Editorial

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From time to time it is worth standing back and taking stock. This journal is concerned with engineering and computational mechanics. According to the *Oxford English Dictionary*, mechanics is ‘that department of applied mathematics which treats motion and tendencies to motion: comprising kinematics, the science of abstract motion, and dynamics (including statics and kinetics), the science of the action of forces in producing motion or equilibrium’. Mechanics is concerned with motion, and motion is concerned with change. The mathematics of change is described by partial differential equations, which are often solved numerically, and are to be found in many of the papers published in this journal. The Editorial Advisory Panel recently discussed the meaning of mechanics in terms of papers published in the journal and, as a result, has altered the wording of the remit of *Engineering and Computational Mechanics* to reflect more accurately the journal’s scope. We hope that the journal will continue to flourish!

This issue of *Engineering and Computational Mechanics* contains four full papers, one of which is concerned with environmental fluid mechanics, the other three with various aspects of structural mechanics. Folkard (2011) provides a comprehensive review of the present understanding of flows in vegetated fluvial channels, such as rivers and streams. The review underlines the complexity of plant configurations, the hierarchy of spatial and temporal scales encountered, and the inter-disciplinary nature of the subject. For entire reaches where vegetation is spatially quite diverse and patchy, improved parameterised methods are needed for determining flow resistance. Folkard discusses the applicability, and non-applicability, of empirical resistance formulae, such as Manning’s equation, for characterising the flow resistance of vegetated channels, and the use of drag coefficients related to skin friction and form drag on submerged vegetation. The paper also considers the detailed flow structure in the vicinity of vegetation, the production and dissipation of turbulence, exchange and mixing processes, enhanced sedimentation due to the slowing of the flow, and consequent bed morphological changes. Folkard comments on research developments concerning the effect of vegetation on the advection and diffusion of solutes. Relatively fine-scale modelling is useful for analysing the hydrodynamics of flow–vegetation interaction, estimating suspended sediment and solute fluxes, and hence determining the overall influence of vegetation on the eco-system. At larger scale, the spatial distribution of vegetation becomes a leading factor, and so Folkard examines limits on vegetation growth in the aquatic environment, and the effect of water flow on vegetation patch extent and configuration. He emphasises the importance of feed-

back mechanisms between flows in vegetated channels and water quality, bed morphology and eco-systems, examining each in turn. Future research directions are discussed in the contexts of recent legislation, water management, and advances in instrumentation and modelling techniques. The paper is essential reading for environmental engineers concerned with flows in rivers and streams containing vegetation. And the paper has relevance in other spheres, such as in assessing the effect of mangroves on dissipating the energy of a tsunami – an example being the December 2004 Indian Ocean tsunami, whose destructive power was much reduced by mangroves off the Sri Lankan coast, undoubtedly saving many lives.

The second paper, by Anyaegbunam and Ojiako (2011), presents a stiffness matrix for 15-noded cubic strain triangles based on area coordinates. Cubic strain triangles have been previously applied in finite-element models to predict foundation-bearing capacity, assuming the bed material is incompressible. The cubic strain triangle is of higher accuracy than lower order elements, used in conventional finite-element solvers. Although each element has thirty degrees of freedom, recent advances in matrix solvers mean that the cubic strain triangle is a potential candidate for finite-element analyses in geomechanics, vibration and fluid–structure interaction. Anyaegbunam and Ojiako start with the displacement function of a 15-noded cubic strain triangle, outline the explicit stiffness matrix and the stress–strain relations for a cross-anisotropic material, provide a computer code for evaluating the cubic strain triangle and list the 465 coefficients needed to populate the stiffness matrix. The paper comments on the computer resources required to calculate numerically the stiffness coefficients using Gauss quadrature, with the authors estimating that the use of explicit stiffness coefficients could lead to major efficiency gains in computer resources.

The third paper, by De Proft *et al.* (2011), describes an efficient finite-element model of masonry that treats joints and bricks separately, exploiting partition of unity shape functions. The authors use a generalised finite-element method to model the joint kinematics by means of a cohesive zone law that permits Rankine-type and Mohr–Coulomb-type failure surfaces. The brick is modelled using linear elastic elements. Joint fractures are modelled by means of a local decrease in stiffness. A sequentially linear solution procedure is used based on an event-by-event strategy. The authors consider three examples: a pair of bricks with a joint between them, which are pulled apart in tension; a two-brick shear test; and load displacement of a shear wall with an opening. The results indicate that the authors’ mesoscopic

masonry model gives satisfactory results and holds considerable promise for the future.

In the final paper, Chakraborty and Bhattacharjya (2011) present a robust approach for optimising the design of structures taking uncertainty into account. Robust design optimisation (RDO), first suggested by Taguchi (1978), involves minimising the mean and variance of functions related to structural performance, according to certain constraints. Chakraborty and Bhattacharjya describe deterministic design optimisation (DDO) that neglects uncertainty. They then develop an improved RDO methodology that utilises importance factors, which are proportional to the importance of performance gradients (and hence variances) of the design variables and design parameters. The improved RDO methodology corresponds essentially to a two-criteria DDO, in which the weighted sum of the mean and the importance factor are optimised. The authors present results from two case studies: one the optimised design of a steel tubular column; the other the weight minimisation of a concrete beam. In both cases, the improved RDO method is shown to perform better than the conventional RDO method. Moreover, the authors believe the improved RDO is potentially well suited to the optimisation of complicated structures and applications to multi-objective optimisation. The paper is of obvious significance to structural engineers and designers.

The journal is by definition concerned with mechanics, and so the

editorial panel would again reiterate its wish for practitioners to submit short articles on their experience of new or unusual applications of mechanics in civil engineering practice.

REFERENCES

- Anyaegebunam AJ and Ojiako UG (2011) The explicit stiffness matrix of the 15-noded cubic strain triangle. *Proceedings of the Institution of Civil Engineers, Engineering and Computational Mechanics* **164(1)**: 25–40, doi: 10.1680/eacm.9.00016.
- Chakraborty S and Bhattacharjya S (2011) Improved robust design optimisation of structures. *Proceedings of the Institution of Civil Engineers, Engineering and Computational Mechanics* **164(1)**: 47–57, doi: 10.1680/eacm.9.00034.
- De Proft K, Heyens K and Sluys B (2011) Mesoscopic modelling of masonry failure. *Proceedings of the Institution of Civil Engineers, Engineering and Computational Mechanics* **164(1)**: 41–46, doi: 10.1680/eacm.9.00013.
- Folkard AM (2011) Vegetated flows in their environmental context: a review. *Proceedings of the Institution of Civil Engineers, Engineering and Computational Mechanics*, **164(1)**: 3–24, doi: 10.1680/eacm.8.00006.
- Taguchi G (1978) Performance analysis design. *International Journal of Production Research* **16(6)**: 521–530.