Computational Science & Engineering

CSE Seminar at McGill

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Design of CFD code using high level programming paradigms: Free surface flows with arbitrarily moving rigid bodies

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2:30–3:30 pm
Macdonald-Harrington Building, Room G1

Abstract

The objective of this study is to design and develop a numerical simulation tool for unsteady free surface flows past arbitrarily moving rigid bodies. Creative use of object oriented programming, data abstraction and template metaprogramming paradigms enables us to implement computational fluid dynamics concepts, directly, into a computer code. This results in a computer program that is easier to understand and maintain. The C++ programming language is chosen as the implementation language since it provides direct support of these modern programming paradigms. Automatic generation of the program code from templates augmented with compile time optimizations and function inlining reduces the size of a manually written code up to four times and meets the high level code efficiency requirements at the Fortran level. This numerical simulation tool is applied to the problem of unsteady, laminar, two dimensional flow of a viscous incompressible fluid past transversely oscillating circular cylinder in the presence of a free surface. The code is validated against previous experimental and numerical results and a good agreement is observed. The results of this study represent the first comprehensive numerical study conducted on this problem to date.