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Editorial

Oubay Hassan

Civil and Computational Engineering Research Centre, School of Engineering, University of Wales Swansea, SA2 8PP, U.K.

KEY WORDS: unstructured meshes; Euler equations; Navier–Stokes equations; Maxwell's equations; potential flow; compressible flow; incompressible flow; unsteady flow; flow in porous media; multi-phase flow; volume of fluid; turbomachinary; compressor; hp method; adaptive remeshing; parallel; numerical modelling

This special issue of the *International Journal for Numerical Methods in Fluids* contains some papers focused on the application of unstructured mesh methods for flow and related problems. Unstructured mesh methods continue to attract major interest in the research community and there is high motivation to improve existing methods and to apply the approach to new emerging areas of application.

Two papers address the important problem of multiphase flows and the application to the challenging problem of flow in porous media. Two different methods for the solution of the partial differential equations which result from the modelling of the immiscible displacement of oil by water in homogeneous porous media are presented.

One paper deals with the solution of the compressible, time-accurate, Navier–Stokes equations applied to a specific core-compressor in order to study the rotating stall behaviour.

There is a continued interest in the problem of unsteady flows in the presence of moving bodies. An efficient procedure for the solution of the time dependent, turbulent, compressible flows involving geometries that change in time is presented. A special dual mesh definition, specially tailored for hybrid meshes that also satisfies the geometric conservative law for treating such meshes, is formulated. A spring analogy approach combined with local remeshing is employed to handle moving geometries. A different approach has been developed for the simulation of flows around moving objects in the presence of violent-free surface motion. The approach is based on the volume of fluid (VoF) technique coupled with an incompressible Navier–Stokes solver and operates on adaptive, unstructured meshes.

Adaptive remeshing continues to be studied and applied to a wide range of problems in particular for unsteady flow problems which involve moving objects. In order to address the industrial need, a parallel remeshing of unstructured volume meshes has been developed and coupled with the solution of the unsteady Euler equations and applied to the solution of realistic industrial problems.

An innovative approach that addresses the main difficulties which prevent the use of potential flow solvers for three-dimensional aerodynamics flows is presented. An automatic wake generation strategy combined with an acceleration method based on pFFT-Fast Multipole Tree algorithm has been developed and applied to complex three-dimensional geometries.

Biomedical simulation is an emerging field which is attracting the interest of many researchers. However, the availability of a geometrical representation of the organs of the body of interest is

the starting point of any simulation. A new technique for the reconstruction of objects and the generation of computational meshes starting from a set of medical images representing planar cross sections of the objects is presented.

The use of $H(curl)$ conforming hp finite element methods to simulate the scattering of electromagnetic waves by an arbitrary three-dimensional object is presented. The method uses geometric refinement to resolve singularity coupled with the automatic generation of the polynomial degree through the use of a dispersion relation.

The papers published in this issue include material that was presented at the XIII Conference on Finite Elements for Flow Problems at Swansea, U.K. (4–6 April 2005). The Conference coincided with the 60th birthday of Professor Kenneth Morgan and given the contribution that he has made to unstructured mesh methods, it is appropriate that this Special Issue is based on the papers presented at the Conference by some of Ken's former students.

Ken has dedicated over 30 years to research in finite element methods and more generally unstructured mesh techniques. He worked at the Atomic Weapons Research Establishment, Aldermaston and the University of Exeter before joining the Department of Civil Engineering at Swansea in 1975. Apart from a brief period at Imperial College, London, his subsequent career has been based at Swansea, where he has served as Head of the Department of Civil Engineering and Dean of Engineering. Ken is recognized for his research in the area of unstructured mesh methods applied to the solution of problems in aerospace engineering. For this work he was awarded the degree of DSc (Eng) by the University of Bristol. He is the recipient of a Special Achievement Award from NASA Langley Research Center and the Computational Mechanics Award of the IACM. He was elected Fellow of the Royal Academy of Engineering in 1997.

The guest editor is very grateful to those distinguished researchers who have contributed their papers to the success of this special issue and to the editor of the journal for making this publication possible.

