TIME TABLE

Registration on Monday at 8.30

TIME	Monday	Tuesday	Wednesday	Thursday	Friday
	June 11	**June 12**	**June 13**	**June 14**	**June 15**
9.00 - 9.45	Durban	Pagneux	Kaplunov	Guenneau	Craster
9.45 - 10.30	Durban	Pagneux	Kaplunov	Guenneau	Craster
11.00 - 11.45	Durban	Pagneux	Steigman	Guenneau	Craster
11.45 - 12.30	Durban	Pagneux	Steigman	Guenneau	Craster
14.00 - 14.45	Durban	Kaplunov	Steigman	Guenneau	
14.45 - 15.30	Durban	Kaplunov	Steigman	Guenneau	
16.00 - 16.45	Pagneux	Kaplunov	Steigman	Craster	
16.45 - 17.30	Pagneux	Kaplunov	Steigman	Craster	

ADMISSION AND ACCOMMODATION

Applicants must contact CISM Secretariat at least one month before the beginning of the course. Application forms should be sent on-line through our web site: http://www.cism.it or by post.

A message of confirmation will be sent to accepted participants. If you need assistance for registration please contact our secretariat.

The 700,00 Euro registration fee includes a complimentary bag, four fixed menu buffet lunches (Friday not included), hot beverages, on-line/downloadable lecture notes and wi-fi internet access.

A limited number of participants from universities and research centres who are not supported by their own institutions can be offered board and/or lodging in a reasonably priced hotel. Requests should be sent to CISM Secretariat by **April 11, 2012** along with the applicant's curriculum and a letter of recommendation by the head of the department or a supervisor confirming that the institute cannot provide funding. Preference will be given to applicants from countries that sponsor CISM.

Information about travel and accommodation is available on our web site, or can be mailed upon request.

For further information please contact:

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Centre International des Sciences Mécaniques
International Centre for Mechanical Sciences

ACADEMIC YEAR 2012
The Cercignani Session

DYNAMIC LOCALIZATION PHENOMENA IN ELASTICITY, ACOUSTICS AND ELECTROMAGNETISM

Advanced School
coordinated by

Richard Craster
Imperial College, London
UK

Julius Kaplunov
Brunel University, Uxbridge
UK

Udine, *June 11 - 15,* 2012

DYNAMIC LOCALIZATION PHENOMENA IN ELASTICITY, ACOUSTICS AND ELECTROMAGNETISM

A revolution is currently occurring in physics and engineering through the manufacture and application of smart structures with designer microstructure. Many of the applications: cloaking, invisibility, trapped and defect modes, resonances, ultra-refraction, all-angle-negative refraction, wave guiding along surfaces depend upon subtle properties of wave localization and are ubiquitous across several fields: examples will be drawn from elasticity, acoustics and electromagnetism. There are also numerous applications in more traditional fields such as the Non-Destructive Evaluation and Testing of structures. For example, prestresses or coatings on elastic media can be used to manipulate surface and edge waves, and localized modes arise in coated or deformed waveguides and are modified by fluid flow. In addition, surface and guided waves play a key role in crack and flaw detection and a knowledge of surface and resonant modes is invaluable. Recent work has highlighted how localized defect modes arise in microstructured media and new homogenization theories can be used to create continuum descriptions of micromechanical systems, even at high frequencies. The aim of the course is to introduce an interdisciplinary audience into a variety of interrelated dynamic localisation phenomena occurring in elasticity, acoustic and electromagnetism. In particular, these involve surface and edge waves and also trapped modes localised near defects, shape changes and the edges of elongated waveguides. The effects of layering, prestress, anisotropy, periodic microstructures as well as various multi-field phenomena are addressed with referencing to underlying industrial problems.

The course will provide a unique opportunity to learn simultaneously a wide range of subjects/techniques related to dynamic localisation phenomena. In particular, these include asymptotic and perturbation methods, modern homogenization methodologies, variational methods, basics of non-linear elasticity, the general theory of surface waves, multimodal approach, and advanced applications of St Venant principle. The objective of the lectures is to cover the essential and up to date numerical, asymptotic, and analytical techniques as well as relevant continuum theories that are required to make progress in, and understand, wave localization and allied effects. A major focus will be on a qualitative physical insight into the mechanisms of dynamic localisation.

