

**00-6 IUTAM Symposium on Diffraction and Scattering
in Fluid Mechanics and Elasticity, Manchester,
UK, July 16-20, 2000**

a) Scientific Committee

I.D. Abrahams (UK, Chairman), M.A. Hayes (Ireland),
V.M. Babich (Russia), A. Bostrom (Sweden), D.V. Evans
(UK), R.H.J. Grimshaw (UK), E.J. Kerschen (USA),
A.N. Norris (USA)

b) Short summary of scientific progress achieved

Objectives of the Symposium

Diffraction and scattering phenomena occur in a multitude of areas of physics and engineering, and consequently the understanding and estimation of such wave behaviour is key in many industrial settings. Typical applications, where specialist knowledge is required, include the ultrasonic nondestructive evaluation of components, medical scanning, wave forces on offshore ocean structures (oil-rigs etc.), detection of underwater vehicles or fish shoals. This area has been the focus for a great deal of attention by the theoretical mechanics community for the best part of a century; the fact that it continues to this day to demand such study is due to the combination of a continuance of new and pressing applications, and the development of improved analytical and numerical tools.

It is clear on examining previous IUTAM symposia lists that it has been some time since there has been one concerned with an examination of scattering and diffraction effects in both solids and fluids. In contrast, there has been a very healthy number of small meetings or workshops encompassing specific areas within the proposed theme, for example special sessions at recent Acoustical Society of America and Society for Industrial and Applied Mathematics meetings; the annual International Day on Diffraction meetings (St. Petersburg, Russia); and the annual International Water Wave Workshops. The profusion and variety of smaller workshops concerned with scattering and diffraction indicates that it is timely to bring together workers from different subject disciplines and

industrial focuses, to examine the ways that the various subjects have developed and to stimulate cross-fertilisation of ideas and methods.

To keep within reasonable bounds of size and interests the IUTAM Symposium specialised on the following areas concerned with diffraction and scattering, each of which has a large and identifiable research community:

- diffraction and propagation of water and other free surface waves;
- elasticity;
- aeroacoustics;
- acoustic phenomena in stationary fluids.

Mathematical techniques, including analytical (exact and asymptotic), numerical and hybrid, and their developments were of primary concern at the Symposium, as was the understanding of phenomenological aspects of new models. Emphasis was placed on theoretical analysis of the mechanics, and so straightforward evaluation of specific problems or the presentation of routine numerical results without global conclusions to the subject was discouraged.

The Conference

IUTAM Symposium 2000/10 on Diffraction and Scattering in Fluid Mechanics and Elasticity was held in Manchester, England on July 16-20 2000. It was organized jointly by the Departments of Mathematics at the University of Manchester and Keele University. Accommodation, lecture and dining room facilities were provided within the Chancellors Conference Centre, a purpose built facility run by the University of Manchester. The week was memorable both for the content of the Meeting as well as the exceptional weather: clear blue skies and perfect temperatures around 78° F (26° C). This informal meeting was organized to discuss recent mathematical advances in the field of diffraction, both from the theoretical and more applied points of view. In particular, its primary goal was to bring together groups of researchers working in disparate application areas, but who nevertheless share common models, phenomenological features arising in such problems, and common mathematical tools. To this end, we were delighted to have four Plenary Speakers, Professors Allan Pierce, Ed Kerschen, Roger Grimshaw and John Willis

FRS, who are undisputed leaders in the four thematic areas of our meeting (respectively acoustics, aeroacoustics, water or other free surface waves, elasticity). The forthcoming Proceedings should offer an excellent vehicle for continuing the dialogue between these groups of researchers.

The participants were invited because of their expertise and recent contributions to this field. Collectively, there were around 90 contributors to the Symposium, including 46 speakers, 30 non-attending co-authors and 12 other delegates.

Space limitation here prohibits a full discussion of the academic content of the Symposium or a report on current progress in the area. What clearly emerged from the Meeting was the increasing diversity of application areas of the classical field of diffraction and its related topics, and therefore its continued relevance to the applied mathematics, engineering and scientific communities. Topics such as fracture mechanics, whilst on the surface quite divorced from diffraction theory can be shown to be intimately related to it; in geophysics, oceanographic Rossby waves have recently been found, through satellite altimetry data, to be scattered strongly by ocean ridges and coastlines features; diffraction effects are now known to play a profound role in noise radiation from aerojet engines. In all these examples progress can be made on understanding the physics only through a detailed analysis of the underlying mathematics models. It may be envisaged that the commonality of mathematical systems arising from such diverse physical examples would therefore allow the development of appropriate analytical tools for their solution. To some extent this is true; however, such mathematical systems are often extremely difficult to crack, and despite the fact that the subject has been studied intensively for over a century, it is only very recently that significant progress has been made on obtaining analytical results on a number of key models. Several talks at the Symposium reported progress in this direction.

c) Countries Represented and Number of Participants

Australia 1, France 1, Germany 1, India 1, Japan 1, Latvia 1, Mexico 1, Portugal 1, Russia 8, Spain 1, UK 34, USA 7. Total number of attending delegates 58.

d) Symposium Proceedings

A booklet of refereed two-page abstracts was distributed at the Symposium. The Proceedings, containing refereed articles summarizing the papers presented at the Symposium, will be published in summer/autumn 2001 by Kluwer as part of its Fluid Mechanics and Its Applications series. The editors of this volume are I.D.Abrahams, P.A.Martin and M.J.Simon.

e) Financial Support

The organizers extend their thanks to the following for sponsorship of IUTAM 2000/10:

- The International Union of Theoretical and Applied Mechanics
- Keele University
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- The Royal Society of London
- The University of Manchester

f) Scientific Program

The sessions were organized into themes, obvious by the titles of the talks. Speakers' forenames are given in full below, but co-authors' initials only are written.

