CONFERENCE PROGRAM

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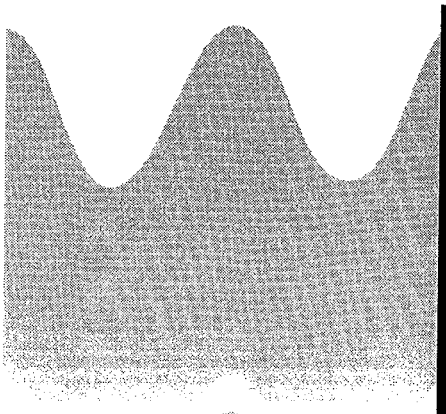

SECOND INTERNATIONAL CONFERENCE ON MATHEMATICAL AND NUMERICAL ASPECTS OF WAVE PROPAGATION

Conference Themes

- Acoustic-Elastic Interaction
- Asymptotics and Numerical Methods
- Combustion and Detonation
- Free Surface Hydrodynamics and Ship Motion
- Medical Imaging
- Nonlinear Waves
- Ocean Acoustics
- Radiation and Scattering
- Seismic Imaging and Geophysics
- Sonar and Radar
- Target Identification
- Tomography

June 7-10, 1993
Clayton Hall
University of Delaware

Conducted by the Society for Industrial and Applied Mathematics with the cooperation of the Institut National de Recherche en Informatique et en Automatique

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DEADLINE DATES

Dormitory Registration
May 21, 1993

Conference Preregistration
May 24, 1993

STEERING COMMITTEE

Ralph E. Kleinman, Chair
University of Delaware, USA

Thomas Angell
University of Delaware, USA

Gary Cohen
Insitut National de Recherche en Informatique et en Automatique, France

Jean Roberts
Institut National de Recherche en Informatique et en Automatique, France

Fadil Santosa
University of Delaware, USA

Ivar Stakgold
University of Delaware, USA

INTERNATIONAL PROGRAM COMMITTEE

David Colton, Chair
University of Delaware, USA

Alain Bamberger
Institut Français de Pétrole, France

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Université Paris VII, France

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Institut National de Recherche en Informatique et en Automatique, France

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University of California, Los Angeles, USA

Roland Glowinski
University of Houston, USA

Rainer Kress
Universität Göttingen, Germany

Jean-Claude Nedelec
Ecole Polytechnique, France

Gary Roach
University of Strathclyde, Scotland

Staffan Ström
Royal Institute of Technology, Sweden

William Symes
Rice University, USA

Peter van den Berg
Delft University of Technology, The Netherlands

PROCEEDINGS

A copy of the conference proceedings is included in the cost of registration and will be distributed to attendees at the conference.

FUNDING

SIAM is conducting this conference with the partial support of the National Science Foundation.

Following are subject classifications for the sessions. The codes in parentheses designate session type and number. The session types are Invited Presentations (IP), Contributed Presentations (CP) and Poster Sessions.

Acoustics
Ocean Acoustics (CP20, page 7; Poster 5, page 7)

Combustion and Reaction Diffusion Problems
Combustion Waves (CP3, page 4)
Detonation Waves (Poster 2, page 5)
Reaction Diffusion (CP22, page 8)

Controllability
Controllability (CP25, page 8)

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Analytical and Numerical Problems for Nonlinear Wave Propagation in "Nearly" Integrable Systems (IP10, page 9)
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Solvability and Asymptotic Behavior of Solutions of Ordinary Differential Equations with Operator Coefficients (IP4, page 6)

Modeling and Simulation
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Plasmas
Plasmas and Heating (Poster 7, page 9)

Radiation and Scattering
Low Frequency Scattering (CP18, page 7)
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Random and Periodic Media
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Random Media and Rough Surfaces (CP2, page 4)

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Waveguides and Cavities
Microwave Heating (CP28, page 9)
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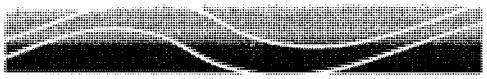

PROGRAM-AT-A-GLANCE

Sunday, June 6

6:00 PM-8:00 PM
Registration for Conference opens
Clayton Hall Lobby Lounge

6:30 PM-8:30 PM
Welcoming Reception
Clayton Hall Lobby Lounge

Monday Morning, June

7:30 **Registration opens**
Clayton Hall Lobby Lounge
Continental Breakfast Service

8:30 **Welcome and Introduction**
Clayton Hall Auditorium

9:00
IP1 **Wave Propagation in Random Media and Applications to Seismology**
George Papanicolaou
Clayton Hall Auditorium

9:45 **Concurrent Sessions**
CP1 **Finite Elements for Maxwell's Equations**
Clayton Hall Auditorium
CP2 **Random Media and Rough Surface**
Clayton Hall Room 101B

10:45 **Coffee and Poster Session 1**
Radiation and Scattering
Clayton Hall Lobby Lounge

11:15 **Concurrent Sessions**
CP3 **Combustion Waves**
Clayton Hall Auditorium
CP4 **Random Media and Atmospheric Propagation**
Clayton Hall Room 101B

Monday Afternoon, June 7

12:15 **Lunch**
Pencader Cafeteria

1:45
IP2 **Open Waveguide Problems: Theory and Computation**
Patrick Joly
Clayton Hall Auditorium

2:30 **Concurrent Sessions**
CP5 **Waveguides**
Clayton Hall Auditorium
CP6 **Mathematical Methods I**
Clayton Hall Room 101B

3:30 **Coffee and Poster Session 2**
Detonation Waves
Clayton Hall Lobby Lounge

4:00 **Concurrent Sessions**
CP7 **Seismograms in Stratified Media**
Clayton Hall Auditorium
CP8 **Mathematical Methods II**
Clayton Hall Room 101B

5:00 **Dinner**
Pencader Cafeteria

Tuesday Morning, June 8

8:00 **Registration opens**
Clayton Hall Lobby Lounge
Continental Breakfast Service

8:30
IP3 **Similarity in Wave Propagation Under a Global Relaxation Law**
Adrianus T. de Hoop
Clayton Hall Auditorium

9:15 **Concurrent Sessions**
CP9 **Scattering by Elastic Bodies**
Clayton Hall Auditorium
CP10 **Higher Order Methods**
Clayton Hall Room 101B

10:15 **Coffee and Poster Session 3**
Diffraction
Clayton Hall Lobby Lounge

10:45 **Concurrent Sessions**
CP11 **Time Domain Inverse Scattering**
Clayton Hall Auditorium
CP12 **Fluids**
Clayton Hall Room 101B

Tuesday Afternoon, June 8

12:05 **Lunch**
Pencader Cafeteria

1:30
IP4 **Solvability and Asymptotic Behavior of Solutions of Ordinary Differential Equations with Operator Coefficients**
Vladimir Maz'ya
Clayton Hall Auditorium

2:15 **Concurrent Sessions**
CP13 **Viscoelasticity**
Clayton Hall Auditorium
CP14 **Asymptotic Diffraction**
Clayton Hall Room 101B

3:15 **Coffee and Poster Session 4**
Wave Propagation in Fluids
Clayton Hall Lobby Lounge

3:45 **Concurrent Sessions**
CP15 **Boundary Element Methods**
Clayton Hall Auditorium
CP16 **Asymptotic Wave Propagation**
Clayton Hall Room 101B
IP5 **Scattering by Diffraction Grating**
Avner Friedman
Clayton Hall Auditorium

5:30 **Dean's Reception**
Clayton Hall Lobby Lounge

Wednesday Morning, June 9

8:00 **Registration opens**
Clayton Hall Lobby Lounge
Continental Breakfast Service

8:30
IP6 **Geophysical Inverse Theory: What Is Theoretically Possible? What Is Practically Achievable?**
Sven Treitel
Clayton Hall Auditorium

9:15 **Concurrent Sessions**
CP17 **Synthetic Seismograms**
Clayton Hall Auditorium
CP18 **Low Frequency Scattering**
Clayton Hall Room 101B

10:15 **Coffee and Poster Session 5**
Ocean Acoustics
Clayton Hall Lobby Lounge

10:45 **Concurrent Sessions**
CP19 **Seismic Inversion**
Clayton Hall Auditorium
CP20 **Ocean Acoustics**
Clayton Hall Room 101B

Wednesday Afternoon, June 9

12:00 **Lunch**
Pencader Cafeteria

1:30
IP7 **Inverse Scattering in the Resonance Region: The Reconstruction of Obstacles and Inhomogeneous Media**
Francesco Zirilli
Clayton Hall Auditorium

2:15 **Concurrent Sessions**
CP21 **Numerical Methods**
Clayton Hall Auditorium
CP22 **Reaction Diffusion**
Clayton Hall Room 101B

3:15 **Coffee and Poster Session 6**
Inverse Problems
Clayton Hall Lobby Lounge

3:45 **Concurrent Sessions**
CP23 **Inverse Obstacle and Media Problems**
Clayton Hall Auditorium
CP24 **Water Waves**
Clayton Hall Room 101B

5:45 **Dinner**
"Casablanca" Moroccan Restaurant

Thursday Morning, June 10

8:00 **Registration Opens**
Clayton Hall Lobby Lounge
Continental Breakfast Service

8:30
IP8 **Asymptotic Behavior of Solutions to Nonlinear Waves and Plate Equations with Boundary Dissipations**
Irena Lasiecka
Clayton Hall Auditorium

9:15 **Concurrent Sessions**
CP25 **Controllability**
Clayton Hall Auditorium
CP26 **Domain Decomposition**
Clayton Hall Room 101B

10:15 **Coffee and Poster Session 7**
Plasmas and Heating
Clayton Hall Lobby Lounge

10:45 **Concurrent Sessions**
CP27 **Periodic Structures**
Clayton Hall Auditorium
CP28 **Microwave Heating**
Clayton Hall Room 101B