The lectures are chosen to appeal to researchers, primarily but not exclusively graduate students and postdoctoral researchers, from Mechanical, Aerospace and Civil Engineering programs and will naturally also be of interest to Physicists and Applied Mathematicians and will focus on recent work in localized modes and waves that are unlikely to appear in traditional university graduate courses; the lectures are also suitable for industrial researchers who encounter resonant or localised waves. The topics explore the applications in Engineering and Physics, notably in photonics, showing the interconnections with acoustics and elasticity that are normally treated independently. Both theoreticians and experimentalists are expected to gain useful knowledge from attending the course.

PRELIMINARY SUGGESTED READINGS

L. Brillouin, Wave propagation in periodic systems, Dover, 1953

R.V. Craster, J. Kaplunov and A. Pichugin, High frequency homogenization for periodic media, Proc R Soc Lond A, 466, 2341-2362, 2010.

Horgan C.O., Knowles J K, 1983, Recent developments concerning Saint-Venant principle, Advances in Applied Mechanics, 23, 179-269.

Karp B., Durban D., 2011, Saint Venant's principle in dynamics of structures, Applied Mechanics Reviews, pending, 72 p ms., 150 refs.

S. Anantha Ramakrishna, Tomasz M. Grzegorczyk, Physics and Applications of Negative Refractive Index Materials,CRC Press, 2008.

S. Maier, Plasmonics - Fundamentals and Applications, Springer Verlag, 2007.

P. Chadwick, Surface and interfacial waves of arbitrary form in isotropic elastic media. - Elasticity 6 (1976), 73-80.

A.N. Norris, V.V. Krylov, and I.D. Abrahams, Flexural edge waves and comments on 'A new bending wave solution for the classical plate equation'. – JASA 107 (2000), 1781-1785.

J. Kaplunov, A. Zakharov, and D. Prikazchikov, Explicit models for elastic and piezoelastic surface waves. – IMA J. Appl. Math. 71 (2006), 768-782.

Linton, C.M. & McIver, P. Embedded trapped modes in water waves and acoustics. Wave Motion, 45, 16-29 (2007).

V. Pagneux, Revisiting the edge resonance for Lamb waves in a semiinfinite plate.

Journal of the Acoustical Society of America, 120(2), 649-656 (2006)

V. Pagneux, Complex resonance and localized vibrations at the edge of a semi-infinite elastic cylinder, Mathematics and Mechanics of Solids 1081286511412439, first published on July 7, 2011 as doi:10.1177/1081286511412439

V. Zernov and J.Kaplunov, Three dimensional edge-waves in plates. Proceedings of the Royal Society of London, A464, 301-318 (2008).

D.J. Steigmann and R.W. Ogden, 2007, Surface waves supported by thin-film/substrate interactions. IMA J. Appl. Math. 72, 730-47.

D.J. Steigmann, 2009, On the formulation of balance laws for electromagnetic continua. Math. Mech. Solids 14, 390-402.

D.J. Steigmann, 2009, Linear theory for the bending and extension of a thin, residually stressed, fiber-reinforced lamina. Int. J. Engng. Sci. 47, 1367-78.

D.J. Steigmann, 2010, Elastic waves interacting with a thin, pre-stressed, fiber-reinforced surface film. Int. J. Engng. Sci. 48, 1604-09.

M. Barham, D.J. Steigmann and D. White, Magnetoelasticity of highly deformable thin films: theory and simulation. Int. J. Non-linear Mech. (doi: 10.1016/j.ijnonlinmec.2011.05.004).

INVITED LECTURERS

Richard Craster - Imperial College, London, UK
6 lectures on: High frequency homogenization in periodic structured media. Introduction to Floquet-Bloch waves; Models from solid state physics and structural mechanics; Localized defect states and modes;Review of conventional low frequency homogenization; High frequency modelling; Localized forcing.

