SIAM Conference on

Mathematical and Computational Issues in Geophysical Fluid and Solid Mechanics

September 25–28, 1989

Stouffer Greenway Plaza Hotel
Houston, Texas

CONFERENCE THEMES

Reactive Flows in Porous Media
Adaptive Mesh Methods
Conservation Laws in Scientific Computing
Contaminant Transport Modeling
Fluid Flows Among Solid Obstacles
Domain Decomposition Methods
Mechanics of Geological Materials
Models of Fault Constitutive Properties

AND

SIAM Workshop on

Geophysical Inversion

September 27–29, 1989

WORKSHOP THEMES

Inverse Scattering
Tomography
Wave Equation Migration
Velocity Estimation
Elastic Inversion
Multiparameter Inversion
Complex Wave Phenomena
Inverse Modeling

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DEADLINE DATES

**Advance Conference and
Workshop Registration**

September 21, 1989

Hotel Reservations

August 21, 1989

CONFERENCE ORGANIZING COMMITTEE

William E. Fitzgibbon, Co-chair
University of Houston
Mary F. Wheeler, Co-chair
University of Houston
Richard E. Ewing
University of Wyoming
Roland Glowinski
University of Houston
Richard P. Kendall
J.S. Nolen & Associates, Houston
John MacBain
British Petroleum Exploration, Houston
George R. Sell
University of Minnesota
William W. Symes
Rice University
Alan Weiser
Exxon Production Research Corporation

WORKSHOP ORGANIZING COMMITTEE

J. Bee Bednar, Chair
Amerada Hess Corporation, Tulsa
Lawrence R. Lines
Amoco Production Company, Tulsa
R.H. Stolt
Conoco, Inc., Ponca City
A. B. Weglein
ARCO Exploration Company, Plano

CONFERENCE INVITED PRESENTATIONS

Monday, September 25/8:30 AM
Invited Presentation 1
Waves in Porous Media Saturated by Multiphase Fluids

Models for the propagation of waves in fluid-saturated porous media will be discussed. For a single-phase fluid the model is due to Biot (1956–1962); the object here is to develop a corresponding model for the case of a two-phase fluid (such as water and oil). The differential system will be presented, along with a description of conceptual experiments to define the coefficients in the equations. An application to well-logging will be outlined.

Jim Douglas, Jr.
Purdue University

Monday, September 25/9:15 AM
Invited Presentation 2
Advances in the Analysis of Reactive Flows

Combustion in fluids, solids, and heterogeneous materials involves two basic models of propagation — slow moving deflagrations with speeds on the order of 1 meter/sec. and fast moving detonations with speeds on the order of 1,000 meter/sec. Several problems regarding the formation, structure, and stability of detonation waves will be discussed. The differing role of small scale heterogeneities in both fluids and solids in enhancing combustion will be emphasized as well as some of the fundamental differences in the stability properties of multi-dimensional detonation waves for fluids and solids. The methods of analysis will involve sophisticated multiple scale asymptotics, homogenization theory, and numerical simulation both directly on the governing equations and also on various simplified asymptotic equations.

Andrew J. Majda
Princeton University

Monday, September 25/10:30 AM
Invited Presentation 3
Adaptive Mesh Methods for Reactive Flows

The numerical solution of nonlinear partial differential equations modelling reacting flows is often complicated by large local gradients in the solution that evolves in time. The discrete approximations to the solution and the differential equation are more accurate and efficient if the mesh is dense in regions with sharp transitions and sparse where the solution is smooth. Also, if the mesh points move so the solution at the mesh points changes slowly, then the time truncation errors can be significantly reduced. The methods we propose, do this by equidistributing a performance index or mesh function that reflects the accuracy of the numerical approximation. The time and space discretizations use second- and fourth-order conservative approximations on nonuniform moving meshes. Examples will be presented that compare different adaptive mesh and numerical differencing strategies.

James M. Hyman
Los Alamos National Laboratory

Monday, September 25/11:15 AM
Invited Presentation 4
Probing a Random Medium with a Pulse

In a variety of scientific and engineering applications, waves are used as probes of media so complex that their properties may profitably be described as random functions of position. The interpretation of results then requires a mixture of wave propagation and signal processing theories.

The speaker will present a theory for the signal generated when a pulse is backscattered from a randomly stratified half space. It is assumed that the medium has a stochastic microstructure embedded in the nontrivial macrostructure and is probed with a pulse intermediate between these two spatial scales. The problem is analyzed using limit theorems for stochastic differential equations with multiple spatial scales, and the backscattered signal is characterized as a locally stationary Gaussian process with frequency content that changes slowly with time in response to the medium macrostructure.

Benjamin S. White
Exxon Research and Engineering Company

Tuesday, September 26/8:30 AM
Invited Presentation 5
Conservation Laws in Scientific Computing

Numerical approximation of nonlinear hyperbolic conservation laws has been an active area of research for a long time due to the importance of conservation laws in the mathematical modelling of physical phenomena and the inherent difficulties in the numerical approximation by standard finite difference and finite element methods. The solution of nonlinear conservation laws generically develops discontinuities. The numerical schemes must be designed to handle solutions which are only piecewise smooth.

The speaker will present the background to modern high resolution shock capturing schemes. Basic principles and convergence results for these schemes will be outlined. The effect of spatial inhomogeneities will be discussed and applications to geophysical fluid mechanics will be presented.

Bjorn Engquist
University of California, Los Angeles

Tuesday, September 26/9:15 AM
Invited Presentation 6
Mathematical Aspects of Phase Separation

Spinodal decomposition and coarsening of a molten mixture of materials are processes that have been extensively modeled and studied. Nevertheless, the mathematics of these models is still in its infancy. Analogously, but less well known, models exist for mush formation and coarsening of pure substance. Recent mathematical developments regarding these models will be reviewed.

Paul Fife
University of Utah

CONFERENCE INVITED PRESENTATIONS

Tuesday, September 26/2:00
Invited Presentation 7
Conservation Laws that Change Type and Porous Medium Flow

Systems of conservation laws describing time evolution of a physical system are expected, on the basis of linear theory, to be of hyperbolic type. However, certain complex flows, such as multiphase flow in porous media, dynamic phase transitions in elasticity, and flows with liquid-vapor transitions, exhibit a change of type: linearization about some states leads to equations that are elliptic in space-time.

The speaker will summarize what is currently known about the mathematical properties of such systems, including solution of the Riemann problem, shock admissibility criteria, regularization by higher-order terms, and numerical simulation. She will also discuss the relation of systems which arise from modelling of phase transitions in solids to the examples which have appeared in modelling of three-phase flow in porous media.

Barbara Lee Keyfitz
University of Houston

Tuesday, September 26/2:45
Invited Presentation 8
Nonlinear Phenomena in Reacting Porous Media: Applications to Ore Body and Petroleum Reservoir Genesis

Coupling of reaction and transport in rocks can lead to a variety of nonlinear phenomena underlying the richness of natural and engineered geologic systems. To illustrate the variety of phenomena in reactive, porous media, three classes of systems are reviewed. Reaction fronts driven by an impulse flow are shown to support a hierarchy of morphological transitions ranging from the bifurcation of fingers to complex branching trees and states of oscillatory morphology. In stressed media, the coupling of mechanical and chemical variables can lead to the spontaneous segregation of the system into banded, spotted, and other patterns of mineral concentration. Finally, the coupling of reactions and kilometer-scale flows can yield flow-induced periodic arrays or rock cementation and porosity enhancement. The role of these phenomena in the generation, migration, and trapping of petroleum and the formation of ore bodies is discussed.

Peter J. Ortoleva
Indiana University, Bloomington

Wednesday, September 27/8:30 AM
Invited Presentation 9
Groundwater Flow and Contaminant Transport Modelling

The simulation of groundwater flow and transport is important, not only because it permits the forecasting of the environmental impacts of groundwater exploitation and contaminant remediation, but also because it is an essential element in the optimization algorithms used for cost effective design. While many of the early simulators focused upon groundwater flow and used standard finite difference strategies, those used today are designed to address relatively complex systems and often employ more sophisticated numerical procedures. The speaker will review the history of groundwater flow and transport modelling from the point of view of problem complexity and numerical procedures.

George F. Pinder
University of Vermont

Wednesday, September 27/9:15 AM
Invited Presentation 10
Models of Fault Constitutive Properties and Earthquake Occurrence

Earthquakes in the earth's crust, arise from unstable fault slip events that periodically release accumulating elastic strain energy. At the time of an earthquake, a sudden loss of fault strength occurs that is restored during the interval separating earthquakes. Faults often exhibit a period of stable decelerating slip after earthquakes and may undergo long-term stable fault creep or creep events that occur without earthquake slip. Sliding experiments on faults in the laboratory show similar behaviors.

The laboratory observations and sliding phenomena of faults in nature have been simulated using models with rate- and state-dependent constitutive laws for fault strength. The state dependence is of the fading memory type and the state variable has been interpreted to correspond to the age of load-supporting contacts along the fault. The contacts strengthen with increasing contactage. During slip, such contacts are continuously created and destroyed with the result that the effective age contacts depend on slip history.

