3. Applications of Adaptive Gridding Methods to Combustion Problems
   Bernard Larroussetou
   INRIA-Sophia Antipolis, France
   T. Daniel Butler
   Los Alamos National Laboratory
5. Impact of Supercomputers on the Solution of Combustion Problems
   Harry A. Dwyer
   University of California, Davis, CA
6. The Role of Asymptotics in Computational Combustion
   D. Scott Stewart
   University of Illinois, Urbana
7. Multidimensional Moving Boundary Problems
   Gunter H. Meyer
   Georgia Institute of Technology
8. Turbulent Combustion
   Jay P. Boris
   Naval Research Laboratory

Special Functions
Welcoming Reception
Sunday, March 8, 8:00 PM – 10:00 PM
Crystal Room
Beer Party
Monday, March 9, 8:00 PM – 10:00 PM
Crystal Room

UPCOMING CONFERENCES
May 17–20, 1987
SIAM Short Course and Conference on Optimization
Hotel Intercontinental
Boston, MA
May 24–28, 1987
SIAM Short Course and Conference on Applied Geometry: Geometric Modeling, Computational Geometry, Tiling, and Robotics
Albany Hilton
Albany, NY
October 12–15, 1987
SIAM Annual Meeting
Marriott Hotel – City Center
Denver, CO
### Sunday, March 8/PM
- 5:00 PM/Emerald Room
  - Registration Opens
- 6:00 PM/Crystal Room
  - Welcoming Reception
- 10:00 PM/Emerald Room
  - Registration Closes

### Monday, March 9/AM
- 7:00 AM/Emerald Room
  - Registration Opens
- 8:15 AM/Emerald Room
  - Opening Remarks
- 8:30 AM/Emerald Room
  - Invited Presentations 1 and 2
    - Chair: David Kassoy
    - University of Colorado, Boulder
- 8:30 AM
  - Numerical Computation of Turbulent Combustion
    - Stephen J. Pope
    - Cornell University
- 9:15 AM
  - Computational Questions that Arise in Detonation Physics and High Speed Flows
    - John L. Bzdil
    - Los Alamos National Laboratory
- 10:00 AM/Coffee
- 10:30 AM/Concurrent Sessions
  - Minisymposium 1/Emerald Room
    - Detonation Physics and High Speed Flows
      - Chair: Andrew J. Majda
      - Princeton University
    - Minisymposium 2/Washington Room
      - Computation of Systems with Complex Chemical Kinetics
        - Chair: Robert J. Kee
        - Sandia National Laboratories
    - Minisymposium 8/Nevada Room
      - Turbulent Combustion
        - Chair: Jay P. Boris
        - Naval Research Laboratory

### Monday, March 9/PM
- 12:30 PM/Lunch
- 2:00 PM/Concurrent Sessions
  - Contributed Presentations 1/Emerald Room
  - Finite Element Methods
    - Chair: Bernard Larrouetou
    - INRIA-Sophia Antipolis, France
    - Contributed Presentations 2/Washington Room
  - Detonation Stability
    - Chair: John Buckmaster
    - University of Illinois, Urbana and University of Washington, Seattle
- 3:30 PM/Coffee
- 4:00 PM/Concurrent Sessions
  - Contributed Presentations 3/Emerald Room
  - Detonations
    - Chair: Antoni Oppenheim
    - University of California, Berkeley
    - Contributed Presentations 4/Washington Room
  - Turbulence
    - Chair: Jay P. Boris
    - Naval Research Laboratory
    - Contributed Presentations 5/Nevada Room
  - Complex Chemistry
    - Chair: D. Scott Stewart
    - University of Illinois, Urbana
- 8:00 PM/Crystal Room
  - Beer Party

### Tuesday, March 10/AM
- 8:30 AM/Emerald Room
  - Invited Presentations 3 and 4
    - Chair: Ronald Rehm
    - National Bureau of Standards
    - Gaithersburg, MD
- 8:30 AM
  - Physical Processes in Combustion Engineering that Require Advanced Numerical Treatment
    - Frediano V. Bracco
    - Princeton University
- 9:15 AM
  - The Use of Analytical Knowledge and Adaptive Gridding in Combustion Problems
    - James M. Hyman
    - Los Alamos National Laboratory
- 10:00 AM/Coffee
- 10:30 AM/Concurrent Sessions
  - Minisymposium 3/Emerald Room
    - Applications of Adaptive Gridding Methods to Combustion Problems
      - Chair: Bernard Larrouetou
      - INRIA-Sophia Antipolis, France
    - Minisymposium 4/Washington Room
      - Numerical Solution of Engineering Problems in Combustion
        - Chair: T. Daniel Butler
        - Los Alamos National Laboratory
### Program-At-A-Glance