11:25
IP9 **Hybrid Numerical and Analytical Methods**
Joseph B. Keller

Thursday Afternoon, June 10

12:00 **Lunch**
Pencader Cafeteria

1:30
IP10 **Analytical and Numerical Problems for Nonlinear Wave Propagation in "Nearly" Integrable Systems**
Gérard A. Maugin
Clayton Hall Auditorium

2:15 **Concurrent Sessions**
CP29 **Finite Element Methods**
Clayton Hall Auditorium
CP30 **Nonlinear Waves**
Clayton Hall Room 101B

3:15 **Coffee and Poster Session 8**
Modeling and Simulation
Clayton Hall Lobby Lounge

3:45 **Concurrent Sessions**
CP31 **Obstacle Scattering**
Clayton Hall Auditorium
CP32 **Inverse Scattering**
Clayton Hall Room 101B

5:05 **Conference adjourns**

MONDAY MORNING, JUNE 7

7:30/Clayton Hall Lobby Lounge

Registration opens

8:30/Clayton Hall Auditorium

Welcome and Introduction

Ralph E. Kleinman, University of Delaware
David P. Roselle, President
University of Delaware

9:00/Clayton Hall Auditorium

IP1/Chair: Ivar Stakgold, University of Delaware

Wave Propagation in Random Media and Applications to Seismology

Consider a pulsed acoustic or elastic wave impinging on a material that is inhomogeneous, the earth's crust for example. The reflected signal is measured at the surface and it looks very noisy, like a seismogram. What information about the medium can we extract from this signal? In reflection seismology this is a classic question that has received a great deal of attention over the last forty years. It has also received a lot of attention as a difficult problem in mathematics, namely the inverse scattering problem.

The question can be viewed as a problem in stochastic processes: model the reflecting material as a random medium, characterize all possible reflected signals as a particular class of nonstationary stochastic processes and then pose the recovery of material properties as a statistical estimation problem for this class of processes.

The speaker will present an overview of this work and discuss the results of extensive numerical simulations to test the theory and the estimation algorithms.

George Papanicolaou
Courant Institute of Mathematical Sciences
New York University, and School of Mathematics, Institute for Advanced Study, Princeton

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9:45-10:45

Concurrent Sessions

CP1/Clayton Hall Auditorium

Finite Elements for Maxwell's Equations

Chair: Jean C. Nedelec, Ecole Polytechnique, France

9:45 **Finite Element Time Domain Methods for Maxwell's Equations**
Peter Monk, University of Delaware

10:05 **Finite Element Solutions and Full 2nd Order Absorbing Boundary Conditions for 2D Unsteady Maxwell Equations**
Fadi El Dabaghi, Institut National de Recherche en Informatique et en Automatique, Rocquencourt, France

10:25 **Lumping of the Mass Matrix for Mixed Finite Elements of H(curl)**
Yves Haugazeau and *Patrick Lacoste,* CISI-Ingenierie, France

CP2/Clayton Hall Room 101B

Random Media and Rough Surface

Chair: Alain Bamberger, Institut Français de Pétrole, France

9:45 **A New Formulation of Electromagnetic Scattering from Rough Dielectric Interfaces**
John A. DeSanto, Colorado School of Mines

10:05 **Scattering by an Infinite Array of Randomly Spaced Coplanar Cracks: A Non-Uniform Random Case**
Yozo Mikata, Old Dominion University

10:25 **Estimation of Local Power Spectral Densities for Non-stationary Signals using Wavelet Transform**
J.F. Clouet and J.P. Fouque, Ecole Polytechnique, France; and *M. Postel,* Université Pierre et Marie Curie, France

10:45-11:15/Clayton Hall Lobby Lounge

Coffee and Poster Session 1—Radiation and Scattering

Adiabatic Mode Radiation from Dielectric Wedge-Shaped Waveguide into Chiral Environment
Valery E. Grikurov, St. Petersburg University, Russia

A Thermoelastic Approach to Laser Spallation
George Dassios and Vassilis Kostopoulos, University of Patras, Greece

Factorization of Floquet's Characteristic Equation in the Case of Problems with Relection Symmetry
Raj K. Kaul and *Robert C.A. Barone,* State University of New York, Buffalo

Wave Propagation and Localization in a Periodic Rod
Dong Li and Haym Benaroya, Rutgers University

Electromagnetic Fields in Transient Boundary Lossy Medium
Alexander G. Nerukh, Kharkov Institute of Radioelectronics, Ukraine, and *Irena Yu Shavorykina,* Kharkov State University, Ukraine

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11:15 AM-12:15 PM

Concurrent Sessions

CP3/Clayton Hall Auditorium

Combustion Waves

Chair: Jean C. Nedelec, Ecole Polytechnique, France

11:15 **Chemical Engineering Approach: Influence of Reaction on Wave Propagation**
G.M. Zhong and F. Meunier, LIMSI-CNRS, France

11:35 **Modeling Modes of Combustion in Gaseous Suspensions**
Petr M. Krishenik, E.N. Rumanov, and Shkadinskij, Russian Academy of Sciences, Russia

11:55 **Self-similar Regimes of Converging Gasless Combustion Wave**
Igor A. Filimonov and Nickolaj I. Kidin, Russian Academy of Sciences, Russia

CP4/Clayton Hall Room 101B

Random Media and Atmospheric Propagation

Chair: Alain Bamberger, Institut Français de Pétrole, France

11:15 **Reflection, Transmission, and Dissipation of Power in Wave Propagation through Stratified Nonlinear Random Media**
Renato Spigler, Università di Padova, Italy

11:35 **Parabolic Equation Solution of Radiowave Propagation Problems on Large Domains**
Mireille Levy, Rutherford Appleton Laboratory, United Kingdom

11:55 **Influence of Layer and Anisotropic Fluctuations of the Refractive Index on the Beyond-the-Horizon SHF Propagation over the Sea**
Konstantin V. Koshel and Andrey A. Shishkarev, Pacific Oceanological Institute, Russia

MONDAY AFTERNOON, JUNE 7

12:15-1:45/Pencader Cafeteria

Lunch

1:45/Clayton Hall Auditorium

IP2/Chair: Gary Cohen, Institut National de Recherche en Informatique et en Automatique, France

Open Waveguide Problems: Theory and Computation

The study of open waveguides is a very attractive field for applied mathematicians from both theoretical and computational points of view, and it has important applications in different domains of physics such as acoustics, electromagnetism, elasticity, and hydrodynamics.

An open waveguide can be seen as a cylindrical and infinite domain of propagation which is invariant under translation in one privileged space direction, let us say x_3, and whose transverse section is also unbounded in the variables $x = (x_1, x_2)$. A guided mode is by definition a particular solution of the propagation equations which is a wave propagating without distortion in the direction x_3 and whose transverse energy, this is the main point, is finite. Physically this means that the corresponding wave remains localized in some bounded region of the cross section.

The solutions depend harmonically on time, with frequency $\omega > 0$, and x_3, with wave number $\beta > 0$ and ω and β are related by the so called dispersion relations of the modes. From the numerical point of view, one is interested in the computation of the dispersion relations $\omega^2 = f(\beta)$ and of the corresponding guided waves. The main difficulty is linked to the unboundedness of the transverse cross section of the propagation medium.

The speaker will present an overview of the state-of-the-art concerning the theory and computation of open waveguides. He will discuss recent results in different fields of application and present some open questions.

Patrick Joly
Institut National de Recherche en Informatique et en Automatique, France

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2:30-3:30

Concurrent Sessions1

CP5/Clayton Hall Auditorium

Waveguides

Chair: Guy Chavent, Institut National de Recherche en Informatique et en Automatique, France

2:30 **A Finite Element Solution to Electromagnetic Waveguide Problems**
Patrick Joly and *Christine Poirier,* Institut National de Recherche en Informatique et en Automatique, Rocquencourt, France

2:50 **Mathematical and Numerical Study of the Guided Modes of Stratified Dielectric Waveguides**
Anne-Sophie Bonnet-Ben Dhia and *Fabrice Mahe,* E.N.S.T.A./S.M.P., France

3:10 **Simulation and Analysis of the Domain Integral Equation for Electromagnetic Waveguides**
H.P. Urbach, Philips Research Laboratory, The Netherlands

CP6/Clayton Hall Room 101B

Mathematical Methods I

Chair: George Dassios, University of Patras, Greece

2:30 **Closed-form Transient Solutions for the Canonical Sommerfeld Problem**
Keijo I. Nikoskinen, Helsinki University of Technology, Finland

2:50 **An Alternative Construction of the General Solution of the Wave Equation**
John E. Gray, Naval Surface Warfare Center

3:10 **Dyadic Scattering: A Unified Approach to the Classical Theories**
George Dassios and Demosthenes Polyzos, University of Patras, Greece

3:30-4:00/Clayton Hall Lobby Lounge

Coffee and Poster Session 2—Detonation Waves

Generation and Propagation of Overdriven Detonation Waves in Gas Medium Space-Variable Chemical Composition
E.S. Prokhorov, Lavrentyev Institute of Hydrodynamics, Russia

Model of Bubble Detonation
P.A. Fomin and *A.V. Trotsyuk*, Lavrentyev Institute of Hydrodynamics, Russia

Model of Stationary Heterogeneous Detonation in Film Systems
P.A. Fomin, Lavrentyev Institute of Hydrodynamics, Russia

Propagating Curved Detonation Waves
Bruce G. Bukiet, New Jersey Institute of Technology

4:00-5:00

Concurrent Sessions

CP7/Clayton Hall Auditorium

Seismograms in Stratified Media

Chair: Guy Chavent, Institut National de Recherche en Informatique et en Automatique, France