In addition to regular limit cycles for slip instability and fault creep of various types, simulations show that chaotic unstable slip patterns can occur. Solutions for the instability nucleation process have been used in simulations of earthquake sequences. The nucleation process is highly time- and stress-dependent. The models indicate that rates of earthquake occurrence are sensitive to the history of stressing of the fault. Aftershocks and foreshocks sequences appear to result from perturbation of the stressing history.

James H. Dieterich
U.S. Geological Survey, Menlo Park, CA

Wednesday, September 27/2:00
Invited Presentation 11
An Operator Splitting, Domain Decomposition Numerical Model for Contaminant Transport in Aquifer Flow

The development of an accurate, robust, and cost-effective numerical model for the simulation of groundwater contamination and mitigation techniques will be discussed. These problems are of particular relevance today because of the increasing requirements by government and industrial groups to evaluate contamination situations. The application of parallel algorithms on emerging computer architectures offers great promise in developing more realistic and economical computer codes. Two fruitful approaches that we have employed are operator splitting and domain decomposition.

Mary Wheeler
University of Houston

Please see centerspread for
Program-At-A-Glance
and pages 10–11 for
Workshop on Geophysical Inversion.

Wednesday, September 27/2:45
Invited Presentation 12
Nonlinear Response of Geological Materials

A noteworthy feature of the mechanical response of geological materials is that highly nonlinear effects are observed in a variety of important practical situations. This is true, for example, of inelastic deformation of soils or reservoir rocks, of flow of granular media or of fluids through porous media, of stick-slip behavior on geological faults, and of fracture or comminution of rocks or concretes. The observed macroscopic behavior is often associated with microstructural failure or instability (microcracking, dilatancy, shear localization). Constitutive equations, both scalar and tensorial, which describe some of these effects will be discussed as well as the problems of experimental measurement of material properties.

Michael M. Carroll
Rice University

Thursday, September 28/8:30 AM
Invited Presentation 13
The Method of Homogenization for Fluid Flows Among Solid Obstacles

The mathematical theory of homogenization deals with the relations between microscopic scales, where the physical phenomena are described by partial differential equations, and the macroscopic scales where the effective equations may have a different form. This approach explains in a qualitative way why a fluid flowing among solid obstacles can be described by different macroscopic equations. The speaker will address some of the mathematical results in this direction.

Luc Tartar
Carnegie Mellon University

Thursday, September 28/9:15 AM
Invited Presentation 14
Elastic Guided Waves in Heterogeneous Media — Mathematical Analysis

The speaker will present some results concerning the theory of existence and behavior of guided waves in an elastic isotropic heterogeneous medium occupying the whole space $\mathbb{R}^3$ in which the coefficients are supposed to depend only on two space coordinates. These results are obtained by using the abstract spectral theory of self adjoint operators in Hilbert spaces and more specifically the well known Max-Min principle. For instance, this approach has been successfully applied to various problems of guided waves in acoustic stratified media and in optical fibers.

Alain Bamberger
Institut Francais du Petrole, France

MINISYMPOSIA

Minisymposium 1
Combustion

The speakers will discuss the interaction between numerical calculations and theoretical asymptotic approximations in the study of the propagation of reacting fronts. In particular, the focus will be on topics such as geometrical shock/detonation dynamics, the influence of small scale heterogeneities enhancing combustion in both solid and fluids — including the effects of high frequency nonlinearly resonant waves — and the related topic of "hot spot formation" (important for the understanding of D.D.T.).

Organizer: Rodolfo R. Rosales
Massachusetts Institute of Technology

Detonation Instability and the Character of the Frequency Spectrum of Plane Detonation Flows
D. Scott Stewart, University of Illinois, Urbana

Modeling Multidimensional Detonation with Detonation Shock Dynamics
John B. Bdzil, Los Alamos National Laboratory

Detonation Waves and Deflagration Waves in the One Dimensional ZND Model for High Mach Number Combustion
David H. Wagner, University of Houston

Fast Time Effects Due to Focussing of an Unsupported Detonation Wave
Rupert Klein, Princeton University

From Weak Detonation to ZND Detonation
Ashwani Kapila, Rensselaer Polytechnic Institute; and John B. Bdzil, Los Alamos National Laboratory

Dynamic Homogenization and the Interaction of Long and Short Waves
(To be presented by organizer)

Monday, September 25/2:00 – 6:00
Minisymposium 2
Chromatography, Characteristics, Fronts and Riemann Problems; Computations and Theory

Concentration, saturation and phase boundaries develop characteristic nonlinear wave forms and definite propagation speeds. They provide a simple picture for understanding the reservoir fluid flow which results from complex reservoir chemistry.

The speakers will examine two related issues: (a) chromatographic analysis to understand, in a single space dimension, the formation, propagation and interaction of concentration and saturation waves in petroleum reservoirs, and
(b) higher dimensional computations (e.g. front tracking) which use chromatography to identify and track or capture discontinuous waves such as Buckley-Leverett fronts. Recent advances in the mathematical theory of Riemann
problems enable a systematic solution for a wide range of saturation and compositional waves and reveal new and significant phenomena. Progress with computational methods shows that this mathematical analysis of Riemann problems can be used in higher dimensional computations as well as in one dimension.

Organizer: James G. Glimm
Courant Institute of Mathematical Sciences, New York University

A Computational Tool to Study Riemann Problems
Bradley Plohr, University of Wisconsin, Madison

Characteristic Structure of Models for Multiphase Flow
John A. Trangenstein, Lawrence Livermore National Laboratory

Front Tracking, Oil Reservoirs, and Engineering Scale Problems
James G. Glimm, Courant Institute of Mathematical Sciences, New York University; Brent Lindquist, SUNY-Stony Brook; and Qiang Zhang, Courant Institute of Mathematical Sciences, New York University

The Pinch Off Phenomena in Two Viscous Flows in Hele-Shaw Cell
Qiang Zhang, Courant Institute of Mathematical Sciences, New York University

On the Solutions of Riemann Problems for Multi-Component Two-Phase Flow through Permeable Media
Thormond Johansen, Institute for Energy Technology; Larry W. Lake, University of Texas, Austin; Aslak Tveito and Ragnar Winther, University of Oslo, Norway

Theory of "Miscible" Displacement Processes
Franklin M. Orr, Jr., Stanford University

Monday, September 25/2:00 – 5:30
Minisymposium 3
Theoretical and Practical Aspects of Electrical Impedance Tomography

Electrical impedance tomography is a technique for imaging the interior of a conducting body. It works on the premise that voltage measurements on the boundary of the body caused by known applied currents contain information about the conductivity distribution in the body. This imaging technique has many applications including medical imaging, geophysical prospecting, and nondestructive evaluation.

There are several mathematical and practical issues that are currently being investigated. Questions of uniqueness and continuous dependence which are important in computations are being studied. On the practical side, there is the question of finding input current patterns which produce the largest signal-to-noise ratio, as well as the problem of designing efficient and accurate numerical schemes for data inversion. The speakers will address several of these topics.

Organizer: Fadil Santosa
University of Delaware

Imaging Fluid Flow in Rocks Using Electrical Impedance Tomography
James G. Berryman, Lawrence Livermore National Laboratory

Uniqueness in the Inverse Conductivity Problem for Many and Single Measurements
Victor Isakov, Wichita State University

Problems in Electric Current Computed Tomography
David Isaacson, Rensselaer Polytechnic Institute

The Discrete Inverse Conductivity Problem
Edward B. Curtis and James A. Morrow, University of Washington

Crack Detection and Characterization from Voltage Measurements
Fadil Santosa, University of Delaware; and Michael Vogelius, University of Maryland, College Park

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Tuesday, 10:30 AM – 12:30
Minisymposium 4 (Part 1 of 3)
Nonlinear Phenomena in Reactive Porous Media

Reaction-transport processes in porous media may lead to couplings that can dramatically affect the spatial distribution of mineralization and petroleum. Topics to be discussed include dissolution fingering, periodic precipitation, preservation of porosity/permeability and pressure seals through mechano-chemical coupling, electrical breakdown patterns and hydrothermal alteration.

Organizer: Peter Ortoleva
Indiana University, Bloomington

Precipitation of Banded Cements as Liesegang Phenomena
John Ross, Stanford University

Bifurcation of Dissolution Front Fingers
John Chadam, McMaster University

Simulating Hydrothermal Alteration
Anthony Lasaga, Yale University

Electric Breakdown Instabilities Associated with In Situ Coal Gasification
William B. Krantz, University of Colorado, Boulder

Tuesday, September 26/10:30 AM – 1:00
Minisymposium 5
Adaptive Techniques for Fluid Flow in Porous Media

Localized phenomena in space and time often dominate the overall physics of field scale geophysical fluid flow problems. Advanced concepts of discretization and accuracy across space and time domains are required to account for the localized phenomena. The complexity of these problems requires solution techniques sufficiently efficient to allow field scale simulations. These solution techniques should also take into account features of advanced computer architectures. Adaptive strategies are required.

The speakers will discuss some of the important ideas that potentially can address such of these questions, including practical and theoretical aspects as well as direct applications to reservoir simulation.

