Prof. Hrvoje Jasak

Prof. Hrvoje Jasak is a lecturer at the Department of Physics, University of Cambridge and director of Wikki Ltd (UK). His research group on fundamental developments of CFD methodology in complex coupled systems, with applications in turbo-machinery, naval hydrodynamics, non-linear solid mechanics. The work includes numerical modelling and linear solver technology for High-Performance Computing method development. Hrvoje is a practical programmer and a member of OpenFOAM Governance structure. Hrvoje Jasak graduated mechanical engineering at the University of Zagreb in 1992. He completed his PhD in Computational Fluid Dynamics in prof. Gosman's group at Imperial College in 1996. He is one of two original authors of OpenFOAM, a leading Open Source CFD package today. His research interests are focused on numerical simulation in Continuum Mechanics, specifically on the Finite Volume discretisation and OpenFOAM.

Plenary Lecture 3:
Non-Linearity in Irregular Sea States Coupled CFD-HOS Models

Over the last 15 years, maturity of Computational Fluid Dynamics (CFD) simulation tools for naval hydrodynamics applications has developed considerably and is routinely deployed in design and optimisation of ship hulls and off-shore structures: this is a clear success. Current points of research and validation of naval hydrodynamics CFD are shifting towards simulation of full-scale ships under self-propulsion and active steering. Further, off-design loading conditions such as slamming, hydro-elasticity, green water and freak wave loads can be modelled with some confidence. Aspects of turbulence modelling in free surface flows, presence of captured air bubbles in water, cavitation on propulsors and other similar enhancements of the flow model can be used with a good level of confidence. However, questions arise in terms of applicability and fidelity of simulations with reference to practical use cases. Are the simulations – in addition to being accurate – actually relevant for realistic load conditions in operation? Are we modelling the stochastic nature of wave loading in an appropriate manner? While, for example, external aerodynamics CFD for cars does not account for wind direction, such uncertainties in loading conditions in naval hydrodynamics are order of magnitude larger. Optimising ship resistance on calm seas or calculating sea-keeping in regular waves does not give a fair representation of actual load conditions. In this talk, we shall address the problems of realistic representation of load condi- tions and compare them with routine naval hydrodynamics CFD today. The presenta- tion includes various examples of non-linearity and coupling across the scales needed for practical CFD. Ideas for future direction of simulations and examples of High Order Spectrum (HOS) non-linear potential flow solvers to practical CFD shall be presented.