

02-4 IUTAM Symposium on Asymptotics, Singularities and Homogenisation in Problems of Mechanics, Liverpool, UK, 8 - 11 July 2002

a) Scientific Committee

A. B. Movchan (UK, Chairman), I. D. Abrahams (UK), A. G. Aslanyan (Russia), D. Bigoni (Italy), H. Gao (Germany), K. Z. Markov (Bulgaria), R. C. McPhedran (Australia), J. Salencon (France), W. Wendland (Germany)

b) Short summary of scientific progress achieved

The objective of the Symposium was to provide cross-linking of research activities in intensively developing areas of applied mathematics, continuum mechanics and theoretical physics involving asymptotic analysis and studies of singularities near non-smooth boundaries.

Asymptotic analysis has proved to be one of the most powerful tools in singularly perturbed problems of mechanics and during recent years there were some new exciting developments in high order homogenisation theory, models of dynamic fracture, propagation of waves in composites and lattice models in mechanics of defects. In many of these areas rigorous asymptotic techniques can be engaged to produce a substantial breakthrough in longstanding problems.

Phenomena of very different physical nature can be described in many instances by mathematical models of similar type.

Examples include elastic and electromagnetic waves, dislocation dynamics and fluid motion along interface boundaries.

The idea of bringing international experts in these fields together worked very well and the Symposium proved to be a great success. It initiated interesting new developments on the interfaces between applied mathematics, mechanics and theoretical physics.

The topics covered in the Symposium included:

- Perturbation problems for partial differential equations and their applications in mechanics
- Homogenisation theory in models of composite structures
- Fracture. Mathematical models of cracks in solids
- Wave propagation, scattering
- Models of photonic and phononic band gap composite materials
- Models of dislocations in lattice structures
- Asymptotic and numerical models of imperfect interfaces

Forty-four oral presentations and two poster sessions were given during the four days of the Symposium. Judging by the response of the participants the Symposium was highly successful and all the objectives were achieved completely.

c) Countries represented and number of participants

The meeting attracted 72 participants from 12 countries: Australia, Denmark, France, Germany, Italy, Japan, Mexico, The Netherlands, Poland, Russia, UK, USA.

d) Publication of Proceedings of the Symposium

The Proceedings will be published by Kluwer Academic Publishers in 2003 (editor: A. B. Movchan).

e) Financial supports

The Symposium was sponsored by the following funding bodies:

- International Union of Theoretical and Applied Mechanics
- European Office of Aerospace Research and Development, Air Force Office of Scientific Research, United States Air Force Research Laboratory
- London Mathematical Society
- Kluwer Academic Publishers
- University of Liverpool

We wish to thank our sponsors for their contribution to the success of the Symposium.

f) Scientific program

Welcome address by J.W. Bruce Pro-Vice-Chancellor of
Liverpool University

Lectures, 8 July

J.R. Willis, *Dynamic perturbation of a propagating crack: implications for crack stability*

H. Gao, *Extending fracture mechanics concepts to biological nanocomposite materials*

D. Bigoni¹, E. Radi, D. Capuani, *Instabilities and near tip crack fields in elastic, incompressible*

A.J.M. Spencer, *Exact singular solutions for an inhomogeneous thick elastic*

Yu.A. Antipov, V.V. Silvestrov, *Method of hyperelliptic surfaces for vector functional-difference*

F.J. Sabina, J. Bravo-Castillero, R. Rodriguez-Ramos, R. Guinovart-Diaz, *Analysis of fibre-reinforced materials via the asymptotic homogenization*

M. Gei, E. Radi, *Near-Tip fields of mode III steady-state crack propagation in elastic-plastic strain gradient*

A. Cherkaev, *Damageable structures of waiting links*

I.S. Jones, *Methods of assessment of thermal striping fatigue damage*

O. Obrezanova, A.B. Movchan, J.R. Willis, *Dynamic crack stability*

I. Monetto, W.J. Drugan, *On micromechanics-based non-local modeling of elastic matrices containing non-spherical heterogeneities*

Poster Session I, 8 July

M.D. Hughes, K. Chen, *Fast iterative solution of coupled 3-dimensional fluid-structure interaction problems*

G.T. Piliposian, P.G. Appleby, *A simple model of the origin and transport of ²²²Rn and ²¹⁰Pb in the atmosphere*

S.B. Platts, N.V. Movchan, *Filtering and polarisation of elastic waves by 2D phononic crystals*

P.G. Appleby, A. Ploger, L. Camarero, *The transport of fallout radionuclides in a high mountain lake*

A. Selsil, A.B. Movchan, N.V. Movchan, *Asymptotic analysis of heat transfer in a system of channels connected by thin conducting walls*

G.S. Mishuris, K. Kolk, G. Kuhn, *3D Singularities and its application to fatigue crack growth simulation*

S.E. Mikhailov, J. Orlik, *Asymptotic homogenisation in strength and durability analysis of composites*

M.L. Shendeleva, *Wave analogies in thermal wave reflection and refraction at an interface*

V.N. Biktashev, *Envelope equations for modulated non-conservative waves*

M. Brun, D. Bigoni, D. Capuani, *Boundary elements for non-linear elasticity*

E. Babenkova, J. Kaplunov, *The two-term asymptotic expansion in the case of low-frequency vibrations of elongated elastic rectangular*

C.G. Poulton, S. Guenneau, A. Nicolet, A.B. Movchan, *Investigation of the coupling between light and sound waves in periodic structures with finite element and Rayleigh methods*

R. Suckley, V.N. Biktashev, *Geometry of the slow manifold in the Hodgkin-Huxley system of equations*

C.J. Powles, *Supersonic leading-edge noise*

J.B. Lawrie, R. Kirby, *Analysing the performance of a dissipative silencer: a mode-matching approach*