Organizers: J. C. Diaz, University of Tulsa; and R. E. Ewing, University of Wyoming, Laramie

A Linear Solver for Locally Refined Reservoir Simulation Models
Alan Weiser, Exxon Product Research Company

Practical Applications of Local Grid Refinement in Reservoir Simulation
M. Wasserman, Chevron Research Company

Grid Refinement for Reservoir Simulation
R.E. Ewing, University of Wyoming, Laramie; B. A. Boyett, and M. S. El-Mandouh, Mobil Research and Development

Time Stepping Methods with Local Refinement in Time As Well As Space
Joseph Pasciak, Brookhaven National Laboratory

Knowledge-Based Systems for Activity Indicators in Self-Adaptive Grid Methods
C. G. Macedo, Jr., University of Oklahoma; *J.C. Diaz*, University of Tulsa; and R. E. Ewing, University of Wyoming, Laramie

Issues in Geophysical Fluid and Solid Mechanics

MINISYMPOSIA

Tuesday, September 26/10:30 AM – 12:30
Minisymposium 6
Fundamental Waves in Flows of Fluids and Solids

Recent progress in the study of fundamental solutions of nonlinear conservation laws has illuminated the structure of flows of fluids and solids. Realistic models of these flows exhibit interesting complications, such as coincidence of wave speeds and change of type; the resolution of these phenomena has lead to new mathematical phenomena.

The speakers will focus on the structure of nonlinear waves in three-phase flows in porous media, in elastic solids, and in model problems that elucidate the new phenomena.

Organizer: Bradley Plohr
University of Wisconsin, Madison

Systems of Conservation Laws that Change Type
Helge Holden, University of Trondheim, Norway

Riemann Problems for Oil Reservoir Modeling
Eli Isaacson, University of Wyoming, Laramie

Solution of a Riemann Problem in Elasticity
Xabier Garaizar, Courant Institute of Mathematical Sciences, New York University

Systems of Nonstrictly Hyperbolic Conservation Laws
Michael Shearer, North Carolina State University

Tuesday, September 26/4:00 – 5:30
Minisymposium 7 (Part 1 of 3)
Some Analytic Advances in Differential Equations, Numerical Methods, and Inverse Problems

The speakers in this minisymposium will discuss some of their recent research in the areas of functional differential equations, differential equations with trace type functional coefficients, viscosity solution techniques, nonlinear stability analysis, inverse problems in seismology, and parameter determination, including numerical methods for some of these topics.

Organizer: John R. Cannon
Lamar University

Inverse Problems for Hyperbolic Equations Arising in Aerosol Modeling
Avner Friedman, Institute for Mathematics and Its Applications, University of Minnesota; and F. Reitich, School of Mathematics, University of Minnesota

The Reissner-Mindlin Plate Model: Boundary Layers and Numerical Methods
Richard S. Falk, Rutgers University

Multidimensional Inverse Eigenvalue Problems for the Schrodinger Equation
Victor Barcilon, University of Chicago

Tuesday, September 26/4:00 – 5:30
Minisymposium 4 (Part 2 of 3, see Part 1 on page 4)
Nonlinear Phenomena In Reactive Porous Media

Organizer: Peter Ortoleva
Indiana University, Bloomington

Modeling Geologic Reaction Fronts
John Weare, University of California, La Jolla

Simulating the Morphological Transition Hierarchy and Reaction Fronts
Chen Wei, Indiana University, Bloomington

Mechano-Chemical Feedback in the Sedimentary Basin
Thomas Dewers, Indiana University, Bloomington

Wednesday, September 27/10:30 AM – 12:30
Minisymposium 7 (Part 2 of 3, see part 1 on page 5)
Some Analytic Advances in Differential Equations, Numerical Methods, And Inverse Problems

Organizer: John R. Cannon
Lamar University

"Optimal Filtering" for Some Inverse Problems
Lars Elden, Linkoping University; Richard E. Ewing, University of Wyoming; and Thomas I. Seidman, University of Maryland, Baltimore County

Trace Type Functional Partial Differential Equations
P. DuChateau, K. Steube, Colorado State University; and John R. Cannon, Lamar University

High Frequency Inversion Aperture
Norman Bleistein and Jack K. Cohen, Colorado School of Mines

An Inverse Problem of Electro Encephalography
C. Denson Hill, SUNY-Stony Brook

Wednesday, September 27/10:30 AM – 12:30
Minisymposium 8
The Structure and Dynamics of Fluids in Micropores and Near Surfaces

As the diameter of particles comprising a fluid approach the pore diameter, fluid-wall interactions begin to play a critical role in determining the fluids' properties. Similarly, solvent and ionic structure are affected in the vicinity of charged surfaces. Such effects are important in tribology, rheology, capillary condensation, oil recovery and drilling, membrane filtration and so on. The speakers will address recent theoretical and computational advances that have shed considerable insight into the behavior of fluids in micropores and near surfaces. Modeling results involving full-reference hypernetted-chain theory, molecular dynamics, grand-canonical Monte Carlo methods, and polar continuum theories will be presented.

Organizer: John H. Cushman
Purdue University

The Structure of Electrolyte Solutions Near Charged Surfaces
G. M. Torrie, Royal Military College, Kingston, Canada

Shearing Flow of Identical, Smooth, Nearly Elastic Spheres Between Bumpy Boundaries
James T. Jenkins, Cornell University

Structure, Transport, and Flow of Fluids in Planar Pores
Ioannis Bitsanis, Susan Somers, Matthew Tirrell, and H.T. Davis, University of Minnesota

Diffusion and Shear Stress in Micropores
Martin Schoen, Universitat Witten/Herdecke, West Germany; Dennis L. Diestler, John H. Cushman, and Charles L. Rhykerd, Jr., Purdue University

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Wednesday, September 27/10:30 AM – 1:00
Minisymposium 9
Theory and Application of Wavelet Technology in the Geosciences

Knowledge of the propagating wavelet is essential for stratigraphic quality, seismic processing, synthetic to seismic correlation, seismic modelling, and amplitude vs. offset analysis. In the common midpoint record domain, the wavelet changes with offset as well as time. Determining this wavelet from the data and designing the wavelet to enhance certain features have both proven to be elusive problems.

Organizer: John MacBain
British Petroleum Exploration, Houston

Blind ARMA Deconvolution
J. Bee Bednar, Amerada Hess Corporation

Wavelet Estimation for an Acoustic or Elastic Earth
A. B. Weglein, Arco Oil and Gas Company; and B. G. Secrest, British Petroleum Exploration, Houston

Estimation and Shaping the Seismic Wavelet
M. Turhan Tanner, Seismic Research Corporation and Rice University

A Method of Factoring Long Z-Transform Polynomials
J. P. Lindsey, GeoQuest International, Inc.; and James W. Fox, Houston, Texas

Source Identification in Remote Sensing Problems
Bruce Secrest, and John MacBain, British Petroleum Exploration

MINISYMPOSIA

Wednesday, September 27/4:00–6:00
Minisymposium 4 (Part 3 of 3, see Part 1 on
page 4)

Nonlinear Phenomena in Reactive Porous Media

Organizer: Peter Ortoleva
Indiana University, Bloomington

Use of Geochemical Modeling to Improve Acid Simulation Treatment — An Example from the Halfway Formation, Canada
Helen K. Haskin, Texaco, Inc.; Craig H. Moore, Geo-Chemical Research Associates; and Jon S. Dudley, Texaco Canada

Resources Viscous Fingering Through Fractile Media
Ernest Chung, Chevron Oil Field Research Corporation

A Local Equilibrium Method for Predicting Mineral Zoning Sequences
Larry Lake, University of Texas, Austin

Dissolution Fingering at Reaction Fronts
Mary Wheeler, University of Houston

Wednesday, 4:00–6:00
Minisymposium 7 (Part 3 of 3, see Part 1 on
page 5)

Some Analytic Advances in Differential Equations, Numerical Methods, and Inverse Problems

Organizer: John R. Cannon
Lamar University

Diffusion Models with Microstructure
Ralph E. Showalter, University of Texas, Austin

Regularity of the One-Dimensional Acoustic Output Least Squares Forward Map
Robert Michael Lewis and William W. Symes, Rice University

Nonlinear Stability Analyses of Pattern Formation in Dissipative Systems
David J. Wollkind, Washington State University

Integro-Differential Equations of Parabolic Type
John R. Cannon, Lamar University; and Yanping Lin, McGill University

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Thursday, September 28/10:30 AM–1:00
Minisymposium 10

Dynamic Geologic Modeling

Traditionally, geology has been an observational science. Geologists primarily interpreted data using deduction, experiences and intuition. The evolution of geology into a quantitative science, however, coupled with the recent development of cheap, high speed, large memory computers, is now enabling geologists to model dynamic processes and systems operating on global and basinal scales over geologic time. This advance is permitting a more comprehensive evaluation of geologic information, constraining interpretations to that which is physically reasonable and resulting in better predictions away from points of observation.

Topics to be addressed in this session include concepts and methods used in modeling, including fractals, practical applications of model solutions, stratigraphic and subsurface fluid flow modeling, diagenesis, and the impact of visualization techniques on interpretation.