4:00 **Spectral and Numerical Analysis of a 2D Wave Equation in Acoustic or Elastic Media Stratified along Two Directions**
Jean-Luc Boelle, Elf-Aquitaine Production, France; Elisabeth Croc and *Yves Dermenjian*, Université de Provence, France

4:20 **Seismic Pulses in Layered Elastic Media: Three Dimensional Generalized Ray Theory and its Numerical Implementation**
Piotr Borejko, University of Connecticut, Storrs and Franz Ziegler, Technical University of Vienna, Austria

4:40 **Computation of Normal Modes in Stratified Elastic Media**
Gerald W. Hedstrom, Lawrence Livermore National Laboratory

CP8/Clayton Hall Room 101B

Mathematical Methods II

Chair: George Dassios, University of Patras, Greece

4:00 **Time Like Trace Regularity of the Wave Equation**
Gang Bao, University of Minnesota, Minneapolis

4:20 **Wave Field Splitting, Invariant Imbedding, and Phase Space Methods in Direct and Inverse Wave Propagation Modeling**
Louis Fishman, Colorado School of Mines

4:40 **Iterative Regularization of Linear and Nonlinear Ill-posed Problems**
Martin Hanke, Universität Karlsruhe, Germany and Johannes-Kepler-Universität, Austria

5:00/Pencader Cafeteria

Dinner

TUESDAY MORNING, JUNE 8

7:30/Clayton Hall Lobby Lounge

Registration opens

8:30/Clayton Hall Auditorium

IP3/Chair: Ralph E. Kleinman, University of Delaware

Similarity in Wave Propagation Under a Global Relaxation Law

The propagation of acoustic, electromagnetic, and elastodynamic waves in inhomogeneous media is usually, in the first instance, mathematically modeled under the assumption of negligible losses. In practice, however, attenuation and dispersion in the wave phenomena are often observed. These must be attributed to some unknown relaxation phenomenon. As a first attempt to model these phenomena, a global relaxation law is suggested by which the time derivatives are replaced by a relaxation operator with a constant coefficient. Via the Schouten - Van der Pol theorem of the one-sided Laplace transformation with respect to time, the wave motion in such a medium can directly be expressed in terms of the one present in the mediums's lossless counterpart (for which the relaxation coefficients have the value zero). The speaker will discuss in detail an example for acoustic waves in a fluid.

Adrianus T. de Hoop
Laboratory of Electromagnetic Research
Faculty of Electrical Engineering
Delft University of Technology, The Netherlands

9:15-10:15

Concurrent Sessions

CP9/Clayton Hall Auditorium

Scattering by Elastic Bodies

Chair: Staffan Ström, Royal Institute of Technology, Sweden

9:15 **Resonances of Finite-Length Elastic Cylinders and Elastic Spheroids Excited by Sound Scattering**
D. Decultot, F. Lecroq, G. Maze and J. Ripoche, University of Le Havre, France; M.F. Werby, Naval Research Laboratory; J. Niemiec, David Taylor Research Center; X.L. Bao and *Herbert Uberall*, Catholic University

9:35 **Singularity Expansion of Field Near a Caustic of Surface Skimming Bulk Waves in Anisotropic Piezoelectric Media**
Malek Benslama, Laboratoire Microondes ENSEEIHT, France; H. Benslama, Institut de Technologie Universite de Constantine Algerie, Algeria; H. Baudrand, Laboratoire Microonds ENSEEIHT, France; and M. Planat, Laboratoire de Physique et Metrologie des Oscillateurs (CNRS), France

9:55 **Wave Propagation in a Random Micropolar Elastic Medium**
M. Mitra, Presidency College, India and *R.K. Bhattacharyya*, Brahmananda Keshab Chandra College, India

CP10/Clayton Hall Room 101B

Higher Order Methods

Chair: Jean Roberts, Institut National de Recherche en Informatique et en Automatique, France

9:15 **High Order Absorbing Boundary Conditions for Wave Propagation Models. Straight Line Boundary and Corner Cases**
Francis Collino, Institut National de Recherche en Informatique et en Automatique, Rocquencourt, France

9:35 **A Scheme, Fourth Order in Space and Time for the 2-D Linearized Elastodynamics Systems**
Michel Barbiera and *Gary Cohen*, Institut National de Recherche en Informatique et en Automatique, Rocquencourt, France

9:55 **Construction and Analysis of Higher Order Finite Elements with Mass Lumping for the Wave Equation**
Gary Cohen, Patrick Joly and *Nathalie Tordjman*, Institut National de Recherche en Informatique et en Automatique, Rocquencourt, France

10:15-10:45/Clayton Hall Lobby Lounge

Coffee and Poster Session 3—Diffraction

Improved Acoustic Wave Approximations as an Application of the Residual Variable Method
Kagan Tuncay and Nuri Akkas, Middle East Technical University, Turkey

A Method for Computing Exact Solutions to Diffraction Problems
Kenneth B. Howell, University of Alabama, Huntsville

On the Integral Equations for Diffraction Problems
Sergey Smagin, Russian Academy of Sciences, Russia
Regularization of Diffraction Problem of an Arbitrary

Electromagnetic Wave Scattering by a Spherical Shell with a Circular Aperture
Yury V. Svischov and Yury A. Tuchkin, Academy of Science of Ukraine, Ukraine

Several Mathematical Principles and Numerical Algorithms of Stationary Theory of Open Biide Cavities
I.E. Pochanina and N.P. Yashina, Academy of Science of Ukraine, Ukraine

Scattering and Waveguiding of EM and Elastic Waves in Periodic System of In-Plane Obstacles Like Strips or Cracks
Eugene Danicki, Polish Academy of Sciences

The High Frequency Diffraction of Electromagnetic Waves by Cones of Arbitrary Cross-sections
Valery P. Smyshlyaev, Steklov Mathematical Institute, Russia and University of Bath, United Kingdom

Boundary-Value Contact Acoustic Problems for Elastic Plates
Boris Belinskiy, University of North Florida

10:45 AM-12:05 PM

Concurrent Sessions

CP11/Clayton Hall Auditorium

Time Domain Inverse Scattering

Chair: Staffan Ström, Royal Institute of Technology, Sweden

10:45 **Transient Inverse Scattering in Dispersive Homogeneous Bi-Isotropic Media**
Sten Rikte, Lund University, Sweden

11:05 **An Inverse Scattering Algorithm for Layered, Electromagnetically Dispersive Media**
Thomas M. Roberts, Armstrong Laboratory, AL/OES, Brooks Air Force Base

11:25 **A Boundary Integral Equation Method for Solving Elastodynamic Crack Determination Problems**
Naoshi Nishimura, Kyoto University, Japan

11:45 A Simplified Time-Domain Inverse Approach to Nonplanar Stratified Media
Sailing He and *Staffan Ström*, Royal Institute of Technology, Sweden

CP12/Clayton Hall Room 101B
Fluids
Chair: Jean Roberts, Institut National de Recherche en Informatique et en Automatique, France

10:45 Energy Leakage for Kelvin Waves in the Presence of Curved Boundaries
Antonmaria Minzoni and *C. Arturo Vargas*, IIMAS, UNAM, Mexico

11:05 A Hamiltonian Formulation for an Unsteady Vortex Wake
Alan Elcrat, Wichita State University

11:25 Dynamics of Wave Packets in a Two-Layer Shear Flow
Kwok W. Chow, University of Arizona

11:45 Radiation and Diffraction of Surface and Internal Waves on a Submerged Cylinder
I.V. Sturova, Lavrentyev Institute of Hydrodynamics, Siberian Division of the Russian Academy of Sciences, Russia

TUESDAY AFTERNOON, JUNE 8

12:05-1:30/Pencader Cafeteria
Lunch

1:30/Clayton Hall Auditorium
IP4/Chair: Thomas Angell, University of Delaware

Solvability and Asymptotic Behavior of Solutions of Ordinary Differential Equations with Operator Coefficients

The speaker will present some recent results on conditions for uniqueness and existence and asymptotic properties of solutions to the differential equation $A(t,D_t)u=f$ on R^1 with unbounded operator coefficients. One of the results is a theorem on the preservation of a "power-exponential" asymptotics under the Dini type condition

$$\int^{\infty}\omega(t)t^{2(m-1)}dt<\infty$$

where $\omega(t)$ is the continuity modulus of the coefficients at infinity. The condition is best possible in a sense. The proof is based on estimates for the inverse operator of the equation in question. An auxiliary result of independent interest is a comparison theorem for solutions of the operator differential equation $A(t,D_t)u=f$ and those of a certain higher-order ordinary differential equation. As a corollary two-weighted coercive estimates for solutions of $A(t,D_t)u=f$ are obtained. The results have immediate applications to the theory of partial differential equations in unbounded domains and domains with boundary singularities

The results discussed in the presentation were obtained together with V. Kozlov.