**Tuesday, March 10/PM**

**12:30 PM/Lunch**

**2:00 PM/CONCURRENT SESSIONS**
- Contributed Presentations 6/Emerald Room
- Inviscid Flows/Flames in Chambers
  - Chair: Ashwani Kapila
  - Rensselaer Polytechnic Institute
- Contributed Presentations 7/Washington Room
- Drops and Sprays
  - Chair: Howard Baum
  - National Bureau of Standards, Gaithersburg, MD
- Contributed Presentations 8/Nevada Room
- **Plane Flames**
  - Chair: Guy Joulin
  - C.N.R.S., France
  - 3:30 PM/Coffee
- **4:00 PM/CONCURRENT SESSIONS**
  - Contributed Presentations 9/Emerald Room

**Wednesday, March 11/AM**

**8:30 AM/Emerald Room**

- **Invited Presentations 5 and 6**
  - Chair: Stephen Margolis
  - Sandia National Laboratories
  - 8:30 AM
  - **Numerical Solution of Moving Boundary Problems in Combustion Theory**
    - James G. Glimm
    - Courant Institute of Mathematical Sciences
    - New York University
  - 9:15 AM
  - **Using Asymptotics to Define Numerical Experiments in Combustion**
    - John Buckmaster
    - University of Illinois, Urbana and University of Washington, Seattle
  - 10:00 AM/Coffee
  - 10:30 AM/CONCURRENT SESSIONS
    - Minisymposium 5/Emerald Room
    - **Impact of Supercomputers on the Solution of Combustion Problems**
     - Chair: Harry Dwyer
     - University of California, Davis
     - Minisymposium 6/Washington Room
    - **The Role of Asymptotics in Computational Combustion**
     - Chair: D. Scott Stewart
     - University of Illinois, Urbana

**Wednesday, March 11 PM**

**12:30 PM/Lunch**

**2:00 PM/CONCURRENT SESSIONS**
- Contributed Presentations 12/Emerald Room
- **Vector Parallel Processing**
  - Chair: Sisira Weeratunga
  - Avco Research Laboratory
  - Minisymposium 7/Washington Room
- **Multidimensional Moving Boundary Problems**
  - Chair: Gunter H. Meyer
  - Georgia Institute of Technology
  - 3:30 PM/Coffee
  - 4:00 PM/CONCURRENT SESSIONS
    - Contributed Presentations 13/Nevada Room
    - **Theoretical Problems**
     - Chair: Arje Nachman
     - Air Force Office of Scientific Research
     - Contributed Presentations 14/Emerald Room
    - **Modeling of Laminar Flames**
     - Chair: Peyman Givi
     - Flow Research Company

**Special Notice to Contributed Presentation Authors and Chairmen of Contributed Presentation Sessions:**

Fifteen minutes are allowed for each contributed presentation. Presenters are requested to spend a maximum of 12 minutes for their presentation, and 3 minutes for questions and answers.

**Please note:**
For presentations with more than one author, an underlined name is used to denote the author who will present the paper.
MINISYMPOSIA

Monday, March 9/10:30 AM
Minisymposium 1/Emerald Room
DETONATION PHYSICS AND HIGH SPEED FLOWS

Recent work involving both numerical modeling and asymptotics on a variety of problems will be discussed including the following: the development of exothermic hot spots and their role in initiation of detonation; the decaying mechanisms and their effects on detonation velocity in expanding geometries, and theories for the regular spacing of Mach stems in reacting shock waves.