Organizer: Martin A. Perlmutter
Texaco E&P Technology Division, Houston

Mathematics and Geology: Scientific Control of Art and Legerdemain
I. Lerche, University of South Carolina

Fractal and Physical Models for Sediment Transport and Deposition
Karen L. Prestegard and Roy E. Plotnick, University of Illinois, Chicago

Computer Simulation of Clastic Sedimentary Processes
Daniel M. Tetzlaff, Atlas Wireline Services

Mathematical Models of Subsurface Processes in Sedimentary Basins
Charles H. Norris and Craig M. Bethke, University of Illinois, Urbana

Scientific Visualization and Numerical Geological Modeling
Lyle D. Meier, Texaco, Houston

Thursday, September 28/10:30 AM–12:30
Minisymposium 11

Novel Computational Procedures For Water Resources

Effective simulation of nonlinear water resources problems involving advection and transport requires improved methods of model formulation and solution. In this minisymposium, promising methods will be presented which allow for optimal spatial approximation, tracking of particles in reactive flows, efficient matrix solution, and simulation of thermally induced instabilities.

The techniques will be presented in the context of particular surface and subsurface flow and transport problems but will offer potential benefits across the spectrum of geophysical simulation problems.

Organizer: William G. Gray
University of Notre Dame

Localized Adjoint Methods for Porous Media Flow Problems
Michael A. Celia, Massachusetts Institute of Technology; Ismael Herrera, Instituto de Geofisica, Mexico; Thomas F. Russell, University of Colorado, Denver; and Richard E. Ewing, University of Wyoming, Laramie

The Conjugate Gradient Method Applied to the Wave Equation
Ingemar P. E. Kinnmark and Jose E. Robledo, University of Notre Dame

Stability of the Steam-Liquid Layer in a Porous Medium Heated from Below
Bruce Simpson and Peter A. Forsyth, University of Waterloo, Canada

Simulation of Reactive Transport in Natural Porous Media Using Particle Methods
Andrew F. B. Thompson, Lawrence Livermore National Laboratory; David E. Dougherty, University of California, Irvine; and Richard B. Knapp, Lawrence Livermore National Laboratory

CONTRIBUTED PRESENTATIONS

Monday, September 25/4:00
Contributed Presentations 1

Higher-Order Numerical Techniques for Shocks in Soils
John A. Trangenstein, Lawrence Livermore National Laboratory

Model for Non-Linear Response of Partially and Fully Saturated Porous Media
Tom Dey, Los Alamos National Laboratory

Study of Catastrophic Behavior in Air Elastic System
Vadim Komkov, Air Force Institute of Technology

Numerical Simulation of Shock Attenuation in Saturated Rock
Robert P. Swift and Armand V. Attia, Lawrence Livermore National Laboratory

Thin Plate Flexure on a Stratified Lithosphere
Dennis L. Harry and John F. Ferguson, University of Texas, Dallas

Monday, September 25/4:00
Contributed Presentations 2

A Numerical Study of the Onset of Baroclinic and Related Instabilities in Spherical Geometry
Joseph D. Fehribach, University of Alabama, Huntsville; and Timothy L. Miller, NASA/Marshall

The Stability of Oceanic Eddies and Fronts on a Continuously Stratified Ocean
John Kroll, Old Dominion University

Valve Like Critical Level in a Rotating Compressible Atmosphere
P. Kandaswamy, Bharathiar University, India

Modeling of Coupled Heat-Mass-Stress Effects in Geological Media
Sharad Kelkar, George Zyvoloski and Steve Birdsell, Los Alamos National Laboratory

Monday, September 25/4:00
Contributed Presentations 3

Absorbing Boundary Conditions for Elastic Waves in the Presence of Interfaces
Robert L. Higdon, Oregon State University

Transient Reflectivity of Fluid Filled Porous Media
James Corones and Zhiming Sun, Iowa State University

Wave Propagation in Inhomogeneous Media: A One-Way Wave Multiple Scattering Series Solution
David M. Pai, University of Houston

An Absorbing Boundary Condition Using a Retarded Time Equation
Yi Luo and Gerard Schuster, University of Utah

Tuesday, September 26/ 4:00
Contributed Presentations 4

Eigenmodes for an Elastic Halfspace Surrounding a Semi-rigid Circular Cylinder
Pratap N. Sahay, CICECE, Espinoza, Mexico; and Anton Z. Capri, University of Edmonton, Canada

Multidomain Adaptive Pseudospectral Methods for Acoustic Wave Propagation in Discontinuous Media
Jeffrey M. Augenbaum, University of Connecticut, Storrs

Probing Electromechanically Coupled Porous Media using Surface Displacement and Displacement/Stress Conditions
Jeffrey R. Sachs, Clarkson University, and Alan J. Grodzinsky, Massachusetts Institute of Technology

Characterization of a Stratified Medium by a Method of Equivalent Impedances
P. Joly and J.E. Roberts, INRIA, France

Wave Propagation in Inhomogeneous Media: A Method of Generalized Separation of Variables
David M. Pai, University of Houston

Tuesday, September 26/ 4:00
Contributed Presentations 5

An Analytical Solution of a Leaky Artesian Well Problem
John Bownds, Oak Ridge National Laboratory; and Tony Rizk, North Carolina State University

Combinatorial Optimization of Groundwater Remediation
David E. Dougherty, University of California, Irvine

Ground Water Flow from Recharge Basins
Daniel Dicker, SUNY, Stony Brook

Finite Element Solutions of the Flood Flow
Linda J. Hayes, Mehmet S. Cuhadaroglu, Stephen Wright and David Maidment, University of Texas, Austin

Comments on Sensitivity Conservation Laws in Solid and Fluid Mechanics
Vadim Komkov, Air Force Institute of Technology

On Upstream Weighting in Reservoir Simulation
Y. Brenier and J. Jaffre, INRIA, France

Wednesday, September 27/ 4:00
Contributed Presentations 6

Properties of the Magma and Modified Magma Equations
Jeffrey R. Sachs, Clarkson University; Daisuke Takahashi and Junkichi Satsuma, University of Tokyo, Japan

On Mathematical Relationships Between Some Mean Geoidal Heights and Local Gravity Anomaly
M. K. Paul, Geological Survey of Canada, Ottawa

Some Numerical Aspects of Modeling Wind Blown Turbulent Buoyant Plumes
Glenn P. Forney and Howard R. Baum, National Institute of Standards and Technology

A Problem of Kelvin-Helmholtz Instability
W.E. Harter and R. Narayanan, University of Florida

Wednesday, September 27/ 4:00
Contributed Presentations 7

Interpolation and 3-D Stereo-Modeling of Geophysical Quantities Inside Volumes
Rolland L. Hardy, Iowa State University

Elastic Composites with Crystallographic Symmetry
Richard James, University of Minnesota, Minneapolis; Robert Lipton, University of California, Berkeley; and Adam Lutoborski, Syracuse University

Fourth Order Schemes for the 3D Heterogeneous Acoustic Equations
Gary Cohen and Tuong Haduong, INRIA, France

Thursday, September 28/10:30 AM
Contributed Presentations 8

Fluid Dynamics of Non-Newtonian Systems
Derek M. Kiminta, Texas Tech University

Approximate Solutions to Flow Problems in Porous Media Using the Integral Method
Robert W. Zimmerman and Gudmundur S. Bodvarsson, University of California, Berkeley

Simulation by Homogenization in Heterogeneous Media
Brahim Amaziane, Universite de Pau and C.N.R.S., France; Alain Bourgeat, Universite de Saint-Etienne, France; and Joe Koebbe, Utah State University

Cellular Automata Simulation of Multicomponent Porous Flow Processes at the Pore Scale
Kenneth Eggert, Bryan Travis, Shiyi Chen and Gary Doolen, Los Alamos National Laboratory

Three Dimensional Cellular Automata Solutions of Porous Flow and Transport
Bryan J. Travis, Kenneth G. Eggert and Shi Yi Chen, Los Alamos National Laboratory

Comparative Study of Pseudospectral and Petrov-Galerkin Numerical Simulation of Laboratory Displacement Experiments
Oistein Boe, Stig Hestholm and Aladin Kamel, IBM Bergen Scientific Center, Norway

Thursday, September 28/10:30 AM
Contributed Presentations 9

Eulerian-Lagrangean Least Squares Collocation and the Transport Equation
L.R. Bentley, Princeton University; and G.F. Pinder, University of Vermont

A Parallel Pseudospectral Method for the Solution of the Wave Equation on a Hypercube
R.A. Renaut and M.L. Woo, Arizona State University

An Iterative Variational Solver for Approximating the Solution of Sparse Banded Matrix Equations in the Simulation of Subsurface Flows
Jerry F. Magnan and Richard Bertram, Florida State University

Least Squares Collocation Method for Solution of Transport Equations on Irregular Domains Using an Orthogonal Mesh
Jeffrey P. Laible and George F. Pinder, University of Vermont

Parsimonious Staggered Grid Finite-Differencing of the Wave Equation
Gerard Schuster and Yi Luo, University of Utah

Forward and Inverse Modeling of the Advection-Diffusion Equation in the Presence of Sharp Fronts
Manfred Koch and Gangpeng Zhang, Florida State University

7

CONFERENCE ON ISSUES IN GEOPHYSICAL FLUID AND SOLID MECHANICS

6:00-9:00 pm
Registration for Conference

7:00 pm
Welcoming Reception

7:00 am
Registration for Conference Opens

8:15 am
Welcoming Remarks
William Fitzgibbon
University of Houston

8:30 am
Invited Presentation 1
Waves in Porous Media Saturated by Multiphase Fluids
Jim Douglas, Jr.
Purdue University

9:15 am
Invited Presentation 2
Advances in the Analysis of Reactive Flows
Andrew J. Majda
Princeton University

10:00 am
Coffee

10:30 am
Invited Presentation 3
Adaptive Mesh Methods for Reactive Flows
James Hyman
Los Alamos National Laboratory

11:15 am
Invited Presentation 4
Probing a Random Medium with a Pulse
Benjamin White
Exxon Research and Engineering Co.