Session 1. Chair: Andrew J Willmott

I David Abrahams: Opening address and aims of the symposium

Nick R T Biggs, D Porter & D Stirling: Wave diffraction through a perforated barrier of non-zero width

Mridula Kanoria & B N Mandal: Reflection by slotted thick barriers under oblique wave attack -- a numerical study

Plenary Lecturer Roger H J Grimshaw: Nonlinear effects in wave scattering and generation due to flow interaction with topography

Session 2. Chair: Chris M Linton

Alexander Shermenev & M Shermeneva: Long periodic waves on a beach

Jean-Marc Vanden-Broeck: Time dependent gravity-capillary flows past an obstacle

Philip McIver: Approximations to embedded trapped modes in wave guides

Session 3. Chair: Maureen McIver

C G Poulton, Alexander B Movchan, R C McPhedran, N A Nicorovici & Y A Antipov: Propagation of elastic waves in doubly periodic structures and phononic gaps

Alexander Sergeev & D Sergeev: Wave passage through a string having multielement inclusions with partial interior dynamics

Andrei K Abramian & E Shelepova: Formation of an unknown discrete spectrum in a general spectrum for structures interacting with a fluid

Daniel Bosquetti, J Sanchez-Dehesa, D Caballero, E Marega & G E Marques: An improved time-domain method to study the sound scattering in inhomogeneous systems

Session 4. Chair: Philip McIver

Richard Porter & D V Evans: Trapped modes about tube bundles in waveguides

Nobumasa Sugimoto & K Tsujimoto: Effects of temperature gradient on the propagation of an acoustic solitary wave in an air-filled tube

Richard H Tew: Scattering by blunt and sharp convex objects in two dimensions

Yuri A Antipov: Diffraction by an impedance circular cone and a slice of a hard or soft cone

Valery P Smyshlyaev & V M Babich: Diffraction of creeping waves by conical singularities

Session 5. Chair: Valery P Smyshlyaev

John G Harris: Elastic surface waves in curved structures

Paul A Martin & J R Berger: Waves in wood: elastic waves in cylindrically orthotropic materials

Plenary Lecturer John R Willis & A B Movchan: Theory of crack front waves

Session 6. Chair: John G Harris

Fiona H Kerr & A M Baird: Acoustic modelling of signature reduction materials for underwater applications

Peter R Brazier-Smith: A unified model for the properties of composite materials

S B Khelil, Alain Merlen, V Preobrazhensky & P Pernod: Numerical simulation of acoustic wave phase conjugation in active media

Session 7. Chair: Roger H J Grimshaw

Chris M Linton: The finite dock problem

I D Abrahams, C W Hughes, Gareth W Owen, A J Willmott: Scattering of Rossby waves by ocean ridges

Maureen McIver: Localised oscillations near submerged obstacles

Anton Duchkov & S V Goldin: Seismic wave dynamics in regular and singular points of the ray

Session 8. Chair: C John Chapman

Alexander Kaptsov & S Kuznetov: Spectral properties of the Christoffel equation for Rayleigh waves

Vladimir A Borovikov: Singularities of the Green function for non-strictly hyperbolic operators

M Bochniak & Fioralba Cakoni: Domain sensitivity analysis of the elastic far-field pattern

V A Borovikov & Dmitri Gridin: Kiss singularities of Green's functions for non-strictly hyperbolic equations

Session 9. Chair: Nigel Peake

Luis M B C Campos & M H Kobayashi: On the scattering of sound by a thick shear layer

A J Cooper & Nigel Peake: Acoustic resonance in aeroengine intake ducts

Plenary Lecturer Ed J Kerschen: Effects of airfoil shape and angle of attack on sound generated by interaction with high-frequency gusts

Session 10. Chair: Nobumasa Sugimoto

C John Chapman: The wavenumber surface in blade-vortex interaction

Nigel Peake & S V Sorokin: Waves in fluid-structure interaction problems with mean flow: sandwich panels and nonlinear aspects

Yibin B Fu: Propagation of steady nonlinear waves in a pre-stressed coated elastic half-space

Session 11. Chair: Paul A Martin

Patricia A Lewis: Numerical calculation of diffraction coefficients in anisotropic materials

V M Babich, V A Borovikov, Larissa Ju Fradkin, D Gridin, V Kamotski & V P Smyshlyaev: Diffraction coefficients for tilted surface-breaking cracks

Anthony M J Davis & I D Abrahams: Matrix Wiener-Hopf factorization for a partially clamped plate

Andrew T Peplow, M Stojek & I Karasalo: Boundary integral methods for elastic layered media

Session 12. Chair: Andrew N Norris

Sergei V Sorokin: On the nonlinear formulation of the dynamics of elastic thin-walled structures in heavy fluid loading conditions

Philip L Marston, F J Blonigen, K Gipson, B T Hefner & S F Morse: Ultrasonic backscattering enhancements for truncated objects in water: quantitative models and tests and special cases

Plenary Lecturer Allan D Pierce: Variational methods in diffraction

Session 13. Chair: R Douglas Gregory

Sergey Kadyrov: A two-dimensional model of the interaction between a pressure wave and a submerged sandwich panel

Andrew N Norris: Acoustic scattering from inhomogeneous wave bearing structures

Ivan V Andronov: A new class of point models in diffraction by thin elastic plates

Jane B Lawrie & I D Abrahams: On the propagation and scattering of fluid-structural waves in a three-dimensional cavity bounded by thin elastic walls

Report composed by I. David Abrahams