CHAIR AND ORGANIZER
Andrew J. Majda
Princeton University
Princeton, NJ

A Theory for Regular Spacing of Reacting Mach Stems
(to be presented by the chair)

Numerical Modeling Initiative of Reacting Shock Waves
Victor Roytburd
Rensselaer Polytechnic Institute
Troy, NY

Detonation Wave Initiation by Energy Deposition at a Boundary
D. R. Kassoy
University of Colorado, Boulder
Boulder, CO
and
J. F. Clarke
Cranfield Institute of Technology
Cranfield, England
and
N. Riley
University of East Anglia
Norwich, England

Some Theoretical and Numerical Results for Diverging Detonations
Bruce Bukiet and James Jones
Los Alamos National Laboratory
Los Alamos, NM

Tuesday, March 10/10:30 AM
Minisymposium 3/Emerald Room
APPLICATIONS OF ADAPTIVE GRIDDING METHODS TO COMBUSTION PROBLEMS

The solutions of many combustion problems exhibit sharp gradients in very thin regions. Therefore an adaptive gridding method, which concentrates the computational nodes in these regions of high spatial activity is necessary for an accurate numerical simulation of these phenomena at a reasonable cost. Several of these adaptive techniques will be described, for transient and steady-state problems, for one-dimensional and two-dimensional geometries. The accuracy and the effectiveness of the resulting numerical methods will be discussed for different physical phenomena.

CHAIR AND ORGANIZER
Bernard Larrouatiou
INRIA-Sophia Antipolis
Valbonne, France

Some Adaptive Numerical Methods for One- and Two-Dimensional Combustion Problems
(to be presented by the chair)

Static and Dynamic Regridding in Extrapolation Integrators for Reaction-Diffusion Systems
U. Nowak
Konrad-Zuse Zentrum für Informationstechnik
Berlin, Federal Republic of Germany

On the Use of Adaptive Methods for Combustion Problems with Complex Chemistry
Mitchell D. Smooke
Yale University
New Haven, CT

Tuesday, March 10/10:30 AM
Minisymposium 4/Washington Room
NUMERICAL SOLUTION OF ENGINEERING PROBLEMS IN COMBUSTION

This series of papers deals primarily with the application of computer programs for the analysis of transient, multidimensional combusting flows. Such numerical models are comprehensive in nature requiring detailed descriptions for the couplled fluid dynamics, mixing, heat transfer, chemical reactions, and fuel spray dynamics. Imperfections in the physics and chemical sub-models embodied in the codes exist. Nevertheless, applications of the codes to practical combustion systems are providing valuable insight and detailed understanding of the processes that occur. The authors will present example solutions to a broad spectrum of problems to illustrate the power of the solution methods.

CHAIR AND ORGANIZER
T. Daniel Butler
Los Alamos National Laboratory
Los Alamos, NM

Numerical Simulations of Reactive Flows
Elaine Oran
Naval Research Laboratory
Washington, DC

(title to be announced)
Keith McIntjes
General Motors Research Laboratories
Warren, MI

Two Recent Applications of the KIVA Computer Program
Peter J. O’Rourke
Los Alamos National Laboratory
Los Alamos, NM

Numerical Simulation of Flame Acceleration in Large-Confinned Channels
Kenneth D. Marx
Sandia National Laboratories
Livermore, CA

Wednesday, March 11/10:30 AM
Minisymposium 5/Emerald Room
IMPACT OF SUPERCOMPUTERS ON THE SOLUTION OF COMBUSTION PROBLEMS

The purpose of this symposium is to present to the applied mathematics community a series of speakers who both develop methods for and use supercomputers in their research studies on combustion. The scientists who will be speaking have had or have access to supercomputers on a regular basis, and are very familiar with the capabilities and limitations of the available numerical algorithms in their areas of specialization. The presentations will include examples of their current research investigations, as well as discussions of their future research directions and plans.

CHAIR AND ORGANIZER
Harry A. Dwyer
University of California, Davis
Davis, CA
<table>
<thead>
<tr>
<th>Minisymposia</th>
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| **Simulation of Supersonic Chemically Reacting Mixing Layers**  
J. Philip Drummond and M. Y. Hussaini  
NASA Langley Research Center  
Hampton, VA |
| **Numerical Aspects in Computing Hyperbolic Conservation Laws with Stiff Source Terms**  
Helen C. Yee  
NASA Ames Research Center  
Moffett Field, CA |
| **Numerical Simulation of Turbulent Premixed Flame Structure**  
William T. Ashurst  
Sandia National Laboratories  
Livermore, CA  
and  
N. Peters  
Institute für Allgemeine Mechanik  
Aachen, W. Germany  
and  
Mitchell D. Smooke  
Yale University  
New Haven, CT |
| **Analysis of Combustion Instability in Liquid-Fueled Ramjets**  
William A. Sirignano  
University of California, Irvine  
Irvine, CA  
and  
Sirignano  
Northwestern University  
Evanson, IL |
| **Adaptive Pseudo-Spectral Computation of Combustion Problems on Supercomputers**  
A. Bayliss  
Northwestern University  
Evanson, IL  
and  
B. J. Matkowsky  
Northwestern University  
Evanson, IL  
and  
Argonne National Laboratory  
Argonne, IL  
and  
M. Minkoff  
Argonne National Laboratory  
Argonne, IL |

