

Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Sorting Category: 07. (C)

Curvilinear immersed-boundary method for simulating unsteady flows in shallow natural streams with arbitrarily complex obstacles¹ SEOKKOO KANG, IMAN BORAZJANI, FOTIS SOTIROPOULOS, St. Anthony Falls Lab, University of Minnesota

— Unsteady 3D simulations of flows in natural streams is a challenging task due to the complexity of the bathymetry, the shallowness of the flow, and the presence of multiple nature- and man-made obstacles. This work is motivated by the need to develop a powerful numerical method for simulating such flows using coherent-structure-resolving turbulence models. We employ the curvilinear immersed boundary method of Ge and Sotiropoulos (Journal of Computational Physics, 2007) and address the critical issue of numerical efficiency in large aspect ratio computational domains and grids such as those encountered in long and shallow open channels. We show that the matrix-free Newton-Krylov method for solving the momentum equations coupled with an algebraic multigrid method with incomplete LU preconditioner for solving the Poisson equation yield a robust and efficient procedure for obtaining time-accurate solutions in such problems. We demonstrate the potential of the numerical approach by carrying out a direct numerical simulation of flow in a long and shallow meandering stream with multiple hydraulic structures.

¹This work was supported by NCED grant EAR-0120914 and the Minnesota supercomputing institute.

Prefer Oral Session
 Prefer Poster Session

Iman Borazjani
boraz002@umn.edu
St. Anthony Falls Lab, University of Minnesota

Date submitted: 03 Aug 2008

Electronic form version 1.4