Vladimir Maz'ya
Department of Mathematics
Linköping University, Sweden

2:15-3:15
Concurrent Sessions

CP13/Clayton Hall Auditorium
Viscoelasticity
Chair: Gary Cohen, Institut National de Recherche en Informatique et en Automatique, France

2:15 On the Fundamental Matrix of the System of Dynamic Linear Thermoelasticity
Norbert Ortner and *Peter Wagner*, Universität Innsbruck, Austria

2:35 Forward Modeling and Inversion in Viscoelastic Media
Joakim O. Blanch, Johan O.A. Robertsson, and William W. Symes, Rice University

2:55 Wave Propagation in Viscoelastic Rods with Uniform Cross Sections
Raymond C.Y. Chin and *Qi Wang*, Indiana University-Purdue University, Indianapolis

CP14/Clayton Hall Room 101B
Asymptotic Diffraction
Chair: Fadil Santosa, University of Delaware

2:15 Numerical Applications of Asymptotic Diffraction
Andrzej Hanyga, University of Bergen, Norway

2:35 Asymptotic Analysis of Transient Waves with Dispersion and Dissipation
Francesco Mainardi, Donatella Tocci, and Massimo Tomirotti, University of Bologna, Italy

2:55 Diffraction in the Shadow of a Smooth Dielectric Strictly Convex Obstacle
Olivier Lafitte, Commissariat a l'Energie Atomique, France

3:15-3:45/Clayton Hall Lobby Lounge
Coffee and Poster Session 4--Wave Propagation in Fluids

On the Period of the Locally Forced Soliton Generation of Two-Layer Flow
Zhao-Ting Xu, Ocean University of Qingdao, People's Republic of China and Samueal Shan-Pu Shen, University of Alberta, Canada

Asymptotics of Laminar Flow Along a Plate with Small Periodic Roughness
V.G. Danilov and M.V. Makarova, Moscow Institute of Electronic Machinedesign, Russia

Exact Nonlinear Travelling Wave Solutions for Model Asymmetric Geophysical Systems
P. Kandaswamy, Bharathiar University, India

A Model for the Waves Propagation and Damping in Two Phases and Cavitation Flow
Hedi Hassis, Ecole Nationale d'Ingenieurs de Tunis, Tunisia; and F. Axisa, Commissariat a l'Energie Atomique C.E.A., France

A Simplified Essentially Non-Oscillatory Shock Capturing Scheme
Shurong Xu and Wensheng Li, Zhongshan University, People's Republic of China

A Mathematical Model for the Generation of Surface Waves Due to a Droplet Striking a Free Surface
A.J. Croft and D.R.S. Talbot, Coventry University, United Kingdom

3:45-4:45
Concurrent Sessions

CP15/Clayton Hall Room 101B
Boundary Element Methods
Chair: Gary Cohen, Institut National de Recherche en Informatique et en Automatique, France

3:45 Mathematical and Numerical Resolution of Time-Domain Maxwell's Equations by a Boundary Integral Method
I. Terrasse, Ecole Polytechnique, France; and Thomson R.C.M. Sice, Malakoff, France

4:05 A Combined Boundary Element and Fourier Method for Time-Harmonic Screen Problems using Singular Trial Functions
Frank Penzel, Technische Hochschule Darmstadt, Germany

4:25 The Seismic Horizontal Borehole Problem: A Mixed Bem-Fem-Modal Approach in the Frequency Domain
Denis Aubry, Ecole Centrale de Paris, France; Didier Clouteau, Institut Français du Pétrole, France; and *Julie Svay*, Ecole Centran de Paris, France and Institut Français du Pétrole, France

CP16/Clayton Hall Room 101B
Asymptotic Wave Propagation
Chair: Fadil Santosa, University of Delaware

3:45 Using Microlocalization to Improve Numerical Treatment of Helmholtz Equation
Armel de La Bourdonnaye, CERMICS-INRIA, France

4:05 Asymptotic Behavior of the Solution of the Maxwell's System with Absorbing Boundary Conditions
Helene Barucq and Bernard Hanouzet, University Bordeaux I, France

4:25 About Asymptotic Methods using Calderon's Operator to Study Scattering Problems by a Composite Body in Electromagnetics
M. Artola, Université Bordeaux I, France and Centre d'Etudes Scientifiques et Techniques d'Aquitaine et Centre de Limeil, France; and M. Cessenat, Centre d'Etudes Scientifiques et Techniques d'Aquitaine et Centre de Limeil, France

4:45/Clayton Hall Auditorium
IP5/Chair: Ivar Stakgold, University of Delaware

Scattering by Diffractive Grating

Consider time-harmonic electromagnetic wave incident to an optical body of doubly-periodic surface. The problem is to establish existence of a unique solution with radiation condition at infinity, and to compute the solution effectively. Several methods will be exposed, and related scattering problems will be discussed.

Avner Friedman
Institute for Mathematics and Its Applications
University of Minnesota, Minneapolis

5:30/Clayton Hall Lobby Lounge
Dean's Reception
Mary P. Richards
Dean, College of Arts and Science
University of Delaware

WEDNESDAY MORNING, JUNE 9

7:30/Clayton Hall Lobby Lounge
Registration opens

8:30/Clayton Hall Auditorium
IP6/Chair: Guy Chavent, Institut National de Recherche en Informatique et en Automatique, France

Geophysical Inverse Theory: What is Theoretically Possible? What is Practically Achievable?

The geophysical inverse problem is ill-posed, and the recorded data is invariably corrupted by noise. While much elegant theory has been developed over the years to infer buried geologic structure from observations, the sophistication of the mathematical tools brought to bear must be balanced by the limitations of the data as well as by the realization that our theoretical models are but imperfect renditions of mother-nature's ways. The speaker will illustrate some of these points with geophysical exploration data.

Sven Treitel
Research Center
Amoco Production Company, Tulsa

9:15-10:15
Concurrent Sessions

CP17/Clayton Hall Auditorium
Synthetic Seismograms
Chair: William Symes, Rice University

9:15 **Accuracy of the High Order Finite Differences for Modeling Wave Propagation in 3D Isotropic and Anisotropic Elastic Media**
Dominique Rodrigues, Heiner Igel, Peter Mora and Bruno Riollet, IPG, France

9:35 **Is There a Better Way to Incorporate Geophysical Data in Finite-Difference Acoustic Forward Modelling?**
Laurent Anne, Jean Brac, Patrick Compte, and *Quang-Huy Tran,* Institut Français du Pétrole, France

9:55 **Parallelization to Obtain Full 3D Seismograms**
James Sochacki, James Madison University; *Patrick O'Leary* and Derek Michum, University of Wyoming

CP18/Clayton Hall Room 101B
Low Frequency Scattering
Chair: P.A. Martin, University of Manchester, United Kingdom

9:15 **Full Low-Frequency Asymptotic Expansion for Elliptic Equations of Second Order**
Ralph E. Kleinman, University of Delaware; and *Boris R. Vainberg,* University of North Carolina, Charlotte

9:35 **Near and Far Scattering Field of a Low-Frequency Plane Harmonic Wave by a Rough Half-Plane**
Federico J. Sabina, Universidad Nacional Autonoma de Mexico, Mexico; and V.M. Babich, Russian Academy of Sciences, Russia

9:55 **The Ellipsoidal Cavity in the Presence of a Low-Frequency Thermoelastic Wave**
Kiriakie Kiriaki, National Technical University, Greece; and Vassilis Kostopoulos, University of Patras, Greece

10:15-10:45/Clayton Hall Lobby Lounge
Coffee and Poster Session 5—Ocean Acoustics

Internal Gravity Waves from a Body Moving in a Stratified Ocean
Vitaly V. Bulatov and Yury V. Vladimiroiv, Russian Academy of Science, Russia

Doubling of Surface Stoneley Wave Propagating along a Fluid-Elastic Interface
A. Alenitsyn, St. Petersburg State University, Russia

Waves in the Basin with Elastic Uneven Bottom
S. Yu. Dobrokhotov, O.L. Tolstova, and I. Yu. Chudinovich, Russian Academy of Science, Russia

Bottom Interaction Effects of Sound Propagating in the Deep Ocean (Normal-Mode Analysis)
J.I. Arvelo, Alliant Techsystems, Inc., Arlington, VA; J.R. Yuan, X.L. Bao and *H. Uberall,* Catholic University of America

A Fourier Spectral Method for a Parabolic Propagation Modelin a Representative Ocean-Acoustic Environment
Marie-Claude Pelissier, Università de Toulon et du Var, France and Centre d'Etudes et de Recherches en Detection Sous-Marine, France

An Investigation of the Problems Associated with the Response of a Harbour to Incident Waves
Jacob A. Alabi, Rivers State University of Science and Technology, Nigeria

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10:45 AM-12:05 PM
Concurrent Sessions

CP19/Clayton Hall Auditorium
Seismic Inversion
Chair: William Symes, Rice University

10:45 **Fast Iterative Solution of Sparsely Sampled Seismic Inverse Problems**
Agur Sevink and Gerard C. Herman, Delft University of Technology, The Netherlands

11:05 **A Solution of An Density Inverse Problem in Two Dimensional Wave Propagation**
Hua Song, Rice University

11:25 **Waveform Inversion through MBTT Reformulation**
François Clement, Institut National de Recherche en Informatique et en Automatique, Rocquencourt, France; and Guy Chavent, CEREMADE, University of Paris, Dauphine, France and Institut National de Recherche en Informatique et en Automatique, Rocquencourt, France

11:45 **Experience with Autoasking a Seismic Inversion Code**
Michel Kern and William W. Symes, Rice University

CP20/Clayton Hall Room 101B
Ocean Acoustics
Chair: P.A. Martin, University of Manchester, United Kingdom

10:45 **Computing the Effective Parameter for the Scattering of Water Waves in Channels with Large, Random Depth Variations**
Andre Nachbin, New Jersey Institute of Technology

11:05 **The Chaotic and Stochastic Dynamics of Linear Waves in the Ocean**
Nessan Fitzmaurice, Case Western Reserve University

11:25 **First and Second Moments of Acoustic Signals in a Random Ocean**
Claire Noel and Marie-Claude Pelissier, Centre d'Etudes et de Recherches en Detection Sous-Marine, France

11:45 **Efficient Modeling of Global Scale Sound Propagation in the Ocean**
M.D. Collins, K.D. Heaney, W.A. Kuperman, and B.E. McDonald, Naval Research Laboratory

WEDNESDAY AFTERNOON, JUNE 9

12:05-1:30/Pencader Cafeteria
Lunch

1:30/Clayton Hall Auditorium
IP7/Chair: David Colton, University of Delaware

Inverse Scattering in the Resonance Region: The Reconstruction of Obstacles and Inhomogeneous Media

The topic of this presentation is inverse scattering problems for acoustic and electromagnetic waves in three space dimensions, in particular harmonic waves characterized by a wave number $k > 0$. The scattering problems associated with a smooth bounded obstacle or an inhomogeneous medium characterized by a refraction index are considered. If $L > 0$ is the characteristic length of the obstacle or of the dishomogeneities contained in the medium, the resonance region is defined by the condition $kL = O(1)$. Since the inverse scattering problems in the resonance region cannot be studied using low or high frequency asymptotic formulas the inversion of the full wave propagation phenomenon is necessary. Scattering in the resonance region is important in industrial and military applications when low resolution images are either good enough or the best possible. The speaker will present an overview of the techniques being used to study these problems with special emphasis on the so called "Herglotz function" technique, and discuss several numerical examples.