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**Further Numerical Results from Detonation Theory**  
G. S. S. Ludford  
Cornell University  
Ithaca, NY  
and  
C. Schmidt-Laine  
Ecole Centrale de Lyon  
France |
| **The Role of Asymptotics in Detonation Initiation Calculation**  
Ashwani K. Kapila  
Rensselaer Polytechnic Institute  
Troy, NY  
and  
University of Minnesota  
Minneapolis, MN |
| **Computation of Criticality in Combustion**  
Karl Gustafson  
University of Colorado  
Boulder, CO |

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Wednesday, March 11/2:00 PM  
Minisymposium 8/Washington Room  
**TURBULENT COMBUSTION**

**Turbulent Combustion**  
Turbulent Combustion depends on the interactions between turbulent fluid dynamic convection, molecular diffusion which must mix the fuel and oxidizer, and chemical reactions which provide kinetic and buoyant energy to drive further turbulent convection. Thus, there are many additional physical effects and variables in turbulent combustion that do not appear in incompressible low Mach number constant density shear mixing. The three papers in this minisymposium consider turbulent combustion in the low, intermediate, and high Mach number regimes.  

**CHAIR AND ORGANIZER**  
Jay P. Boris  
Naval Research Laboratory, Washington, DC |

**Turbulence-Combustion Interactions in Shear Flow**  
Ahmed Ghoniem  
Massachusetts Institute of Technology  
Cambridge, MA |

**Simulations of the Reactive Flowfield in a Combustor**  
K. Kailasanath, J. H. Gardner, Elaine S. Oran, and J. P. Boris  
Naval Research Laboratory  
Washington, DC |

**Onset of Instability in Supersonic Shear Layers**  
R. Gutig, Berkeley Research Associates, Springfield, VA and T. Young, K. Kailasanath, E. Oran, and J. P. Boris  
Naval Research Laboratory, Washington, DC |

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**Wednesday, March 11/10:30 AM**  
Minisymposium 6/Washington Room  
**THE ROLE OF ASYMPTOTICS IN COMPUTATIONAL COMBUSTION**

This minisymposium will focus on numerical problems that have been formulated by the asymptotic theory of combustion. The issue of using asymptotically derived information to enhance direct combustion simulations will be discussed.  

**CHAIR AND ORGANIZER**  
D. Scott Stewart  
University of Illinois  
Urbana, IL |

**Numerical Simulation of Buoyancy Induced Motion of a Hydrogen Flame Bubble**  
Sistra K. Weeratunga  
Aero Research Laboratory, Inc.  
Everett, MA  
and  
John D. Buczkowski  
University of Illinois, Urbana and University of Washington  
Seattle, WA  
and  
Robert E. Johnson  
University of Illinois  
Urbana, IL |
The Effect of An Imbedded Void Upon the Detonation Initiation
Gabi Luttwak, Rafael Ballistics Center, Haifa, Israel

Moving Mesh Forest Fire: A Computational Method for Detonations
W. David Barfield, Los Alamos National Laboratory, Los Alamos, NM

A Model for the Short-Pulse-Duration Shock-Initiation of Explosives
John Starkenberg, U.S. Army Ballistics Research Laboratory, Aberdeen Proving Ground, MD

A Study of Shock-Induced Reaction Processes in Heterogeneous High Explosives
Pier K. Tang, Los Alamos National Laboratory, Los Alamos, NM

A Numerical Model of Combusting Two-Phase Flow in Interior Ballistics
Garry D. Tong, Computational Fluid Mechanics International, South Australia, Australia

TURBULENCE

Computation of Turbulent Diffusion Flames with Radiation
P. L. Viollet, D. Garretton and N. Mechloua, Electricite de France, Chatou, France