12:00 pm
Lunch

2:00-6:00 pm
Minisymposium 1
Combustion
Chair: Rodolfo R. Rosales
Massachusetts Institute of Technology

2:00-6:00 pm
Minisymposium 2
Chromatography, Characteristics, Fronts and Riemann Problems: Computations and Theory
Chair: James G. Glimm
Courant Institute of Mathematical Sciences, New York University

2:00-5:30 pm
Minisymposium 3
Theoretical and Practical Aspects of Electrical Impedance Tomography
Chair: Fadil Santosa
University of Delaware

3:30 pm
Coffee

4:00 pm
Contributed Presentations 1, 2, 3

8:30 am
Invited Presentation 5
Conservation Laws in Scientific Computing
Bjorn Engquist
University of California, Los Angeles

9:15 am
Invited Presentation 6
Mathematical Aspects of Space Separation
Paul Fife
University of Utah

10:00 am
Coffee

10:30 am-12:30 pm
Minisymposium 4 (Part 1 of 3)
Nonlinear Phenomena in Reactive Porous Media
Chair: Peter Ortoleva
Indiana University, Bloomington

10:30 am-1:00 pm
Minisymposium 5
Adaptive Techniques For Fluid Flow in Porous Media
Co-Chairs: J.C. Diaz, University of Tulsa, and R.E. Ewing, University of Wyoming, Laramie

10:30 am-12:30 pm
Minisymposium 6
Fundamental Waves in Flows of Fluids and Solids
Chair: Bradley Plohr
University of Wisconsin, Madison

1:00 pm
Lunch

2:00 pm
Invited Presentation 7
Conservation Laws that Change Type and Porous Medium Flow
Barbara Lee Keyfitz
University of Houston

2:45 pm
Invited Presentation 8
Nonlinear Phenomena in Reacting Porous Media: Applications to Ore Body and Petroleum Reservoir Genesis
Peter Ortoleva
Indiana University, Bloomington

3:30 pm
Coffee

4:00 pm-5:30 pm
Minisymposium 7 (Part 1 of 3)
Some Analytic Advances in Differential Equations, Numerical Methods, and Inverse Problems
Chair: John Cannon
Lamar University.

4:00 pm-5:30 pm
Minisymposium 4 (Part 2 of 3)
Nonlinear Phenomena in Reactive Porous Media
Chair: Peter Ortoleva
Indiana University, Bloomington

4:00 pm
Contributed Presentations 4, 5

6:00 pm
SIAM Beer Party/Justin's Lounge

WORKSHOP PROGRAM-AT-A-GLANCE

WORKSHOP ON GEOPHYSICAL INVERSION

Wednesday Morning, September 27

8:30 am
Invited Presentation 9
Groundwater Flow and Contaminant Transport Modelling
George F. Pinder
University of Vermont

9:15 am
Invited Presentation 10
Models of Fault Constitutive Properties and Earthquake Occurrence
James H. Dieterich
U.S. Geological Survey, Menlo Park

10:00 am
Coffee

10:30 am – 12:30 pm
Minisymposium 7 (Part 2 of 3)
Some Analytic Advances in Differential Equations, Numerical Methods, and Inverse Problems
Chair: John R. Cannon

10:30 am – 12:30 pm
Minisymposium 8
The Structure and Dynamics of Fluids in Micropores and Near Surfaces
Chair: John Cushman
Purdue University

10:30 am – 1:00 pm
Minisymposium 9
Theory and Application of Wavelet Technology in Geosciences
Chair: John MacBain
British Petroleum Exploration, Houston

Wednesday Afternoon, September 27

1:00 pm
Lunch

2:00 pm
Invited Presentation 11
An Operator Splitting, Domain Decomposition Numerical Model for Contaminant Transport in Acquifer Flow
Mary Wheeler
University of Houston

2:45 pm
Invited Presentation 12
Nonlinear Response of Geological Materials
Michael M. Carroll
Rice University

3:30 pm
Coffee

4:00 pm – 6:00 pm
Minisymposium 7 (Part 3 of 3)
Some Analytic Advances in Differential Equations, Numerical Methods, and Inverse Problems
Chair: John R. Cannon
Lamar University

4:00 pm – 6:00 pm
Minisymposium 4 (Part 3 of 3)
Nonlinear Phenomena in Reactive Porous Media
Chair: Peter Ortoleva
Indiana University, Bloomington

4:00 pm
Contributed Presentations 6, 7

Thursday Morning, September 28

8:30 am
Invited Presentation 13
The Method of Homogenization for Fluid Flows Among Solid Obstacles
Luc Tartar
Carnegie Mellon University

9:15 am
Invited Presentation 14
Elastic Guided Waves in Heterogenous Media — Mathematical Analysis
Alain Bamberger
Institut Francais du Petrole, France

10:00 am
Coffee

10:30 am – 1:00 pm
Minisymposium 10
Dynamic Geologic Modeling
Chair: Martin A. Perlmutter
Texaco Inc., Houston

10:30 am – 12:30 pm
Minisymposium 11
Novel Computational Procedures for Water Resources
Chair: William G. Gray
University of Notre Dame

10:30 am
Contributed Presentations 8, 9

Thursday Afternoon, September 28

1:00 pm
Conference Adjourns

6:00 pm
Chuck Wagon Buffet

Wednesday Morning, September 27

8:00 am
Registration for Workshop Opens

10:00 am
Welcoming Remarks
J. Bee Bednar
Amerada Hess Corporation

10:30 am
Invited Presentation 1
Seismic Inversion Revisited
R. H. Stolt
Conoco Inc., Ponca City, Oklahoma

11:15 am
Invited Presentation 2
Seismic Inverse Scattering and Migration/Inversion: Present Status and New Directions
A. B. Weglein
ARCO Oil and Gas Company

Wednesday Afternoon, September 27

12:00 pm
Lunch

1:30 pm
Contributed Presentations 1

3:30 pm
Coffee

4:00 pm
Invited Presentation 3
Seismic Inverse Methods for Complex Structures
Norman Bleistein Colorado School of Mines, Golden

4:45 pm
Invited Presentation 4
Inversion Algorithms: Problems and New Directions
Gregory Beylkin
Schlumberger Doll Research

Thursday Morning, September 28

8:00 AM
Contributed Presentation 2

10:00 AM
Coffee

10:30 AM
Invited Presentation 5
Global and Lithospheric Tomographic Inversion
Robert Clayton
California Institute of Technology

11:15 AM
Invited Presentation 6
Applications of Seismic Travel-Time Tomography: A Review
Lawrence R. Lines
Amoco Production Company

Thursday Afternoon, September 28

12:00 pm
Lunch

1:30 pm
Contributed Presentation 3

3:30 pm
Coffee

4:00 pm
Contributed Presentation 4

6:00 pm
Chuck Wagon Buffet

8:00 pm
Panel
Migration/Inversion — Practice vs. Science
Chair: J. Bee Bednar
Amerada Hess Corporation

Friday Morning, September 29

8:00 am
Contributed Presentations 5

10:00 am
Coffee

10:30 am
Invited Presentation 7
Multimode, One-Dimensional Wave Propagation in a Highly Discontinuous Medium
Robert Burridge
Schlumberger-Doll Research

11:15 am
Invited Presentation 8
Velocity Inversion by Coherency Optimization
William W. Symes
Rice University

Friday Afternoon, September 29

12:00 pm
Lunch

1:00 pm
Contributed Presentations 6

3:30 pm
Workshop Adjourns

WORKSHOP INVITED PRESENTATIONS

Wednesday, September 27/10:30 am
Invited Presentation 1

Seismic Inversion Revisited

Seismic Inversion has often been restricted to a few recent methods of extracting earth properties from seismic reflections. These methods are now mature enough to allow that most seismic processing addresses aspects of the inverse seismic problem; preemption of the term "inversion" for a select group of modern methods can be seen in retrospect as arrogant.

Conventional seismic processing has developed over time as robust, seat-of-pants inversion methodology. Modern concepts have the potential to provide new information, but in practice are less robust (some are useless).

Most of today's promising inversion methods have existed, at least conceptually, since early 1985. Now, however, there is greater appreciation that the earth is more complex than any model. The three independent parameters of the elastic earth model are recognized to be both too few and too many. The noisy, band limited nature of seismic data is more keenly appreciated today, as is the necessity of allowing for that nature in inversion schemes.