Francesco Zirilli
Dipartimento di Matematica "G. Castelnuovo"
Università di Roma "La Sapienza", Italy

2:15-3:15
Concurrent Sessions

CP21/Clayton Hall Auditorium
Numerical Methods
Chair: David Colton, University of Delaware

2:15 **On Krylov Subspace Approximations of Matrix Functions Resolving Some Linear Partial Differential Equations**
Vladimir Druskin, Schlumberger-Doll Research, Ridgefield, CT; and Leonid Knizhnerman, Central Geophysical Expedition, Russia

2:35 **Design of New Finite Element Methods for Fluid—Loaded Plates**
Karl Grosh and Peter M. Pinsky, Stanford University

2:55 **A Chebychev Collocation Method for the Wave Equation in Generalized Coordinates**
Jose M. Carcione, Osservatorio Geofisico Sperimentale, Italy and Hamburg University, Germany; and Jian P. Wang, Nagoya University, Japan

CP22/Clayton Hall Room 101B

Reaction Diffusion

Chair: Ivar Stakgold, University of Delaware

2:15 **Existence and Nonexistence of Traveling Waves and Reaction-Diffusion Front Propagation in Periodic Media**
Jack Xin, University of Arizona

2:35 **Travelling Waves in Isotachophoresis**
James N. Elele, United States Army Electronic Proving Ground

2:55 **Two-Temperature Discrete Model for Traveling Waves in Excitable Media**
S.L. Sobolev, Russian Academy of Science, Russia

3:15-3:45/Clayton Hall Lobby Lounge

Coffee and Poster Session 6—Inverse Problems

Analysis of Ultrasonic Transient Signals
Jean Roux, and Jacques Cahouet, Electricite de France, France

Regularization Methods for Single Photon Emission Tomography
Zheng Kewang, Hebei Institute of Light Industry and Chemical Technology, China

Software for Simultaneous Determination of Sounding Signal and Wave Propagation Velocity
Alexander V. Avdeev, Prosp. Academy, Russia

Inverse Scattering for a Seismic Horizontally Layered Earch Model
Virgil Bardan, Bucharest University, Romania

A Recursive Approach to the Location of Multiple Coherent Sources
Yue Yao, Northern Jiao-tong University, People's Republic of China; and *Guoliang Zeng,* Arizona State University

Wavelets in Direct and Inverse Problems of Linear and Nonlinear Wave Propagation in Soils
Moulay Said El Youssoufi, Université Montpellier II, France

3:45-5:05

Concurrent Sessions

CP23/Clayton Hall Auditorium

Inverse Obstacles and Media Problems

Chair: David Colton, University of Delaware

3:45 **On the Uniqueness of Inverse Scattering Problems by Penetrable Obstacles**
Frank Hettlich, Universität Erlangen-Nürnberg, Germany

4:05 **Elastodynamic Inverse Obstacle Scattering**
Paul A. Martin, University of Manchester, United Kingdom; and G. Dassios, University of Patras, Greece

4:25 **Numerical Solution of the Inverse Impedance Problem**
Andrzej W. Kedzierawski, Delaware State College

4:45 **Single Frequency Nonlinear Ultrasonic Inverse Scattering Tomography in Polar Coordinates**
Brent L. Carruth, Louisville, KY

CP24/Clayton Hall Room 101B

Water Waves

Chair: Ivar Stakgold, University of Delaware

3:45 **Free Surface Waves in a Wavemaker Problem**
Angela Pawell and Ronald B. Guenther, Oregon State University

4:05 **Nonlinear Sloshing Waves**
Susan Cole, Rensselaer Polytechnic Institute

4:25 **New Results about Non-Homogeneous Free-Surface Conditions in Underwater Acoustics and Naval Hydrodynamics**
D. Euvrard, J. Frantz, and O. Mechiche Alami, Ecole Nationale Superieure de Techniques Avancees, France'

4:45 **Asymptotics of Linear Water Waves Over a Gradually Developing Bottom**
Peter N. Zhevandrov, CINVESTAV del I.P.N., Mexico; Sergei Yu. Dobrokhotov, Institute for Problems in Mechanics, Russia; and Valentina M. Kuzmina, Moscow Electronic Engineering Institute, Russia

5:05/Pencader Cafeteria

Dinner

GET-TOGETHERS

SIAM Welcoming Reception
Sunday, June 6, 1993
6:30 PM - 8:30 PM
Clayton Hall Lobby
Cash bar and assorted mini hors d'oeuvres

Dean's Reception
Tuesday, June 8, 1993
5:30 PM
Clayton Hall Lobby
Complementary hors d'oeuvres and beverages

Dinner at "Casablanca"
Moroccan Restaurant
Wednesday, June 9, 1993
5:45 PM
Join in on a Middle Eastern evening and dinner at the "Casablanca" Moroccan Restaurant. Attendees will board buses at 5:45 PM at Clayton Hall and arrive at "Casablanca" at 6:00 PM. You will receive a cocktail of your choice and then be seated for dinner where you will partake of a seven course meal consisting of an array of 3 salads, pastia (a thin pastry with chicken, eggs, cinnamon, sugar and almonds), main course to consist of your choice of the following: chicken with lemon and olives; chicken with hot sauce and cumin; boiled rabbit with garlic, onions, peppers and coriander; beef shishkebabs; or lamb with honey and almonds. Following the main course, you will be served couscous (semolina with vegetable, chicken and chick peas); assorted fresh fruit; hot mint tea and baklava for dessert. Wine will be served with dinner. Entertainment will be provided throughout dinner. Buses will return to the University at about 9:15 PM.
Cost: $26.00 per person

THURSDAY MORNING, JUNE 10

7:30/Clayton Hall Lobby Lounge

Registration opens

8:30/Clayton Hall Auditorium

IP8/Chair: Fadil Santosa, University of Delaware

Asymptotic Behavior of Solutions to Nonlinear Wave and Plate Equations with Boundary Dissipations

Interest in studying the asymptotic behavior, as time $t \to \infty$, of the solutions to nonlinear wave and plate equations has been spurred by recent developments in the control and stabilization of large flexible structures. These structures are very susceptible to undesirable vibrations/oscillations due to the low weight and large dimensions. A question of paramount importance is how to suppress these vibrations by applying a suitable dissipative mechanism to the structure. Of particular physical interest are models in which the dissipative feedback is applied on the boundary (edge) of the structure. The associated mathematical problem is boundary stabilization of nonlinear hyperbolic or hyperbolic-like PDE's including nonlinear wave equations, nonlinear Kirchhoff/Euler Bernoulli equations or Von Karman systems. The speaker will present a fairly general approach leading to results on asymptotic decay rates of the solutions as well as, in some cases, on the existence of finite dimensional attractors. She will discuss multiplier methods, microlocal analysis and some related inverse problems.

Irena Lasiecka
Department of Applied Mathematics
University of Virginia

9:15-10:15

Concurrent Sessions

CP25/Clayton Hall Auditorium

Controllability

Chair: Thomas Angell, University of Delaware

9:15 **Approximation Theory for the Problem of Exact Controllability of the Wave Equation with Boundary Control**
Frederic Bourquin, Laboratoire Central des Ponts et Chaussees, France

9:35 **Optimal Design of Minimally Reflective Coating**
Fadil Santosa and Henry Konstanty, University of Delaware

9:55 **Using Exact Controllability to Solve the Helmholtz Equation at High Wave Numbers**
M.O. Bristeau, INRIA, Le Chesnay, France; R. Glowinski, University of Houston and University of Paris VI and CERFACS, France; and J. Periaux, Dassault Aviation, France

CP26/Clayton Hall Room 101B

Domain Decomposition

Chair: Claude W. Bardos, Université Paris VII, France

9:15 **Domain Decomposition Method and the Helmholtz Problem II**
Bruno Despres, Commissariat A L'Energie Atomique, Centre D'Etudes de Limeil, Valenton, France

9:35 **A Single-Step Overlapping Domian Decomposition Method for Transient Hyperbolic Problems**
Enrico Priolo and Geza Seriani, Osservatorio Geofisico Sperimentale, Italy; and Jose M. Carcione, Osservatorio Geoficico Sperimentale, Italy and Hamburg University, Germany

9:55 **Accurate Local Grid Refinement Schemes**
Richard Ewing, Texas A&M University, College Station; Richard Babarsky, James Madison University; Robert Sharpley, University of South Carolina, Columbia; and James Sochacki, James Madison University

10:15-10:45/Clayton Hall Lobby Lounge

Coffee and Poster Session 7—Plasmas and Heating

The Stabilization of Statistics in Wave and Klein-Gordon Equations. The Scattering Theory for the Solutions of Infinite Energy
A.I. Kometch, Moscow State University, Russia; E.A. Kopylova, Vladimir Polytechnic Institut, Russia; and N.E. Ratanov, Chelyabinsk State University, Russia

On the Reflection of Radiowave from Weakly Reflecting Non-Uniformities of Plasma (Ionosphere)
Valeriy K. Berger, South Euclid, Ohio