Reactive In-Cylinder Flow Simulation by an Implicit Finite-Difference Method
Chia-Chun Hsiao and Fa-Yan Su, Science Applications International Corporation, San Diego, CA

Computation of Turbulent Combustion Characteristics
Essam Eldin Khalil, Cairo University, Cairo, Egypt

The Prediction of Density Fluctuation Influences in High Temperature Axisymmetric Turbulent Jet
P. G. Huang, Michigan Technological University, Houghton, MI and M. A. Leschziner, University of Manchester Institute of Science and Technology, Manchester, England

Investigation of the Modeling of Turbulent Molecular Mixing
G. Kosaly, University of Washington, Seattle, WA and P. Giwi, Flow Research Company, Kent, WA

Numerical Analysis of Combustion Fields In Enclosures
Antoni K. Oppenheim, Maciej Z. Pindera and Douglas A. Rotman, University of California, Berkeley, CA

Numerical Modelling of Flames
Maciej Z. Pindera, University of California at Berkeley, Berkeley, CA

A Numerical Study of Turbulent Reactive Flows in Combustion Chambers
Gaffie D. Hebrard, ONERA-CERT DERMEX, Toulouse, Cedex, France

DROPS AND SPRAYS

Numerical Combustion of Multi-Phase Fluids
Pak Yan-Liang, Rockwell International Corporation, Canoga Park, CA

Dispersion During Evaporation of Drops in Clusters
Josette Béland and Kenneth G. Harstad, Jet Propulsion Laboratory, Pasadena, CA

Mixed Spectral Finite Element Method in Spray Combustion
T. J. Chung, and S. K. Lee, The University of Alabama in Huntsville, Huntsville, AL

Droplet Deformation and breakup in Shear Flows
D. E. Frye, and E. S. Oran, Naval Research Laboratory, Washington, DC
Tuesday, March 10/2:00 PM
Contributed Presentations 8/Nevada Room

PLANE FLAMES

Modified Equation Methods for Laminar Flame Calculations
J. I. Ramos, Carnegie-Mellon University, Pittsburgh, PA

Thick Flames with Localised Heat Loss
Andrew C. McIntosh, The University of Leeds, Leeds, England

Computation of Laminar Burning Velocity of Hydrogen-Enriched Methane-Air Mixture
Shmuel Refael and Eran Sber, Ben-Gurion University of The Negev, Beer-Sheva, Israel

Travelling Combustion Waves in a Porous Medium
Andrew Stuart, Oxford University, Oxford, England

Extinction of Strained Premixed Laminar Flames with Complex Chemistry
Vincent Giovagnigli, Universite Paris VI and Ecole Centrale des Arts et Manufactures, France, and Mitchell D. Smooke, Yale University, New Haven, CT

Partial Extinction of Strained Premixed Laminar Flames with Complex Chemistry

Calculated Extinction Limits for Diluted Laminar Propane/Air Flames
Richard J. Blint, General Motors Research Laboratories, Warren, MI

Tuesday, March 10/4:00 PM
Contributed Presentations 9/Emerald Room

FLAME VORTEX INTERACTION

A Numerical Analysis of a Diffusion Flame-Vortex Interaction
Alan Leverdant, ONERA, Chatillon, France, and Sebastien Candel, ONERA, Chatillon France and E. M2, C. Ecole Centrale, Chatenay Malabry

An Implicit Numerical Procedure for Multispecies Diffusion in Chemical Laser Flows
Victor Quan, Rockwell International, Canoga Park, CA

Calculations of a Two-Dimensional Flame in a Vortex Field
Ronald G. Rehm, Daniel W. Lozier, and Howard R. Baum, National Bureau of Standards, Gaithersburg, MD

Transient Combustion in a Turbulent Eddy
Howard R. Baum, Daniel M. Corley and Ronald G. Rehm, National Bureau of Standards, Gaithersburg, MD

Analysis of Heat Release During Flame-Vortex Pair Interactions
Bose V. S. Manda, and Ann R. Karagolivan, University of California at Los Angeles, Los Angeles, CA

Direct Numerical Simulation of Scalar Dissipation in a Turbulent Mixing Layer
P. A. McMurry, University of Washington, and P. Givi, Flow Research Company, Kent, WA