Developments in migration-inversion include the rise of constant-offset amplitude preserving migration. Facilitated by the Beylkin-Bleistein asymptotic formulation, this type of migration allows postmigration prestack processing, including residual moveout and amplitude versus offset (AVO) analysis.

Linearized inversion, as a form of AVO analysis, has moved from the conceptual to the experimental stage, where it has seen some success under ideal conditions.

R.H. Stolt
Conoco, Inc., Ponca City, Oklahoma

Wednesday Morning, September 27/11:15 am
Invited Presentation 2

Seismic Inverse Scattering and Migration/Inversion: Present Status and New Directions

Seismic inverse scattering has recently evolved to a state where practical procedures are available for obtaining new information about the subsurface. These multidimensional methods typically involve a form of amplitude preserving migration followed by an inversion at depth. These migration/inversion procedures can be made to compensate for real data limitations such as offset aperture. Wave theoretic methods for the preprocessing of seismic data will be described and examples will be presented.

A.B. Weglein
ARCO Oil and Gas Company

Wednesday Afternoon, September 27/4:00 pm
Invited Presentation 3

Seismic Inverse Methods for Complex Structures

The authors have been researching the approach and evolution of seismic modeling and inversion for the past fifteen years. One will trace the development of their work from inversions based on the simplest geometries and background velocity profiles to much more realstic geometries and backgrounds.

The application of the same ideas to the problem of transformation of data to zero offset (dip moveout) will be discussed. Graphical displays will demonstrate various aspects of his theory and a brief description of the theory, in the context of inversion of scalar data in a constant density medium, will be presented.

Norman Bleistein
Colorado School of Mines

Jack K. Cohen
Colorado School of Mines

Wednesday, September 27/4:45 pm
Invited Presentation 4

Inversion Algorithms: Problems and New Directions

Several linearized multi-parameter inversion algorithms and outline problems that affect their performance will be compared. The speaker will also describe a new approach, wavelet decomposition, that might eventually find its way into the inversion schemes.

Gregory Beylkin
Schlumberger Doll Research

Thursday, September 28/10:30 am
Invited Presentation 5

Global and Lithospheric Tomographic Inversion

Seismic tomography has the potential for producing high-resolution velocity inversions. In the crustal seismic reflection problem, the standard tomographic technique requires that the reflector position be known. An approach to this dilemma is to start with a reference model and apply tomography and seismic migration alternately. For the global velocity estimation problem, tomography can be applied to the large collection of earthquake travel times to produce refined models of the earth's mantle.

Robert Clayton
California Institute of Technology

Thursday Morning, September 28/11:15 am
Invited Presentation 6

Applications of Seismic Travel-Time Tomography – A Review

Recent applications of tomography to seismic travel-time inversion will be reviewed. The various implementations include both reflection and transmission tomography. In transmission tomography experiments, sources and/or receivers may be buried beneath the earth's surface, and the direct seismic arrival times are modeled. In reflection tomography, seismic sources and receivers are essentially at the surface, and reflected seismic arrival times are modeled. The reflection tomography procedure also provides useful velocity information for depth migration. The speaker will present data examples which illustrate the use of seismic travel-time tomography.

Lawrence R. Lines
Amoco Production Company

Friday, September 29/10:30 am
Invited Presentation 7

Multimode, One-Dimensional Wave Propagation in a Highly Discontinuous Medium

A pulse propagates obliquely through a one-dimensional medium consisting of a large number N of homogeneous elastic layers. As it propagates, the directly transmitted principal arrival is reduced by transmission loss at each interface, but close to this arrival is a broad pulse, made up of a multiply-scattered energy, which ultimately appears to diffuse about a moving center. This may be regarded as an extension to multimode propagation of the phenomenon first studied by O'Doherty and Anstey in 1971 and further corroborated and elucidated by many authors since then.

When the reflection coefficients at the interfaces are scaled as $1/\sqrt{N}$ while N $\to \infty$, and when time is measured in units of travel time across an average layer, the shape of the broad pulse approaches a limiting form, which propagates according to an integrodifferential equation analogous to the Kolmogorov-Feller forward equation in probability theory.

Robert Burridge
Schlumberger-Doll Research

Hung-Wen Chang
Schlumburger-Doll Research

Friday, September 29/11:15 am
Invited Presentation 8

Velocity Inversion by Coherency Optimization

The speaker will introduce an approach to velocity and reflectivity estimation based on optimizing a differential coherence measure for multiple shot-gather inversions of reflection seismograms. The resulting algorithm appears to avoid severe convergence difficulties reported for output (nonlinear) least-squares inversion. An algorithm appropriate for plane-layered acoustic models, using the convolutional approximation to the plane-wave (p-tau) seismogram will be described in detail.

Theoretical and numerical evidence will be given that coherency optimization, as defined here, yields stable and reasonably accurate estimates of both velocity trend and reflectivity, by exploiting reflection phase moveout and amplitudes in a computationally efficient way. This approach may be applied to field data by extracting velocity and reflectivity estimates from a Gulf of Mexico marine data set. The speaker will close by briefly explaining how the approach may be modified to determine elastic models and source parameters as well as laterally heterogeneous models.

William W. Symes
Rice University

WORKSHOP CONTRIBUTED PRESENTATIONS

PANEL

Wednesday, September 27/1:30 pm
Contributed Presentations 1

Scattered Wave Sensitivity to Narrow Bandwidth Model Perturbations in the Wavenumber Domain
Wafik B. Beydoun and Arthur B. Weglein, Arco Oil and Gas Company, Plano, TX

Rapid Determination of Critical Temperature in Simulated Annealing
Atanu Basu and L. Neil Frazer, Hawaii Institute of Geophysics

Important Features of Coupled Inversion for Reflector Location and Background Velocity with Surface Reflection Data
Christof Stork, California Institute of Technology

Inversion of Anisotropic Media
Mark Meadows, Chevron Oil Field Research Company, La Habre, CA

Thursday Morning, September 28/8:00 am
Contributed Presentations 2

Optimal Regularization of the Linear Seismic Inverse Problem
Manfred Koch, Florida State University

Generalized FK (Frequency-Wavenumber) Migration in Arbitrarily Varying Media
David M. Pai, University of Houston

Hybrid Methods of Forward Modeling and Migration of a Wavefield in an Inhomogeneous and Dissipating Medium
Simeon Katz, University of Southern California

A New Approach to Inverse Problems of Wave Equations
Hua Ding, Zhemin Zheng and Shouze Xu, Academia Sinica, Beijing, China

Thursday, September 28/1:30 pm
Contributed Presentations 3

Tomographic Imaging in Hydrocarbon Reservoirs
J.H. Justice and A.A. Vassiliou, Mobil Research and Development Corporation, Dallas

Seismic Crosshole Tomography and Nonlinear Constrained Optimization
James G. Berryman, Lawrence Livermore National Laboratory

Minimum Cross Entropy Seismic Diffraction Tomography
Tien-when Lo, Texaco Inc., Houston; Gregory L. Duckworth, Bolt Beranek and Newman Inc., Cambridge, MA; and M. Nafi Toksoz, Massachusetts Institute of Technology

Crosshole Data Inversion in Layered Background
David M. Pai, University of Houston

Thursday, September 28/4:00 pm
Contributed Presentations 4

Simulated Annealing Inversion Applied to Ducted Propagation of Acoustic Waves
Stig Hestholm and Aladin Kamel, IBM Bergen Scientific Center, Norway

Multi-parameter Inversion by GPST with Hierarchal Parallelism and Multigrid
Y.M. Chen, SUNY, Stony Brook

Exact Multidimensional Inversion
Douglas J. Foster, Arco Oil and Gas Company, Plano, TX; and Satish C. Singh, University of Paris, France

Forward and Inverse Modeling in 3D Complex Geological Structures
Victor Pereyra, Weidlinger Associates, Los Altos, and Timothy Kunz, Amoco Production Company, Tulsa

Friday, September 29/8:00 am
Contributed Presentations 5

A Regularization Algorithm for Reservoir History-Matching Using A Priori Information
Chang-Bock Chung and Costas Kravaris, University of Michigan, Ann Arbor

Interaction of Inhomogeneous Plane Waves, Head Waves, and Guided Modes with Nonreflecting Boundary Condition for the Time Domain Acoustic Wave Equation
Aladin H. Kamel, IBM Bergen Scientific Center, Norway

Dispersive Effective Medium Theory for Wave Propagation in Periodic Structures
Fadil Santosa, University of Delaware

Edge Diffraction in Terms of Dynamic Ray Tracing
P.M. Bakker, Koninklijke/Shell Exploratie and Produktie Laboratorium, The Netherlands

Friday, September 29/1:00 pm
Contributed Presentations 6

Inversion of Acoustic Volume Reverberation Data for Bathymetry
Thomas J. Eisler, Nautical Charting Research and Development Laboratory, Rockville, MD

The Three Dimensional Inverse Acoustic Scattering Problem: Hard and Soft Obstacles
Francesco Zirilli, Universita di Roma "La Sapienza", Italy

Simultaneous Source-Velocity Determination via Coherency Optimization
Robert M. Lewis and William W. Symes, Rice University

Parametric Effects in Dilution Theory Approximations of Induced Polarization
Thomas P. Gruszka, Grand Valley State University, Allendale, and James R. Wait, University of Arizona

Inversion for Magnetic Anomalies of Arbitrary Three-Dimensional Bodies
R.O. Hansen, Colorado School of Mines; and Xiaomu Wang, Bureau of Geophysical Prospecting, Zhuozhouo City, PRC

TCCR Method for Solving Inverse Problem of Wave Equation
Ganquan Xie, SUNY-Stony Brook

Thursday, September 28/8:00 pm
Panel

Migration/Inversion — Practice vs. Science Time vs. depth . . . do waves really propagate in time?
Pre- vs. post-stack imaging . . . whose hyperbole is first? Are rms velocities useful? Do amplitudes vary with offset?

