QUB - Mechanical and Aerospace Engineering PhD Project

Title: A Higher Order-Lower Order mesh coupling methodology in Computational Fluid Dynamics

Project description:

Most of the conventional CFD codes either open source or commercial are at most second-order accurate in space. Higher-order accurate codes are still being tested and researched upon and are yet to be absorbed into industry due to the complexity in higher order mesh generation and the cost of running the simulation. This work will be focussed on developing and coupling a higher order Cartesian based CFD code on the far-field with a standard second order code in the nearfield to minimize the effort on meshing as well as maximizing the accuracy in the far-field.

Aims and Objectives:

Higher-order (HO) accuracy in CFD is essential for dispersion and/or acoustic related problems in fluid dynamics. Numerical dissipation in formal second order accurate CFD codes prohibits the travel of information from the body of interest downstream at large distances. Higher-order accurate codes such as NekTar++/ Nek5000/PyFR are very promising and they offer the desired level of spatial accuracy for the problem of choice. HO codes require meshes to be HO as well and it is memory and time consuming although there is a break-even point between accuracy and computational time. While HO schemes can be easily implemented on Cartesian meshes, such meshes cannot be used to mesh complex body accurately unless one uses an immersed body method. To extract the potential of a Cartesian higher order scheme, one can couple such a scheme to a standard second order accurate scheme near the objects of interest via an appropriate method - overset meshing is one such an idea and there might be others as well. This way, standardized algorithms from second order schemes and linear meshes can directly be applied near the objects of interest, while higher order Cartesian discretization can be applied to the far-field and coupled appropriately.

Key skills required for the post:

1. Good understanding in Fluid Dynamics.
2. Decent programming experience using C++ and OpenFOAM.
3. The candidate needs to have a working knowledge of using and implementing new routines in OpenFOAM.
4. Good written and verbal communication skills

Key transferable skills that will be developed during the PhD:

1. Advanced knowledge in applied CFD
2. Ability to work in groups
3. Problems solving skills
4. Time management

Lead supervisor:	Dr. Dominic Chandar
Other supervisor(s):	
Guaranteed stipend:	This can include a basic stipend and any guaranteed top-up (if available). N.B. stipend for 20/21 is not yet known, but is likely to exceed £15,000.
Conditional top-up available:	Amount and condition

PhD students in the School have the opportunity to apply to be demonstrators on undergraduate modules. Compensation for this can amount to in excess of £2,400 per year.

Queens University Belfast is a diverse and international institution which is strongly committed to equality and diversity, and to selection on merit. Currently women are under-represented in research positions in the School and accordingly applications from women are particularly welcome.