Influence of Parameters Fluctuations of Reflecting Layer of Plasma on Statistical Properties of Reflected Radio-Wave (Near Critical Frequency)
Valeriy K. Berger, South Euclid, Ohio

Numerical Modelling of Applied-B Ion Diodes
Thomas Westermann, Kernforschungszentrum Karlsruhe GmbH, Germany

Finite Difference Solutions of the Nonlinear One-Dimensional Electrostatic Plasma Multi-Fluid Equations: Solitons and Recurrence
S. Baboolal, Univerity of Durban, Westville, South Africa

10:45-11:25

Concurrent Sessions

CP27/Clayton Hall Auditorium

Periodic Structures

Chair: Thomas Angell, University of Delaware

10:45 **Electromagnetic Waves in Periodic Media**
Toufic Abboud, Ecole Polytechnique, France

11:05 **Nonlinear Optics in Periodic Diffraction Structures**
Gang Bao and David Dobson, University of Minnesota,Minneapolis

CP28/Clayton Hall Room 101B

Microwave Heating

Chair: Claude W. Bardos, Université Paris VII, France

10:45 **Avoiding Spurious Modes in the Computation of Field Patterns in Microwave Ovens**
Alain Bossavit and L. Pichon, Electicite de France and Laboratoire de Genie Electrique de Paris, France

11:05 **3D Numerical Micro-Waves; Heating Applicatons**
P. Chaussecourte, Electricite de France, France; C. Hazard, Groupe d'Hydrodynmaique Navale, France; J.F. Lamaudiere and B. Maestrali, Electricite de France, France

11:25/Clayton Hall Auditorium
IP9/Chair: Ralph E. Kleinman, University of Delaware

Hybrid Numerical and Analytical Methods

Numerical methods and analytical methods can be combined to yield hybrid methods which are more effective than either method alone for certain kinds of problems. Singular problems, for example, are difficult for direct numerical methods. However, singular perturbation methods and certain other analytical procedures are designed to deal with just such difficulties. Therefore hybrid of such methods can be very effective. The speaker will present some examples of hybrid methods including the derivation of exact non-reflecting boundary conditions and their use with the finite element method, the elimination of small features from numerical computations, and the use of numerical methods to solve the inner and outer problems which arise in the method of match asymptotic expansions.

Joseph B. Keller
Department of Mathematics
Stanford University

THURSDAY AFTERNOON, JUNE 10

12:05-1:30/Pencader Cafeteria

Lunch

1:30/Clayton Hall Auditorium
IP10/Chair: Jean Roberts, Institut National de Recherche en Informatique et en Automatique, France

Analytical and Numerical Problems for Nonlinear Wave Propagation in "Nearly" Integrable Systems

Many real dynamical elastic systems, although presenting necessary ingredients for a solitonic behavior, such as nonlinearity and dispersion, are built from an exactly integrable subsystem that is coupled to additional wave equations. They are not exactly integrable since the coupling is likely to generate radiation. Sine-Gordon-d'Alembert systems (in elastic ferroelectrics and in magnetoelasticity), generalized Zakharov systems (surface elastic envelope waves) and generalized Boussinesq systems (in elastic shape memory alloys) are examples of such systems. These systems are often "nearly" integrable in the sense that the amount of radiation observed remains small.

In this presentation, the speaker will discuss numerical simulation of the dynamics of such systems and simple analytical methods for capturing the most characteristic behaviors resulting from coupling. Perturbation of the first few conservation laws of soliton theory is the most efficient method and its predictions are corroborated by simulations for the above-quoted systems. It must be noted that for such nearly integrable systems the evolution of original solitons under the action of perturbations may become quite complicated (annihilation, abrupt split, "perestroika" of solutions, existence of transparency windows, etc.) as shown by the simulations.

Gérard A. Maugin
Laboratoiré de Modélisation en Mécanique
Université Pierre et Marie Curie, France

2:15-3:15

Concurrent Sessions

CP29/Clayton Hall Auditorium

Finite Element Methods

Chair: Roland Glowinski, University of Houston

2:15 **A Multi-Dimensional Galerkin Least Squares Finite Element Method for Time-Harmonic Wave Propagation**
Lonny L. Thompson and Peter M. Pinsky, Stanford University

2:35 **A Method for the Solution of Time-Harmonic Maxwell Equations in Exterior Domains**
Christophe Hazard and Marc Lenoir, Ecole Nationale Superieure de Techniques Avancees, Laboratoire de Simulation et Modelisation des phenomenes de Propagation, France

2:55 **Effect of Sloppy Discretization and Parasitic Waves**
Jukka Tuomela, Helsinki University of Technology, Finland

CP30/Clayton Hall Room 101B

Nonlinear Waves

Chair: Rainer Kress, Universität Göttingen, Germany

2:15 **Nonlinear Conservation Laws of Nonhomogeous PDEs**
G. Ali Zakeri, California State University, Northridge

2:35 **A General Expression of Solutions to Some Nonlinear Wave Equations**
Chuntao Yan, Kansas State University

2:55 **Evolution of Shocks in Solutions of Inviscid Burgers Equation**
Yuliy Baryshnikov, Institute for Control Sciences, Russia and Osnabrueck University, Germany

3:15-3:45/Clayton Hall Lobby Lounge

Coffee and Poster Session 8—Modelling and Simulation

Reduction of Train Induced Vibrations and Waves
Nawawi Chouw, Rong Le and Gunther Schmid, Ruhr-University Bochum, Germany

A Fast Model to Compute Ultrasonic Field in Fluid and Solid with Obstacles
Vanchi Nguyen, *Jacques Cahouet,* and Jean Pascal Noel, Electricite de France, France

Stability of a Computer Model of 1-D Wave Propagation
Mariusz Ziolko, University of Mining and Metallurgy, Poland

Progressive Wave Forms Vs Optimal Energy Considerations in Peristaltic Transport - A SUPG/FEM Approach
K.B. Naidu and B.V. Rathish Kumar, Sri Sathya Sai Institute of Higher Learning, India

Computer Simulation of the Surface Acoustic Waves Propagation
Valentinas Snitka and Rolandas Asauskas, Kaunas University of Technology, Lithuania

Interaction of a Cold Front with Orography
Michael E. Frantz, University of La Verne; and Ellis Cumberbatch, Claremont Graduate School

3:45-5:05

Concurrent Sessions

CP31/Clayton Hall Auditorium

Obstacle Scattering

Chair: Roland Glowinski, University of Houston

3:45 **Helmholtz Equation Solution in an Exterior Domain and with Boundary Conditions for Coated Obstacles**
Anabelle Zebic, Institut National de Recherche en Informatique et en Automatique, Rocquencourt, France

4:05 **Scattering by Obstacles with Singular Boundary**
Rainer Hampel, Mathematisches Institut der Universität Munchen, Germany and *Ricardo Weder,* Universidad Nacional Autonoma de Mexico, Mexico

4:25 **Analytical Regularization of Two Dimensional Problem of Wave Diffraction by Curvilinear Screen Placed in Local Inhomogeneous Media**
A. Poyedinchuk, Y. Tuchkin, and V. Shestopalov, Institute of Radiophysics and Electronics, Academy of Science of Ukraine, Ukraine

4:45 **On the Scattering of Waves by a Wedge with General Boundary Conditions. The Exact Solution**
A.E. Merzon, Moscow State Pedagogical University, Russia; and A.I. Kometch, Moscow State University, Russia

CP32/Clayton Hall Room 101B

Inverse Scattering

Chair: Rainer Kress, Universität Göttingen, Germany

3:45 **The Inverse Scattering Problem for Grazing Incidence on a Rough Surface**
Mark Spivack, University of Cambridge, United Kingdom

4:05 **Inverting Ultrasonic Data on Solid/Fluid Mixtures for Biot-Gassmann Parameters**
James G. Berryman, Lawrence Livermore National Laboratory and David E. Lumley, Stanford University

4:25 **Multidimensional Inverse Scattering Problems in Random and Deterministic Media**
Michael V. Klibanov, University of North Carolina, Charlotte

4:45 **On the Uncertainty Principle for Scattering Transform**
Natalia Grinberg, Moscow, Russia

5:05

Conference Adjourns

CP = Contributed Presentation IP = Invited Presentation PS = Poster Session

*Because of space limitation, co-authors of papers presented are not shown.

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SOCIETY for INDUSTRIAL and APPLIED MATHEMATICS

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Institution	Major / Degree / Year

Primary Professional Interests (Check no more than 3)

- ❑1. Linear algebra and matrix theory.
- ❑2. Real and complex analysis including approximation theory, integral transforms (including Fourier series and wavelets), integral equations, asymptotic methods, and special functions.
- ❑3. Ordinary differential equations including dynamical systems.
- ❑4. Partial differential equations including inverse problems.
- ❑5. Discrete mathematics and graph theory including combinatorics, combinatorial optimization, and networks.
- ❑6. Numerical analysis (theory).
- ❑7. Computational mathematics including scientific computing, parallel computing, and algorithm development.
- ❑8. Computer science including computer architecture, computer hardware, computational complexity, applied logic, database, symbolic computation.
- ❑9. Applied probability including stochastic processes, queueing theory, and signal processing.
- ❑10. Statistics including data analysis and time series analysis.
- ❑11. Control and systems theory including optimal control.
- ❑12. Optimization theory and mathematical programming including discrete and numerical optimization and linear and nonlinear programming.
- ❑13. Communication theory including information theory and coding theory.
- ❑14. Applied geometry including computer-aided design and related robotics.
- ❑15. Image processing including computer graphics, computer vision, related robotics, and tomography.
- ❑16. Classical mechanics of solids including elasticity, structures and vibrations, and constitutive models.
- ❑17. Fluid mechanics including turbulence, aeronautics, and multiphase flow.
- ❑18. Quantum physics, statistical mechanics, and relativity.
- ❑19. Geophysical sciences including reservoir modeling, seismic exploration, and petroleum engineering.
- ❑20. Atmospheric and oceanographic sciences.
- ❑21. Chemical kinetics, combustion theory, thermodynamics, and heat transfer.
- ❑22. Biological sciences including biophysics, biomedical engineering, and biomathematics.
- ❑23. Environmental sciences.
- ❑24. Economics.
- ❑25. Social sciences.
- ❑26. Functional analysis and operator equations, and integral and functional equations.
- ❑27. Management sciences including operations research.
- ❑28. Applied mathematics education (K-12, undergraduate curriculum, graduate study and modeling courses).
- ❑29. Astronomy, planetary sciences, and optics.
- ❑30. Simulation and modeling.
- ❑31. Materials science, polymer physics, and structure of matter.
- ❑32. Electromagnetic theory, semiconductors, and circuit analysis.
- ❑Other_____