Tuesday, March 10/4:00 PM
Contributed Presentations 10/Washington Room

NEW NUMERICAL METHODS

Lagrangian Flame Modelling Using Adaptive Gridding
K. Balasubraman, P. J. Ronney, E. S. Oran and J. P. Boris, Naval Research Laboratory, Washington, DC

Second Order Scheme for Reacting Flow Application to Detonation
A. Bourgade, Cei-V. CEA Villeneuve St. Georges, France

A Second-Order Random-Choice Algorithm for Hyperbolic Systems of Equations
P. L. Roe, E. F. Toro, Cranfield Institute of Technology, United Kingdom

BIC-FEM-CT For Combustion Problems
R. Lohner and G. Patnaik, Berkeley Research Associates, Springfield, VA and Naval Research Laboratory, Washington, DC

Effect of Boundary Conditions in Computational Flame Simulation
S. Nakamura, The Ohio State University, Columbus, OH

Multiquadrics: A New Tool For Accurate Hydrodynamic Simulations
Edward J. Kansa, Lawrence Livermore National Laboratory, Livermore, CA

Tuesday, March 10/4:00 PM
Contributed Presentations 11/Nevada Room

COAL COMBUSTION

A Comprehensive Single Particle Char Combustion Model
Yam Yee Lee, University of Mississippi, University, MS

Mathematical Modeling of Coal Dust Explosions

Equilibrium Composition for Coal Flames Including Condensed Phases as Nonideal Solutions
Francis E. Spencer, Jr., David J. Wildman and James C. Hendrie, Jr., Pittsburgh Energy Technology Center, Pittsburgh, PA

Estimation of Standard Enthalpy for Coal from ASTM Heating Value via Linear Programming
Francis E. Spencer, Jr., and David J. Wildman, Pittsburgh Energy Technology Center, Pittsburgh, PA

Simplified Model of Coal Particle Combustion
M. J. Lytle and Ismail Celik, West Virginia University, Morganton, WV and Thomas J. O'Brien, Morganton Energy Technology Center, Morganton, WV

Application of Single Char Particle Model to the Combustion of Portuguese Anthracites
Joao Fernando Pereira Gomes, OPPI, SARL Lisbon, Portugal

Wednesday, March 11/2:00 PM
Contributed Presentations 12/Emerald Room

VECTOR/PARALLEL PROCESSING

Vectorizing “Bit-Twiddling” Algorithms
David S. Dodson, Convex Computer Corporation, Richardson, TX

Scramjet Simulation on the CEDAR Multiprocessor Supercomputer
Richard Roloff, University of Illinois, Urbana, IL

Parallelization of an Elliptic Solver for Reacting Flows
David E. Keyes, and Mitchell D. Smooke, Yale University, New Haven, CT

Optimization of Householder Transformations Part I: Linear Least Squares
Jim Armstrong, Convex Computer Corporation, Richardson, TX

Wednesday, March 11/4:00 PM
Contributed Presentations 13/Nevada Room

THEORETICAL PROBLEMS

Shock Waves in the Inviscid Limit of the id Navier-Stokes Equations for Compressible Flow
David Hoff, Indiana University, Bloomington, IN, and Tai-Ping Liu, University of Maryland, College Park, MD
**Contributed Presentations**

- The Application of Symmetry and Bifurcation Theory to the Study of Burner-Stabilized Flames
  Barbara Keyfitz, University of Houston, Houston, TX
- The Existence and Behavior of Viscous Structure for Plane Detonation Waves
  David H. Wagner, University of Houston, Houston, TX
- Catastrophic Instabilities in Square Wave Models of Detonation
  Rodolfo R. Rosales, Massachusetts Institute of Technology, Cambridge, MA
- Critical Behavior of an Ignition Model in Chemical Combustion
  Peter J. Tonellato, Marquette University, Milwaukee, WI and Paul C. Fife, University of Arizona, Tucson, AZ
- The Calculations of the Derivative of Second Virial Coefficients Based on exp-6 Intermolecular Potential
  Wu Xiong, Xian Modern Chemistry Research Institute, Xian, China

**TRANSPORTATION INFORMATION**

**By Air**

PARKWAY TRAVEL has been selected to be the official agent for the conference and will guarantee the lowest fares available to San Francisco. Calling hours are 8:30 am – 5:30 pm (EST) Monday through Friday. Call toll-free from the U.S. 1-800-236-6500. If calling from abroad, phone 1-215-977-9666. Be certain to mention that you are attending the March SIAM Conference on Numerical Combustion in San Francisco. Parkway Travel will mail you your tickets upon flight confirmation.

