Dr. Zhihua Xie

Dr. Zhihua Xie is a Senior Lecturer in the School of Engineering at Cardiff University, where he was appointed to a lectureship in 2017. He obtained his PhD in Computational Fluid Dynamics (CFD) at the University of Leeds in 2010, funded by the Marie Curie EST Fellowship. After that, he worked as a research associate at Cardiff University from 2010 to 2012 and at Imperial College London between 2013 and 2016. His research interests span a broad range of topics in the development of novel CFD methods, multiphase flows, turbulence modelling and simulation, fluid-structure interaction, and high-performance computing with applications in hydraulic, coastal, and ocean engineering. He has published over 60 peer-reviewed journal papers spanning from reputable numerical method and fluid mechanics journals (JCP, JFM etc). His research is funded by EPSRC, Royal Society and British Council. He is a member of the EPSRC Peer Review College, UK Turbulence Consortium, Leadership Team of IAHR Technical Committee on Coastal and Maritime Hydraulics, Technical Program Committee for ISOPE, and an active reviewer for over 40 international leading journals.

Keynote Presentation 9:
Development of advanced CFD tools for turbulent multiphase flows and wave-structure interaction

Turbulent multiphase flows where two or more fluids have interfacial surfaces are often found in environmental and industrial engineering applications. The objective of this study is to investigate the fluid dynamics of three-dimensional (3D) two- and three-phase multiphase flow problems, such as bubbles, droplets, liquid jet, falling liquid films, breaking waves and their interaction with fixed or moving complex geometries. In this talk, three numerical codes developed (one for finite volume method, one for control-volume finite-element method, and the other for finite difference method) for solving 3D Navier-Stokes equations with interface capturing are briefly introduced first, with different techniques to deal with the solid and air-water boundaries. And then the FVM code Xdolphin3D will be presented in detail, with a focus on the 3D wave-structure interaction. The large-eddy simulation approach has been adopted for turbulent multiphase flows, for which the spatially filtered Navier–Stokes equations are solved and the dynamic Smagorinsky sub-grid scale model is employed to compute the unresolved scales of turbulence. Both algebraic and geometric volume-of-fluid methods together with the continuum surface force model for the surface tension have been implemented to capture the air-water interface, which can accurately simulate a range of free-surface flow problems, including the turbulence statistics and coherent structures. For the simulation of complex geometries in a fixed Cartesian grid, a novel Cartesian Cut-cell method has been developed, which allows the representation of fixed or moving bodies in the flow. The code has been parallelised using MPI and a domain decomposition technique. Some numerical examples are shown to provide some insight into physics and also to demonstrate the capability of the numerical tool developed.