SIAM use only

F/M _____

CR# _____

Inv.# _____

Sub ____ Logged _____

Lts/Chron _____

please complete reverse side

Society Memberships
(Check all that apply)

ACM_____	AIAA_____	AMS_____	APS_____	ASA_____	ASME_____
IEEE_____	IMS_____	MAA_____	ORSA_____	TIMS_____	Other_____

Membership Benefits

Dues cover the period January 1, 1993 through December 31, 1993. Members will receive all issues of *SIAM Review* and *SIAM News*. Members are entitled to purchase one each of no more than four SIAM journals, for their personal use only, at member discount prices. Members can join any of the SIAM Activity Groups at $10 per group. Members are entitled to 20% off list prices on all SIAM books, and receive member discounted registration at SIAM sponsored meetings.

Student members have the same benefits as regular members. Students receive one activity group membership free; additional activity group memberships are $10 each.

Associate members are spouses of regular members and are entitled to all privileges of regular members except that they do not receive *SIAM Review*. Associate members should indicate the full name of their spouse on their application.

Fees and Subscriptions

Compute payment as follows:

Dues (Regular Members): $79.00 _____

Dues (Student Members): $15.00 _____

Dues (Associate Members): $18.00 _____

Dues (Activity Groups): $10.00 per group checked below: _____

Control and Systems Theory _____ Discrete Mathematics _____ Dynamical Systems _____

Geometric Design _____ Geosciences _____ Linear Algebra _____ Optimization _____

Orthogonal Polynomials and Special Functions _____ Supercomputing _____

SIAM Journal on . . .	Member Prices: USA, Canada, Mexico/Elsewhere	
Applied Mathematics (bimonthly)	$54/$59	_____
Computing (bimonthly)	$54/$59	_____
Control and Optimization (bimonthly)	$54/$59	_____
Discrete Mathematics (quarterly)	$44/$47	_____
Mathematical Analysis (bimonthly)	$54/$59	_____
Matrix Analysis and Applications (quarterly)	$44/$47	_____
Numerical Analysis (bimonthly)	$54/$59	_____
Optimization (quarterly)	$44/$47	_____
Scientific Computing (bimonthly)	$54/$59	_____
Theory of Probability and Its Applications (quarterly)	$99/$102	_____
1992-93 Combined Membership List	$9	_____

TOTAL $ _____

Application for Membership

I apply for membership in SIAM:

Signature _____

Spouse's Name (If applying for Associate Membership) _____

Student Status Certification

CERTIFICATION (student members only)

I hereby certify that the applicant is actively engaged in a degree program and is a full-time student, teaching/research assistant, or fellow:

Name of College or University _____

Department Chair (signature please) _____ Date _____

Please enclose payment with this application and mail to: SIAM, P.O. Box 7260, Philadelphia, PA 19101-7260

MEMBERS OUTSIDE THE USA

For SIAM members residing outside the USA, SIAM will accept payment of membership dues and subscription fees by American Express, MasterCard, and VISA. Because SIAM incurs considerable cost in obtaining payment via credit cards, please use credit cards only when other methods of payment are difficult to arrange.

❑ American Express ❑ MasterCard ❑ VISA

Credit Card # _____ Expiration date_____

For further information, please contact SIAM Customer Services:
Telephone: 215-382-9800 / Toll-free (U.S. only): 800-447-SIAM / Telex: 446715 / Fax: 215-386-7999
E-mail: service@siam.org / Address: 3600 University City Science Center, Philadelphia, PA 19104-2688

The University of Delaware in Newark, located midway between Washington, D.C. and New York City, is approximately an hour from Philadelphia and Baltimore, and twenty minutes from Wilmington.

BY AIR

SIAM has selected Continental and USAir as the official airline carriers for this conference. Continental is offering 5% off the lowest applicable fare and 45% off full coach fares.

USAir is the major carrier into Philadelphia. USAir (at time of program production) is offering discounted fares into some designed cities. Unfortunately, Philadelphia is not considered one of the designated discounted cities. USAir does offer the most flights into Philadelphia.

To make travel reservations, SIAM recommends that you contact Get-A-Way Travel at 1-800-233-3863 or 215-379-6800. Ask for Glen Geary at the SIAM Conference Desk. Get-A-Way travel will book your flight on Continental, USAir, or the airline of your choice. Your tickets will be mailed to you. When making a reservation, be sure to mention that you are attending the SIAM Conference on Wave Propagation.

SHUTTLE SERVICE FROM AIRPORT

Shuttle service to and from the campus is provided by Delaware Express (800)-648-5466 and Airport Shuttle (302)-655-8878. The Airport Shuttle has service counters located in the baggage claim areas of terminals A, B, C and E. Terminal D is equipped with a courtesy phone. You must check in with Airport Shuttle. Airport Express vans are white and green. The approximate one-way cost to the University is $24.00. The Delaware Express does not have a courtesy desk or phone. Call their 800 number and they will direct you to a pick up location. Delaware Express shuttles are white and blue and the approximate one-way cost to the University is $24.50. NO ADVANCE RESERVATIONS ARE NEEDED FOR THE AIRPORT SHUTTLE, HOWEVER THE DELAWARE SHUTTLE REQUIRES THAT YOU MAKE RESERVATIONS FOR PICK UP AT LEAST 24-HOURS PRIOR TO SCHEDULED ARRIVAL. To schedule your return trip to the airport you must also make a reservation for pick up at the University (Christiana Commons) 24 hours in advance of scheduled departure.

BY CAR

From the north: Take I-95 South to Delaware Exit 1B, Route 896 North, and continue north on South College Avenue pass the Delaware stadium complex and past central campus. Turn left onto Main Street. Continue north on 896 to Clayton Hall. Directional signs for Clayton Hall are posted throughout Newark.

From the south: Take I-95 North to Maryland Exit 109B, then take Route 279 North (also called Route 2). Proceed into Newark via Route 2 (also called Elkton Road) and follow 896 North signs to Clayton Hall. Directional signs for Clayton Hall are posted throughout Newark.

BY TRAIN

Amtrak trains run between Florida and New England and stop in Wilmington. From the Wilmington station, it is a 20 minute ride to campus. Delaware Area Regional Transportation (DART) buses transport passengers between Wilmington and Newark. This service is available only on weekdays and the last bus leaves at 6:33 PM. To contact DART, phone (302) 655-3381.

AREA LODGING

The following is a partial list of motels that are within 5 to 15 minutes of the University by car. These motels have special rates set up with the University. When making your reservation be sure to mention that you are attending a conference at the University at Clayton Hall Conference Center to ensure that you get the discounted rates. If you would like an additional list of motels available contact SIAM Conference Department, telephone: 215-382-9800; email: meetings@siam.org

SIAM has not reserved rooms over these dates at any of these motels and cannot guarantee availability.

Comfort Inn
1120 South College Avenue
Newark, Delaware 19711
302-368-8715

Howard Johnson's
1119 S. College Avenue
Newark, Delaware 19713
302-368-8521

Travelodge
268 East Main Street
Newark, Delaware 19711
302-737-5050
Closest to Clayton Hall and University

CAR RENTAL

Dollar Rent A Car has been selected as the official car rental agency for this conference. Cars can be rented at the Philadelphia International Airport. The following unlimited mileage rates will apply between May 31 - June 14, 1993. (These rates do not include refueling services, tax, optional collision damage waiver, and personal accident insurance.)

Type of Car	Daily Rate	Weekly Rate
Economy	$32.00	$160.00
Compact	$30.00	$160.00
Intermediate	$33.00	$165.00
Standard	$33.00	$165.00
Premium	$41.00	$205.00
Mini Van	$41.00	$205.00

Reservations

We encourage you to make an advance reservation, since on-site availability cannot be guaranteed. Make reservations by calling 1-800-800-0044. When making reservations, be sure to give the SIAM Reservation Code: CCSIA7. You should also mention that you are attending the Second International Conference on Wave Propagation, June 7-10, 1993, Newark, Delaware, in order to receive the indicated rates.

Cars can be picked up at the Philadelphia International Airport at the Dollar Car Rental Desk located in the baggage claim area of the airport, and must be dropped off at the same location.

You must be 21 years of age and have a valid U.S. or international driver's license.

You must have an American Express, Master Card, VISA or Diner's Club credit card in order to rent a car.

UNIVERSITY (DORMITORY) INFORMATION

Founded in 1743 as a small academy, the University of Delaware is set on a beautifully landscaped 1,100-acre campus in the town of Newark. SIAM is holding a block of rooms at the University's Christiana Towers for attendees of this conference. The Christiana Towers is a high rise apartment residence hall located at the northernmost end of the university. The rooms in the Christiana Towers are fully carpeted suites with living/dining areas, kitchenettes, one or two bedrooms, private baths, telephone and individually-controlled air conditioning, ice machines, and daily maid service. The Towers are adjacent to and within walking distance of Clayton Hall, the site of the technical sessions. Rooms do not include television, radio, clock or cooking utensils. Wake-up service is provided upon request.