**SPECIAL DISCOUNTS**

United Airlines has been chosen as the official carrier for the conference and they have agreed (through Parkway Travel) to offer up to 40% off of regular coach fares, or 5% off the lowest applicable fare. These special fares will not be available through any agency other than Parkway Travel and we suggest that you call them before making other arrangements. Parkway Travel will give you the lowest fare regardless of which carrier you choose. In order to get the flight of your choice, we suggest making reservations as soon as possible.

**BY CAR FROM THE AIRPORT**

Take 101 North until the freeway splits. Go left towards the Golden Gate Bridge. Follow the Golden Gate signs to the end of the freeway until it becomes Franklin Street. Proceed three blocks to Post Street and turn right. Continue to the intersection of Van Ness Avenue and turn left. The hotel will be three blocks up, on the right.

**BY PUBLIC TRANSPORTATION FROM THE AIRPORT**

Take Lorries Airport Service, located on the island on the arrival level of the airport. The shuttle departs every twenty minutes, and costs $8.00. A taxi will cost $25.00.

**By Car**

**FROM LOS ANGELES**

Take highway 5 North to 580 West to the Bay Bridge. Take the Market Street exit on the right. Proceed to Market Street and turn left, and then take the first right onto Pine Street. Continue on Pine Street to Van Ness Avenue; the hotel is at 1500 Van Ness Avenue.

**CAR RENTAL**

Budget has been selected as the official car rental agency for the SIAM Conference on Numerical Combustion. The following rates apply:

<table>
<thead>
<tr>
<th>Type of Car</th>
<th>Daily Rate</th>
<th>Weekly Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economy</td>
<td>$827</td>
<td>$149</td>
</tr>
<tr>
<td>Compact</td>
<td>$829</td>
<td>$160</td>
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<tr>
<td>Intermediate</td>
<td>$831</td>
<td>$171</td>
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<tr>
<td>Full Size</td>
<td>$833</td>
<td>$182</td>
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<tr>
<td>Premium</td>
<td>$835</td>
<td>$193</td>
</tr>
<tr>
<td>Luxury</td>
<td>$839</td>
<td>$249</td>
</tr>
</tbody>
</table>

- We encourage you to make an advance reservation, as on-site availability cannot be guaranteed. Call 1-800-772-3773.
- Cars may be picked up at the airport, or at the 1301 Van Ness Street location downtown, just two blocks from the conference site.

- Cars must be picked up and dropped off at the same location.
- You will be given 100 free miles per day (cumulative) and charged 80.20 per mile thereafter.
- You must be 21 years of age to rent a car and have a valid drivers license.
- You must have one of the following credit cards to rent a car: AMEX, Master Card, VISA, Diners Club, Sears.
- The prices quoted do not include refueling services, tax, optional collision damage waiver, and personal accident insurance.
- Be certain to mention that you are attending the March 9 – 11, 1987 SIAM conference in San Francisco.

**HOTEL INFORMATION**

SIAM is holding a block of rooms at the conference site, the Holiday Inn-Golden Gateway. These rooms are being held on a first come, first served basis at $68/night and $80/week. These rooms will be held for our exclusive use only until February 14, after which date reservations will depend on availability.

We urge you to make your reservations as soon as possible. You may do so by telephoning (415) 441-4000, or via the Hotel Reservation Form on the inside back page of this brochure (domestic mail only). When making reservations by telephone, be certain to obtain the discounted rate by identifying yourself as an attendee at the SIAM Conference on Numerical Combustion.

**Late Arrival Policy:** If you plan to arrive after 6:00 pm, you must guarantee one night by payment at AMEX, VISA, MC or Diners Club.

Check-in 2:00 PM, check-out 12:00 noon

If you need to change or cancel your reservation, please be certain to contact the hotel by 4:00 PM on your stated day of arrival.

**REGISTRATION INFORMATION**

Please complete the Advance Registration Form, found on the inside back cover of this brochure, and return it to SIAM in the envelope provided (domestic mail only).