Chair: J. Bee Bednar, Amerada Hess Corporation

Participants: Affiliation

J. Bednar, Amerada Hess Corporation
F. Gilbert, University of California/San Diego
T. Keho, Arco Oil and Gas Company
A. Devaney, Northeastern University
J. Cohen, Colorado School of Mines
R. Parsons, Conoco, Inc.
T. Ulrych, University of British Columbia
J. Fokkma, Technical University of Delft

11

BOOKSHELF

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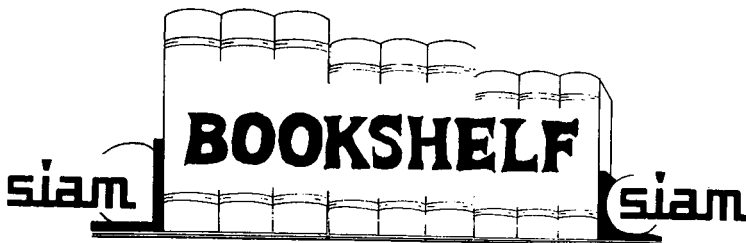
Mathematical Aspects of Vortex Dynamics

Edited by Russel E. Caflisch

The workshop on Mathematical Aspects of Vortex Dynamics was held at the Xerox Training Center in Leesburg, Virginia, on April 25-27, 1988. This volume presents 19 papers representing the invited and contributed talks at the workshop.

The book discusses a variety of fluid problems, including vortex sheets and shear layers, the vortex reconnection problem, vortex methods, coherent vortex structures, fluid dynamic stability, systems of point vortices, turbulence modeling and other applications.

Contents. Mathematical Analysis of Vortex Dynamics; Improved Vortex Methods for Three-Dimensional Flows; The Relation Between Thin Vortex Layers and Vortex Sheets; Computations of Broad-Band Instabilities in a Class of Closed- Streamline Flows; Vortex-Sheet Dynamics and Some References to Hyperfunction Theory; A Free Surface Vortex Method with Weak Viscous Effects; An Iterative Method for Computing Steady Vortex Flow Systems; On Invariant Measures for the 2-D Euler Flow; On Similarity Flows Containing Two-Branched Vortex Sheets; Strain-Induced Vortex Stripping; Convergence of the Vortex Method for Vortex Sheets; Boundary Conditions and Deterministic Vortex Methods for the Navier- Stokes Equations; Observations on Vorticity Creation Boundary Conditions; Vortex Dynamics of Stratified Flows; Remarks on Vortex Breakdown; Numerical Studies of Vortex Reconnection; Vortex Lattices in Theory and Practice; The Dynamics of Vortex Structures in the Wall Region of a Turbulent Boundary Layer; The Energy of a Vortex Lattice Configuration.

April 1989
xii + 220 pages, Softcover
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SIAM Member Price: $23.60
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Parallel Processing and Medium Scale Multiprocessors

Edited by Arthur Wouk

The papers in this book represent those presented at the ARO research workshop on Parallel Processing and Medium-Scale Multiprocessors held at Stanford University in January 1986. The workshop brought together research workers with strong connections to scientific computation as well as an interest in the systems programming problems that are restricting the application of the new hardware being developed.

The papers contained in this proceedings cover several areas, including systems programming, parallel language/programming systems, and applications programming. The work reported includes investigations into debugging of operating systems, portability of applications programs and parallel operating systems, efficient resource allocation in multiprocessors, parallel constructs for applications programming languages, and applications programming efforts on diverse architectures.

Contents. Debugging Multi-task Programs; Matrix Computations and Game Playing on the iPSC; DOMINO: A Transportable Operating System for Parallel Computation; Statistical Methodologies for the Control of Dynamic Remapping; Sparse Cholesky Factorization on a Local-memory Multiprocessor; Concurrent Global Optimization on a Network of Computers; Heterogeneous Processes on Homogeneous Processors; Matrix Multiplication on Boolean Cubes Using Generic Communication Primitives; The Force on the Flex: Global Parallelism and Portability; SCHEDULE: An Aid to Programming Explicitly Parallel Algorithms in FORTRAN; Dynamic Grid Manipulation for PDEs on Hypercube Parallel Processors; Solving Compressible Euler Equations on a Hypercube Simulator.

June 1989
xii + 204 pages (est.), Softcover
ISBN 0-89871-238-6
List Price: $31.50
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Order Code PR38

Combinatorial Algorithms: An Update

Herbert S. Wilf

CBMS-NSF Regional Conference Series in Applied Mathematics 55

In *Combinatorial Algorithms: An Update,* the author presents a survey of some of the new work that has been done since the appearance of the second edition of *Combinatorial Algorithms.* Topics that are discussed include progress in the following areas: Gray Codes, listing of subsets of given size of a given universe, listing rooted and free trees, selecting free trees and unlabeled graphs uniformly at random, and ranking and unranking problems on unlabeled trees.

Contents. The Original Gray Code; Other Gray Codes; Variations on the Theme; Choosing 2-Samples; Listing Rooted Trees; Random Selection of Trees; Listing Free Trees; Generating Random Graphs.

April 1989
v + 48 pages, Softcover
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SIAM/CBMS Member Price: $9.60
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Stochastic Processes in the Neurosciences

Henry C. Tuckwell

CBMS-NSF Regional Conference Series in Applied Mathematics No. 56

This monograph is centered on quantitative analysis of nerve-cell behavior. The work is foundational, with many higher order problems still remaining, especially in connection with neural networks. Thoroughly addressed topics include stochastic problems in neurobiology, and the treatment of the theory of related Markov processes.

Contents. Deterministic Theories and Stochastic Phenomena in Neurobiology; Synaptic Transmission; Early Stochastic Models for Neuronal Activity including Poisson Processes and Random Walks; Discontinuous Markov Processes with Exponential Decay; One-dimensional Diffusion Processes; Stochastic PDEs; Statistical Analysis of Stochastic Neural Activity; Channel Noise; Wiener Kernel Expansions; Stochastic Activity of Neuronal Populations.

June 1989
v + 126 pages, Softcover
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- For those of you having to use a corporate or university travel agent, you may still purchase your ticket through the local agents, just be sure to mention to the agent the above discounts. Your local agent can call the American Airlines Convention Desk to make your reservation. Make sure that the agent uses the SIAM account number S16090.

CAR RENTAL

DOLLAR RENT A CAR has been selected as the official rental agency for the SIAM Conference on Geophysical Science. The following rates will apply during the dates of September 23 – 31, 1989:

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- The prices quoted do not include refueling services, tax, optimal collision damage waiver, and personal accident insurance.

TO MAKE A RESERVATION
Call Dollar Rent A Car at 1-800-421-6878. Make sure to give them the SIAM Account Code Number CCSIA6 and tell them that you are an attendee at the SIAM Conference on Geophysical Sciences, September 25 – 31, 1989 in Houston, Texas. Cars can be picked up at both the Hobby and the Inter-Continental Airports.

DIRECTIONS FOR DRIVING

From the South (including Hobby Airport):
Take Broadway to Interstate 45 North. Proceed to the Southwest Freeway, which is also called U.S. 59 South. Continue to the Edloe exit. The hotel is located at Edloe and the Southwest Freeway.

From the West:
Take Interstate 10 to the Southwest Freeway (U.S. 59 South). Take the Edloe exit. Or, take U.S. 59 North and take the Edloe exit.

From the East:
Take Interstate 10 to the Southwest Freeway (U.S. 59 South). Take the Edloe exit.

PUBLIC TRANSPORTATION FROM THE AIRPORT

Houston is served by two airports: Hobby Airport and Intercontinental Airport. Approximate fares follow:

	From Hobby	From Intercontinental
Taxis	$16.00	$26.00
Limousine	$ 5.00	$ 7.00

From Hobby Airport, take the Hobby Airport Transportation Service van. From Intercontinental, take the Northline Bus Service. In both cases, ask to be dropped off at the Greenway Plaza Terminal. Call Stouffer Greenway Plaza Hotel for gratis transportation on the phone provided.

Stouffer Greenway Plaza Hotel
Six Greenway Plaza East
Southwest Freeway at Edloe Street
Houston, TX 77046
(713) 629-1200

SIAM is holding a block of rooms at the Stouffer Greenway Plaza, on a first come first served basis at the specially discounted rates of $72/Single and $80/Double. These rooms will be held for our exclusive use only until August 25, 1989, 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 (713) 629-1200, 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 Geophysical Sciences.