I.M. Mohamed, J.B. Lawrie, *A parametric investigation of the acoustic power in a two dimensional waveguide with membrane bounded cavity*

M. Perelmuter, *Fracture criterion for cracks with bridged zone*

Lectures 9 July

I.D. Abrahams, *On the approximate factorization of Wiener-Hopf kernels with applications in structural acoustics*

R.C. McPhedran, N. Nicorovici, C.G. Poulton, L.C. Botten, *Localized states in photonic crystals: A multipole method*

J.S. Jensen, O. Sigmund, *Periodic band gap structures as optimal designs*

F.Zolla, S. Guenneau, *Artificial ferro-magnetic anisotropy: Homogenization of 3D finite photonic crystals*

S.T. Kolaczowski, *Catalytic combustion: making the connection between the physical/chemical processes and the mathematical model of the reactor*

V. Karlin, *Nonmodal instability as the mechanism of acceleration of cellular flames*

C.G. Poulton, A. Spence, *Numerical methods for the solution of non-linear eigenvalue problems arising in electromagnetism*

M. Hori, T. Ichimura, H. Nakagawa, *Application of homogenization techniques to two earthquake problems*

A. Fadili, J.R.A. Pearson, P.M.J. Tardy, *Stochastic homogenisation of fluid flows in heterogeneous porous media*

E. Sanchez-Palencia, *On a kind of singular perturbations for transmission problems*

S. Sorokin, O.A. Ershova, S.V. Grishina, *Asymptotic analysis of vibrations and wave propagation in sandwich plates with parametric stiffness modulation*

P.G. Martinsson, G. Rodin, *Boundary algebraic equations for lattice problems*

J. Sanchez-Hubert, H. Ranarivelo, *Asymptotics of laminated shells. Membrane - bending coupling and numerical implementation*

Lectures, 10 July

L. Berlyand, *Discrete network approximation for effective properties of high contrast random highly packed solid and fluid composites*

L.E. Fraenkel, *A diffusing vortex circle in a viscous fluid*

C.J. Chapman, *The asymptotic theory of fluid-structure interaction with heavy fluid loading*

J. Sivaloganathan, *Singular minimisers, configurational forces and implications for fracture in nonlinear elasticity*

E. Cherkaev, *Coupled effective properties of a random mixture*

S. Vladimirov, *Dynamics of charged rotators and lattice waves in a plasma environment*

C.M. Linton, *Embedding formulas and singularities in acoustic scattering*

Lectures, 11 July

- A. Lacey, *Singular behaviour of solutions to some parabolic models of shear-band formation*
- D.F. Parker, *Stretch, flexure and twist in finite elasticity*
- Y. Fu, Y.P. Lin, *A WKB analysis of the buckling of an everted neo-Hookean cylindrical tube*
- H. Ockendon, *Models for the textile industry*
- R. Craster, Yu. V. Obsonov, *Model multi-phase composites*
- W.J. Drugan, *Comparisons of exact and gradient-approximate nonlocal constitutive equations from a Hashin-Shtrikman-Willis variational principle for random elastic composite materials*
- A. Nicolet, S. Guenneau, F. Zolla, C. Geuzaine, B. Kuhmeyer, G. Renversez, *Numerical investigation of photonic crystal fibres by means of finite elements and matrix of diffraction methods*
- B. Gralak, A. Tip, *Calculation of dispersion relation in absorptive photonic crystals*
- S.E. Mikhailov, I.V. Namestnikova, *Non-local approach to fatigue crack initiation and propagation*
- G. Mishuris, *Asymptotic behaviour of mode III interface crack for various thin nonhomogeneous anisotropic interfaces*
- A.G. Aslanyan, A.B. Movchan, O. Selsil, *Estimates for the first six eigenfrequencies for a massive body supported by thin cylindrical rods*
- J. Kaplunov, V. Kovalev, M. Wilde, *Asymptotic analysis of higher order peripheral modes in acoustic wave scattering by elastic cylinders and spheres*
- K. Khusnutdinova, *Non-linear dynamics of bi-layer and coupled Klein-Gordon equations*

Poster Session II, 11 July

- D.A. MacDonald, *On linear vortex breakdown in a slowly-varying tube impulsively rotated about its axis with constant angular velocity*
- P.J. Message, *The use of asymptotic series for Lie series generating functions in deriving multiple Fourier series expressions for orbital perturbations*
- O. Avila-Pozos, *Propagation of elastic waves along interfaces in layered beams*

S. Guenneau, C.G. Poulton, A.B. Movchan, *Oblique propagation of electromagnetic and elastic waves for an array of cylindrical fibres*

D.J. Hasanyan, G.T. Piliposyan, A.H. Kamalyan, M.I. Karakhanyan, *Some dynamical problems for a functionally inhomogeneous elastic material, including anti-plane deformations*

V.V. Zalipaev, *Summation of Gaussian beams in 3D problems of radiation and scattering of elastic waves*

S. Haq, *Models of dislocation in lattice structures*

D. Esparza, N.V. Movchan, *Effect of interface bonding on the stress singularity at the vertex of a thin conical inclusion*

S.C. Hawkins, K. Chen, *Preconditioning for finger pattern matrices arising from wavelet discretisations of boundary integral equations*

J.P. Bercial, *Asymptotic analysis of wave equation in a 3D layer containing a dynamic crack*

J. Servant, S. Guenneau, A.B. Movchan, C.G. Poulton, *Scattering by a single circular cylinder in oblique incidence*

I.S. Jones, O. Selsil, A.B. Movchan, *A thermoelasticity problem in a domain with an edge crack: Asymptotic analysis*

Report composed by Alexander B. Movchan.