Università degli Studi di Trieste, 26th April 2006

Object-Oriented CFD with OpenFOAM

Dr. Hrvoje Jasak
Wikki Ltd, United Kingdom
E-mail: h.jasak@wikki.co.uk
Web: http://www.openfoam.org
Web: http://www.h.jasak.dial.pipex.com

Abstract

Continual improvements in numerical methods, increasing computer power and better understanding of physics is opening new areas for numerical modelling in Computational Continuum Mechanics. However, increased model complexity and new solution methods pose considerable challenges in terms of software implementation to the level that a new approach is needed. Procedural programming and a "physics-centred" approach, combined with the closed architecture of today's commercial CFD solvers does not meet the requirements of the research community; a new, "application-based" toolkit approach is required.

In this presentation, a C++ numerical simulation package for continuum mechanics **OpenFOAM (Field Operation And Manipulation)** will be described. The package simplifies the implementation of physical models by mimicking the form of partial differential equations in software. Object-orientation naturally leads to code re-use, layered development, easy customisation and modular software validation, as well as opening the field for new techniques that could not be fitted into existing solvers.

OpenFOAM implements the Finite Volume and Finite Element discretisation, Lagrangian particle tracking and auxiliary tools in library form (*e.g.* mesh manipulation and motion, material properties, error estimation, parallel programming *etc.*), handles complex geometry through polyhedral mesh support and allows for close coupling between various models.

Use of OpenFOAM is rapidly expanding in the research community and among industrial users, covering a wide range of continuum models. This includes turbulent, multi-phase and free surface flows, complex heat and mass transfer, combustion, non-linear stress analysis and fluid-solid interaction. The talk will be completed with a review of current research areas and new horizons and development plans.