David Durban - Israel Institute of Technology, Haifa, Israel
6 lectures on: Dynamic St Venant Principle. Review of classical St Venant principle (SVP); Early ideas on dynamic SVP; Experimental evidence for validity of DSVP; End effects in waveguides with free lateral surfaces; Constrained waveguides including energy leaking surfaces; Half-space and wedge geometries; Composites and laminates: Beyond linear elasticity. Open questions in formulating DSVP.

Sebastien Guenneau - Aix-Marseilles University, France
6 lectures on: Locally resonant structures in electromagnetism and elastodynamics. Electromagnetic metamaterials; Transformation optics for invisibility cloaks and twisted waveguides; Plasmonics and structured surfaces. Acoustic metamaterials; Localised modes in arrays of split ring resonators; Phononic band gap guidance in arrays of elastic fibers; Transformation elastodynamics for flexural waves.

Julius Kaplunov - Brunel University, Uxbridge, UK
6 lectures on: Explicit models for surface and edge elastic waves. The focus is on the asymptotic derivations and applications of the dual hyperbolic-elliptic formulations specialised for the elastic wave motions localised near surfaces and interfaces. Pre-stressed, anisotropic, electroelastic and coated solids are considered. Analogous parabolic-elliptic models for edge flexural waves on thin elastic plates are also discussed.

Vincent Pagneux - Université Maine, Le Mans, France
6 lectures on: Edge and trapped modes in elasticity. Review of trapped modes for scalar waves; Multimodal method; Edge waves due to impedance; Elastic vector waves; Multimodal method with numerical modes; Complex resonances and trapped modes at free edges; 2D and 3D plate models; Consequences of edge modes in closed cavity.

David Steigmann - University of California at Berkeley, CA, USA
6 lectures on: Theory of elastic surface/substrate interactions. Small-thickness expansions of the equations for thin films interacting with elastic substrates. Effects of pre-stress, anisotropy and gradients of elastic properties. Magnetoelastic surface waves and normal-field instability. Length scales, experimental and theoretical multi-scale analyses of cementitious media and shale.

LECTURES

All lectures will be given in English. Lecture notes can be downloaded from CISM web site, instructions will be sent to accepted participants.

DYNAMIC LOCALIZATION PHENOMENA IN ELASTICITY, ACOUSTICS AND ELECTROMAGNETISM

Udine, June 11 - 15, 2012
Application Form
(Please print or type)

Surname _____

Name _____

Affiliation _____

Address_____

_____

E-mail _____

Phone_____Fax_____

Method of payment upon receipt of confirmation (Please check the box)

The fee of Euro 700,00 includes IVA/VAT tax and excludes bank charges

❑ *I shall send a check of Euro* _____

❑ *Payment will be made to CISM - Bank Account N° 094570210900, VENETO BANCA - Udine (CAB 12300 - ABI 05035 - SWIFT/BIC VEBHIT2M - IBAN CODE IT46 N 05035 12300 09457 0210900). Copy of the receipt should be sent to the secretariat*

❑ *I shall pay at the registration counter with check, cash or VISA Credit Card (Mastercard/Eurocard, Visa, CartaSi)*

IMPORTANT: CISM is obliged to present an invoice for the above sum. Please indicate to whom the invoice should be addressed.

Name _____

Address _____

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C.F.* _____

VAT/IVA* No_____

(*) Only for EU residents or foreigners with a permanent business activity in Italy.

Only for Italian Public Companies

❑ *I ask for IVA exemption (ex law n. 537/1993 - art. 14 comma 10).*

Privacy policy: I understand that data received via this form will be used only to provide information about CISM and its activities, within the limits set by the Italian legislative decree no. 196/2003 and subsequent amendments.
Complete information on CISM's privacy policy is available at http://www.cism.it/courses/privacy_statement/

I have read the "Admission and Accommodation" terms and conditions and agree.

Date _____ Signature

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