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Editorial

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KEY WORDS: groundwater; stabilization; discontinuous Galerkin; unstructured meshes; parameter estimation; parabolic equation; numerical modelling; finite element; finite volume; flow in porous media; variably saturated flow; constitutive models; convergence; flux continuous; discontinuous coefficients; quadrature and pressure equation; higher order; full tensor; control-volume discretization; inhomogeneity; reactive flows; stabilization; compressible; incompressible; SUPG; two-fluid model; GLS; semi-GLS; multigrid; Newton–Krylov; quadrature free; Euler equations; Navier–Stokes equations; shock capturing; mesh generation; surface meshing; anisotropic mesh; parallel processing; fluid–structured interaction; initial position method; level set method; *a posteriori* error estimation; goal-oriented mesh adaptation; rarefied flow; microflow; characteristic-based split (CBS) algorithm; temperature jump

This special issue of the *International Journal for Numerical Methods in Fluids* contains some papers that are focused on four areas of topical interest, namely sub-surface or groundwater flows, stabilization techniques, discontinuous Galerkin and unstructured mesh methods, including moving boundaries.

The papers on ground water flow include new computational methods to address flows in variable saturated non-deformable fractured porous media. Work is described on new flux continuous schemes on both structured and unstructured meshes with particular detailed focused on higher order convection schemes, multipoint flux approximation (MPFA) methods and numerical converges studies.

Several papers are devoted to the use of stabilization methods applied to reactive flows, two-phase flows and incompressible viscous flows. Reactive flows form an important class of problem that provide significant challenges both in the physical description and the numerical solution. Here recent developments in the design and implementation of finite element methods with stabilization are described involving low-Mach number flows with large heat release. Two-phase flows are encountered in a wide variety of application areas, including the ever increasingly important area of biological flows. A method of simulating such flows is presented using a discretization based upon SUPG. An approach for the simulation of flows of incompressible viscous flows with high Reynolds numbers using a Galerkin least squares (GLS) technique of stabilization of the finite element method is presented.

There is continued interest in methods for flow analysis based upon discontinuous Galerkin (DG). The papers cover the efficient application of DG methods applied to the steady solution of the Euler equations. A simplified version of the quadrature free implementation applicable to general equations of state and a simplified curved boundary treatment are investigated. Shock-capturing methods used to reduce over-shoots at discontinuities is a particularly important area of study and an interior penalty DG method is described for the Navier–Stokes equations.

Unstructured meshes continue to be studied and applied to a wide range of problems. An area of great importance is the generation of meshes in three dimensions with anisotropic elements and one of the contributions provides a description of a new approach that is applicable to domains of arbitrary shape. One of the strengths of the unstructured approach is the flexibility to simulate flow problems within which boundaries of the domain move. Examples include bodies in relative motion and the movement of boundaries in a fluid–structure interface. Techniques for an efficient implementation on parallel computer hardware are described where local remeshing to adapt the mesh to a moving boundary is implemented, whilst an Eulerian framework for modelling fluid–structure interaction is presented.

The papers published in this issue include material presented at the XIII Conference on Finite Elements for Flow Problems at Swansea, U.K. (4–6 April 2005). The presentations were given in themed sessions that brought together active researchers who were making contributions to the field. I would like to express my appreciation to the authors and the organizers of the sessions.