The registration desk will be located in the Emerald Room on the Lobby Level of the hotel, and will be open as listed below:

- **Sunday, March 8/5:00 PM – 10:00 PM**
- **Monday, March 9/7:00 AM – 8:00 PM**
- **Tuesday, March 10/8:00 AM – 6:00 PM**
- **Wednesday, March 11/8:00 AM – 6:00 PM**

**Registration Fees**

<table>
<thead>
<tr>
<th>SIAM Member</th>
<th>Non-Member</th>
<th>Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advance</td>
<td>$875</td>
<td>$895</td>
</tr>
<tr>
<td>On-Site</td>
<td>$895</td>
<td>$915</td>
</tr>
</tbody>
</table>

**Beer Party**

Monday, March 9, 8:00 PM
Crystal Room
$10.00
NON SIAM MEMBERS
Non-member registrants are encouraged to join SIAM in order to obtain the member rate for conference registration and all the other benefits of SIAM membership.

SIAM CORPORATE MEMBERS
Non-member attendees who are employed by the following institutions are entitled to the SIAM member rate:
Aerospace Corporation
Amoco Production Company
AT&T Bell Laboratories
Boeing Company
Cray Research, Inc.
Culler Scientific Systems Corporation
E.I. Du Pont de Nemours and Company
Eastman Kodak Company
Exxon Production Research Company

Exxon Research and Engineering Company
General Electric Company
General Motors Corporation
Giers Schumberger
GTE Laboratories, Inc.
IBM Corporation
Institute for Computer Applications in Science and Engineering (ICASE)
IMSL, Inc.
MacNeal-Schwendler Corporation
Marathon Oil Company
Martin Marietta Energy Systems
Mathematical Sciences Research Institute
Standard Oil Company of Ohio (SOHIO)
Supercomputing Research Center, a division of Institute for Defense Analyses
Texaco, Inc.
United Technologies Corporation

CREDIT CARDS
SIAM is now accepting credit cards for the payment of registration fees and special functions. When you complete the Advance Registration Form, please be certain to indicate the type of credit card, the number, and the expiration date.

SPECIAL NOTE
There will be no prorated fees. There will be no refunds after the conference starts.

To Advance Registrants
Please be certain to process your advance registration form yourself. If this task is delegated to an employee, quite often the form does not reach SIAM by the deadline, and oftentimes not at all.
If SIAM does not receive your advance registration form by the stated deadline, you will be asked to give us a check or a credit card number at the conference. We will not process either until we have ascertained that your registration form has gone astray. In the event that we receive your form after the conference, we will return your check or credit card slip.

ADVANCE REGISTRATION FORM
SIAM Conference on Numerical Combustion
The form must be received at the SIAM office by March 4, 1987.

REGISTRATION FEES

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<td>$115</td>
</tr>
</tbody>
</table>

Registration amount enclosed: $___ $___ $___

Beer Party $10.00 $___ $___ $___

TOTAL $___ $___ $___

☐ I wish to pay by credit card. ☐ AMEX ☐ MC ☐ VISA

Card Number__________________________

Expiration date____________________

Signature__________________________

If paying by check, please make it payable to SIAM.

HOTEL RESERVATION FORM
SIAM Conference on Numerical Combustion
Holiday Inn-Golden Gateway, San Francisco, California
March 9 - 11, 1987

A limited number of specialty discounted rooms will be held for our exclusive use only until February 14, 1987, after which reservations will depend on availability. WE URGE YOU TO MAKE YOUR RESERVATIONS AS SOON AS POSSIBLE.

Your reservation is not confirmed unless verified by phone (415) 441-4000, or 800/HOLIDAY. Do not forget to place a stamp on the reverse side of this card.

Name ____________________________ Phone __________________

(please print) (please print)

Address __________________________

City ____________________________ State ________ Zip __________

Please reserve: ☐ Single/868 ☐ Double/890 ☐ Please guarantee my room for late arrival (after 6:00 p.m.)*

Arrival Date ____________ Arrival Time ____________ Check-out Date ____________

☐ AMEX ☐ MC ☐ VISA ☐ Dinners Club

Card Number ____________________________ Expiration Date ____________ Signature ____________

☐ Please send me information about membership in SIAM.

Domestic mail: Enclose card with payment in the envelope provided.
Foreign mail: Use your own envelope and mail to SIAM, 117 South 17th Street, 14th Floor, Philadelphia, PA 19103-5052, USA. Telephone: 215-564-2922.