ROOM RATES

1 bedroom, 1 person	$45.50 per night
1 bedroom, 2 people	$31.50 per night per person
2 bedrooms, 2 people	$36.00 per night per person
2 bedrooms, 3 people	$26.75 per night per person
2 bedrooms, 4 people	$22.00 per night per person

Delaware does not charge sales tax so the room rates are not subject to any additional charges.

RESERVATION DEADLINE **May 21, 1993**

TO MAKE A RESERVATION

Use the Housing Reservation Form in this program or call the University of Delaware, Clayton Hall at (302) 831-2216 ask for Carol Seifred.

Identify yourself as an attendee at the SIAM Conference on Wave Propagation.

Be sure to request a written confirmation.

Room reservations must be paid for in full and in advance.

CANCELLATION

To obtain a refund, reservations must be cancelled seven (7) days prior to your scheduled arrival. Refunds will be sent to you in the mail in the form of a check within three weeks of cancellation.

ARRIVALS AND DEPARTURES

You may check in at the Christiana Towers on a 24-hour basis; you must check out by 12:00 Noon. To check in, go to the Christiana Commons, a low building located between the two high-rise Towers. Upon check in you will be given your keys and directed to the appropriate Tower. If checking in after midnight, you must knock on the door to get the attention of the receptionist on duty. Doors will be locked to ensure security.

UNIVERSITY FACILITIES

The university is equipped with an indoor pool and weight room located in Carpenters Hall. The pool is open daily from 7:30 AM - 8:30 AM, 12:00 noon - 1 PM and 4:00 PM - 6:00 PM. Tennis courts are located directly in front of the Christiana Towers. Attendees should bring their own equipment. There is no cost for utilizing these facilities as long as attendees display their name badges.

WITHIN WALKING DISTANCE

The Deer Park, Down Under, and Crab Trap are a few of the restaurants within a ten minute walk from the Christiana Towers. The nearby Fairfield Shopping Center has drug, liquor, grocery, variety, and take out food shops.

PARKING

Located adjacent to the Christiana Towers is a parking lot with ample free parking.

CHILDCARE SERVICE

Arrangements for childcare can be made with Girls Incorporated, a licensed and accredited daycare facility. Arrangements must be made in advance by calling 302-292-0425 and asking for Dawn. Service is subject to availability. SIAM supplys the information, but in no way takes responsibility or is liable for any damages that may occur by using any of the suggested services. It is the responsibility of the attendees to choose the service that best suits their needs.

MEAL TICKETS

The University cafeteria located in Pencader Hall (attached to Clayton Hall) will be open for daily meal service. Tickets can be purchased at the Clayton Hall registration desk. The cafeteria is open for service as follows:

Breakfast	7:00 AM - 8:30 AM	$4.75
Lunch	11:30 AM - 1:30 PM	$7.50
Dinner	5:00 PM - 6:30 PM	$9.50

Children under 4 years of age pay $1 less than the prices listed above. Vegetarian meals are available.

REGISTRATION INFORMATION

Please complete the Preregistration Form found on the back of this program. We urge attendees to register in advance to get the lower registration fee. The preregistration deadline is May 24, 1993. The registration desk will be located in the Clayton Hall Lobby and will be open as listed below:

Sunday, June 6	6:30 PM - 8:30 PM
Monday, June 7	7:30 AM - 3:30 PM
Tuesday, June 8	8:00 AM - 3:30 PM
Wednesday, June 9	8:00 AM - 3:30 PM
Thursday, June 10	8:00 AM - 2:00 PM

REGISTRATION FEES:

	SIAM Member	Non Member	Student
Preregistration	$165	$195	$55
Registration	$195	$225	$55

The conference registration fees include a copy of the proceedings and continental breakfast service each morning prior to the start of the morning sessions.

NON-SIAM MEMBERS

We encourage non-SIAM members to join SIAM. If you join now, you will obtain the member rate for conference registration and enjoy all the other benefits of SIAM membership. Join SIAM by sending your completed membership form (see p.11) along with your conference registration form. Be sure to include both membership dues and registration fees in your payment for a savings of $30.00.

NOTICE

There will be no prorated fees. No refunds will be issued once the conference has started. If SIAM does not receive your Preregistration Form by May 24, 1993, you will be asked to register and pay the full registration fee for the conference.

CREDIT CARDS

SIAM accepts Visa, MasterCard and American Express for payment of registration fees, special functions, memberships, and book orders. When you complete the Preregistration Form, please be certain to indicate the type of credit card, the account number and the expiration date.

TELEPHONE MESSAGES

Messages for attendees at the conference between the hours of 8:00 AM and 5:00 PM should be directed to the telephone number at the University of Delaware, Clayton Hall (302) 831-1259. The University will either connect the caller with the SIAM registration desk or take a message for the attendees. Attendees should check with the University Registration Desk at Clayton Hall for any messages on a regular basis. SIAM will have a message board where message will be posted. Messages prior to 8:00 AM and after 5:00 PM should be directed to Christiana Commons at 302-831-1254. Messages will be placed in message boxes at the registration desk located in the Commons.

SIAM CORPORATE MEMBERS

Non-member attendees who are employed by the following institutions are entitled to the SIAM member rate.

Amoco Production Company
AT&T Bell Laboratories
Bellcore
The Boeing Company
BP America
Cray Research Inc.
E.I. du Pont de Nemours & Company
Eastman Kodak Company
Exxon Research and Engineering Company
General Motors Corporation
GTE Laboratories, Incorporated
Hollandse Signaalapparaten, B.V.
IBM Corporation
ICASE
IDA Center for Communications Research
IMSL, Inc.
Lockheed Corporation
MacNeal-Schwendler Corporation
Martin Marietta Energy Systems
Mathematical Sciences Research Institute
NEC Research Institute
Supercomputing Research Center, a Division of Institute for Defense Analyses
Texaco, Inc.
United Technologies Corporation

HOUSING (DORMITORY) RESERVATION FORM

SECOND INTERNATIONAL CONFERENCE ON NUMERICAL ASPECTS OF
WAVE PROPAGATION

June 7 - 10, 1993

UNIVERSITY OF DELAWARE
CHRISTIANA TOWERS

A block of suite/dorms are being held for our exclusive use until May 21, 1993. After that date, reservations will depend on availability. Your reservation is not confirmed until acknowledged in writing by the University or verified by phone. When making reservations by phone, be certain to identify yourself as an attendee at the SIAM Conference on Wave Propagation. Telephone: 302-831-2216.

PLEASE PRINT

Name _____

Phone _____

Address _____

City _____ State _____ Zip _____

Please reserve the following accommodations

- ❑ 1 bedroom, 1 person $45.50 per night
- ❑ 1 bedroom, 2 people $31.50 per person per night
- ❑ 2 bedrooms, 2 people $36.00 per person per night
- ❑ 2 bedrooms, 3 people $26.75 per person per night
- ❑ 2 bedrooms, 4 people $22.00 per person per night

Roommate preference, if any.

_____

IF YOU SELECT OTHER THAN SINGLE ACCOMMODATIONS AND DO NOT INDICATE A ROOMMATE PREFERENCE YOU MAY BE ASSIGNED AND CHARGED A SINGLE ROOM IF NO ROOMMATE IS AVAILABLE.

❑ I am a disabled participant and require appropriate accommodation.

Arrival Date _____ Arrival Time _____ Departure Date _____

❑ I am enclosing my payment for the above reservation. ____(nights) x $____(rate) = $____(total)

❑ Enclosed is my check made payable to "University of Delaware"

Please charge my:

❑ MasterCard ❑ Visa ❑ Discover *The University does not accept American Express for payment.*

Credit Card Number _____ Exp. Date _____

Signature _____

Detach this card and enclose it in an envelope with postage and mail to: Conferences and Centers, Division of Continuing Education, University of Delaware, Newark, Delaware 19716-7430

REGISTRATION FORM

SECOND INTERNATIONAL CONFERENCE ON NUMERICAL ASPECTS OF
WAVE PROPAGATION

JUNE 7 - 10, 1993

UNIVERSITY OF DELAWARE
CLAYTON HALL

Preregistration form and payment must be received at the SIAM office by May 24, 1993 or you will be required to pay the full registration fee. Please make checks payable to SIAM.

Registration Fees: (Please circle your appropriate fee category)

	SIAM Member	Non Member	Student
Preregistration	$165	$195	$55
Registration	$195	$225	$55
Casablanca Dinner	$ 26	$ 26	$26
TOTAL	$_____	$_____	$_____

The conference registration fees include a copy of the proceedings that will be handed out at the conference and continental breakfast service each morning prior to the start of the morning sessions.

PLEASE PRINT

Name _____

Organization _____

Department _____

Office Address _____

City _____ State _____ Zip _____

Fax. No. _____ E-mail Address _____

Home Address _____

City _____ State _____ Zip _____

❑ I am a disabled participant and require appropriate accommodation.

Please update my SIAM records ❑ Yes ❑ No

All correspondence from SIAM should be sent to the above address ❑ Home ❑ Business

Local Address in Delaware _____

NAME BADGE

prefer my name and affiliation to read as follows:

Name: (20 characters) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Affiliation:(30 characters) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

I wish to pay by ❑ American Express ❑ VISA ❑ MC ❑ Check

Credit Card No. _____ Expiration Date _____

Signature _____

Detach this form and enclose it with payment in the envelope provided (domestic mail only) and mail to SIAM Conference Department, 3600 University City Science Center, Philadelphia, PA 19104-2688. Telephone: 215-382-9800; E-mail: meetings@siam.org; FAX: 215-386-7999. Preregistration and payment must be received by May 24, 1993 or you will have to pay the full registration fee on site.