

## Mini-Symposia MSP 059-062 "Mathematical Methods in Solid Mechanics"

**Chairs: Julius D Kaplunov  
and Frederic Y M Wan**

**Subject Areas:** 17. Solid Mechanics  
7. Asymptotics  
24. Mathematics in Industry, Modelling of Industrial Processes

### Summary:

The minisymposium is dedicated to an outstanding scientist in the field of mechanics and applied mathematics Professor Eric Reissner (1913-1996). Among participants there are his friends, students and colleagues. The majority of presentations are concerned with the theory of shells and plates and related topics. Recent advances in non-linear wave propagation, computation mechanics, analysis of singularities and the theory of phase changes in solids are also discussed.

### Speakers:

- Holm Altenbach:** (Martin-Luther-Universität Halle-Wittenberg, Halle, Germany)  
"On different approaches to the determination of the transverse shear stiffness in the plate theory"
- R Douglas Gregory:** (Dept. of Mathematics, University of Manchester, UK)  
"A thick hollow sphere compressed by equal and opposite concentrated loads; An asymptotic solution"
- Julius D Kaplunov:** (Institute for Problems in Mechanics, Russian Academy of Sciences, Russia)  
"Edge and interfacial vibrations of shells and plates"
- Reinhold Kienzler:** (University of Bremen, Department of Production Engineering, Germany)  
"On consistent higher-order plate and shell theories"
- Leonid Yu Kossovich:** (Saratov State University, Russia)  
"Flexural transient waves in shells of revolution: An asymptotic approach"
- Khanh Chau Le:** (Lehrstuhl fuer Allgemeine Mechanik, Ruhr-Universität Bochum, Germany)  
"High-frequency vibrations of shells and rods: Variational-asymptotic approach"
- James G Simmonds:** (Univ. of Virginia, Charlottesville, USA)  
"Computing exact, elastodynamic linear three-dimensional solutions for plates from classical two-dimensional solutions"
- Anthony J M Spencer:** (University of Nottingham, UK)  
"Exact solutions for inhomogeneous thick elastic plates"
- Frederic Y M Wan:** (University of California at Irvine, USA)  
"The outer asymptotic expansion solution without matching"
- Cornelius O Horgan:** (University of Virginia, USA)  
"Anisotropy induced singularities in linear elasticity"

## Mini-Symposia MSP 059-062

### Shock-induced phase changes in solids

**James K Knowles**

*California Institute of Technology, USA*

knowles@caltech.edu

**ABSTRACT.** Experiments involving high-velocity impact on metallic or ceramic specimens are of interest in several fields, especially in geophysics, where such experiments are used to study high-pressure behavior of earth materials. Impacts generated in these experiments sometimes induce phase changes. This talk describes the application to impact-induced phase transitions of recently-developed continuum mechanical models of the macroscopic behavior of phase-changing solids. The role of transition kinetics in determining the material response is explored, and the task of inferring such kinetics from experimental results is briefly discussed.

## Mini-Symposia MSP 059-062

### On the relationship between the Cosserat and Kirchhoff-Love theories of elastic shells

**D Steigmann**

*University of California, Berkeley, USA*

steigman@euler.berkeley.edu

**ABSTRACT.** We clarify the relationship of the Kirchhoff-Love theory of elastic shells to the more general Cosserat theory of deformable surfaces with a single director. The latter has as its kinematical basis two vector fields defined on the surface, one that defines the particle position, and the other, the director, that is intended to account for finite-thickness effects. Specifically, we obtain the Kirchhoff-Love theory by imposing constraints on the director field and deriving the general forms of the associated response functions through a careful application of the rigorous Lagrange multiplier rule. Although this rule is standard, the constraints considered are of an unusual type and the development thus includes more detail than one usually finds in the literature on constrained elasticity. In Naghdi's treatment of the subject the Kirchhoff-Love theory is not derived from the Cosserat theory but instead is considered separately on the basis of distinct balance and invariance postulates. This contrasts with our view that the Cosserat theory should reduce to the Kirchhoff-Love theory upon the introduction of appropriate constraints. There are additional differences between Naghdi's treatment and ours. For example, his relies on the moment-of-momentum