Late Arrival Policy: If you plan to arrive after 6:00, you must guarantee one night's payment by AMEX, VISA or Master Card.

Check-In: Check-in time is 3:00, check-out time is 1:00.

If you need to change or cancel your reservation, please be certain to contact the hotel by 3:00 on your stated day of arrival.

Facilities: Stouffer Greenway Plaza Hotel is equipped with a heated outdoor, olympic-size swimming pool and jacquzzi. There is an on-site health club and sauna, showers and locker room. For those looking for a more rigorous workout, the hotel is connected to the prestigious Houston City Club, a private sports facility which provides 8 indoor racquetball courts and 10 tennis courts, indoor jogging track, Nautilus equipment, a pro shop, and three restaurants. Stouffer guests are automatic members of the Houston City Club, while registered in the hotel.

Restaurants, shopping, etc: Connected to the "Underground", a mini mall featuring many restaurants and service outlets. The Stouffer provides a complimentary shuttle that will take you to the popular Galleria for excellent shopping, an array of restaurants, theaters, and night-life. Within the hotel, you will find Amelia's, a casual California-style dining room for breakfast, lunch and dinner. For cocktails, try City Lights; the rooftop lounge which offers nightly music, dancing, and a view of the Houston skyline.

Parking: Valet parking is available in Stouffer's garage at $8.00 per day. Self-parking is available in Stouffer's garage at $6.00 per day.

[handwritten notes:] Airport Express / $850 Adult / 45 - 1 hour / every 30 min (or) 5 pm / 821-7774

[handwritten notes:] Baggage Claim / Lower Level / South Side / 30 min 7 am - 12:30

REGISTRATION INFORMATION

Please complete the Advance Registration Form found in the back of this brochure, and return it to SIAM; for domestic mail use envelope provided in the middle of this brochure. Attendees are urged to register in advance as the registration fee is lower for advance registrants. The advance registration deadline is September 21, 1989.

The registration desk is in the Greenway Ballroom. It will be open on:

Sunday, September 24	6:00 PM – 9:00 PM
Monday, September 25	7:00 AM – 5:30 PM
Tuesday, September 26	8:00 AM – 5:30 PM
Wednesday, September 27	7:30 AM – 5:30 PM
Thursday, September 28	7:30 AM – 5:30 PM
Friday, September 29	7:30 AM – 3:30 PM

REGISTRATION FEES:

		SIAM Member	Non-Member	Student
Conference and Workshop	Advance	$145	$165	$55
	On-Site	$175	$195	$55
Conference only*	Advance	$ 90	$110	$15
	On-Site	$120	$140	$15
Workshop (includes buffet)	Advance	$110	$110	$40
	On-Site	$130	$130	$40

* Buffet on Thursday evening, September 28, is $26 additional.

Non-Siam Members
Non-member registrants are encouraged to join SIAM to obtain the member rate for meeting registration and all the other benefits of SIAM membership. You can join SIAM by filling out a membership form at the SIAM Registration Desk located outside the Greenway Ballroom of the Stouffer Greenway Plaza Hotel.

Notice
There will be no prorated fees. No refunds will be issued once the conference has started.

If SIAM has not received your Advance Registration Form by September 21, you will be expected to pay the on-site conference fee. However, if your registration is in transit by September 21, SIAM will credit you the difference between advance and on-site registration.

GET-TOGETHERS

Welcoming Reception (Cash Bar)
Sunday, September 24, 7:00 – 9:00 PM
Century 1

Beer Party ($15.00)
Tuesday, September 26, 6:30 – 8:00 PM
Justin's Lounge

Chuck Wagon Buffet ($26.00)
Thursday, September 28, 7:00 – 9:00 PM
Seasonal fresh fruit, cole slaw, potato salad, mixed garden greens, barbecued brisket, barbecued ribs, fried chicken, ranch style beans, corn on the cob, biscuits and corn bread, warm peach cobbler, coffee, tea, or milk. Red and white wine will be served with dinner. Cash bar for those desiring cocktails.

Telephone Messages
The telephone number at the Stouffer Greenway Plaza Hotel is (713)-629-1200. The hotel will either connect you with the SIAM registration desk or forward a message.

Credit Cards
SIAM is now accepting Visa, Master Card, and American Express 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.

SIAM Corporate Members
Non-member attendees employed by the following institutions are entitled to the SIAM member rate for conference registration.

Aerospace Corporation
Amoco Production Company
AT&T Bell Laboratories
Bell Communications Research
The Boeing Company
BP America
Cray Research, Inc.
E.I. DuPont de Nemours and Company
Eastman Kodak Company
Exxon Research and Engineering Company
General Motors Corporation
GTE Laboratories, Inc.
Hollandse Signaalapparaten B.V.
IBM Corporation
ICASE-NASA Langley Research Center
IMSL, Inc.
MacNeal-Schwendler Corporation
Marathon Oil Company
Martin Marietta Energy Systems
Mathematical Sciences Research Institute
Schlumberger Industries
Supercomputing Research Center, a division of Institute for Defense Analyses
Texaco Inc.
United Technologies Corporation

UPCOMING CONFERENCES

November 6 – 10, 1989
SIAM Conference on Geometric Design
Sheraton Mission Palms Hotel
Tempe, AZ

December 11 – 13, 1989
Fourth SIAM Conference on Parallel Processing for Scientific Computing
Hyatt Regency Hotel
Chicago, IL

January 22 – 24, 1990
ACM/SIAM Symposium on Discrete Algorithms
Cathedral Hill Hotel
San Francisco, CA

March 5 – 7, 1990
SIAM Conference on Applied Probability in Science and Engineering
Clarion Hotel
New Orleans, LA

May 7 – 10, 1990
SIAM Conference on Applications of Dynamical Systems
Marriott Hotel
Orlando, FL

July 16 – 20, 1990
SIAM Annual Meeting
Hyatt Regency Hotel
Chicago, Il

HOTEL RESERVATION FORM
SIAM Conference on Geophysical Sciences and Workshop on Geophysical Inversion

September 25–29, 1989
Stouffers Greenway Plaza Hotel
Six Greenway Plaza East
Houston, TX 77046

PLEASE SEND ME A CONFIRMATION NOTICE
Specially discounted rooms are being held for conference registrants until August 21, 1989. After that date, reservations will depend on availability. Your reservation is not confirmed until acknowledged in writing by the hotel or verified by phone. When making reservations by phone, be certain to identify yourself as an attendee at the SIAM Conference and obtain the reservation number of name of person confirming your reservation. Telephone: 1-713-629-1200.

Name _____ Phone _____
     First   Last

Address _____

City _____ State _____ Zip _____

Please reserve [   ] Single ($72) [   ] Double ($80) Arrival Date _____

Arrival Time _____ Check-Out Date _____

Guarantee my room for late arrival (after 6:00) [   ] Yes [   ] No   I choose to pay by: [   ] AMEX* [   ] VISA* [   ] MC* [   ] Check

Credit Card Number _____

Expiration Date _____ Deposit $ _____ (Late Arrival Only)

Signature _____
If you list your credit card number, please enclose this card in an envelope and mail to: Reservations, The Stouffers Greenway Plaza Hotel, Six Greenway Plaza East,, Southwest Freeway at Edloe Street, Houston, TX 77046.
 * You only need to list your credit card number if you want to guarantee your room for late arrival.

ADVANCE REGISTRATION FORM

Advance registration forms must be received at the SIAM office by September 21, 1989. If paying by check make check payable to SIAM.

REGISTRATION FEES:

		SIAM Member	Non Member	Student
Conference and Workshop	Advance	$145	$165	$55
	On-Site	$175	$195	$55
Conference Only*	Advance	$ 90	$110	$15
	On-Site	$120	$140	$15
Workshop (Includes Buffet)	Advance	$110	$110	$40
	On-Site	$130	$130	$40

Buffet on Thursday pm, September 28, is $26 additional.

Registration Fee:

Conference and Workshop	$_____	$_____	$_____
Conference	$_____	$_____	$_____
Workshop (includes buffet)	$_____	$_____	$_____
Beer Party $15	$_____	$_____	$_____
Chuck Wagon Buffet $26	$_____	$_____	$_____
Total	$_____	$_____	$_____

SIAM Conference on Geophysical Sciences and Workshop on Geophysical Inversion
September 25–29, 1989
Houston, Texas

Please Print

Name _____
          First

_____
          Last

Affiliation _____

Department _____

Address _____

City _____ State _____ Zip_____

Telephone Number _____

Local Address in Houston _____

I wish to pay by [   ] AMEX   [   ] VISA   [   ] MC   [   ] Check

Credit Card #: _____

Expiration Date _____

Signature _____
Detach card and enclose with payment in the envelope provided (domestic mail only), or mail to: SIAM, 117 South 17th Street, 14th Floor, Philadelphia, PA 19103-5052. Telephone: (215) 564-2929.

From _____

_____

_____

To: **Reservations**
Stouffer Greenway Plaza Hotel
Six Greenway Plaza East
Southwest Freeway at Edloe Street
Houston, TX 77046

SIAM
117 S. 17th Street
Suite 1400
Philadelphia, PA 19103-5052
U.S.A.

POSTMASTER PLEASE DELIVER TO:

Time-Sensitive Material