A NEW NUMERICAL SOLVER FOR SIMULATING POROUS MEDIA FLOW BASED ON IMMERSED BOUNDARY METHOD

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Abstract

In this study, we present and validate a new numerical solver in OpenFOAM®-v1706 called "ibmPorFoam" that is developed modifying IHFOAM (Higuera et al., 2014) with Immersed Boundary Method. IHFOAM is previously developed modifying interFoam solver of OpenFOAM® to solve flow properties in porous media. IHFOAM solves Volume Averaged Reynolds Averaged Navier-Stokes Equations, captures the free surface using Volume of Fluid method, and is capable of generating and absorbing waves. Immersed boundary method implemented in this study is based on body force approach given by Liu (2013). ibmPorFoam is validated in two parts by using k-ε model as the turbulence closure. In the first part, a porous dam-break experiment (Lin, 1998) is studied as a 2D case study. Free surface measurements inside and outside the porous medium are compared with the numerical results. In the second part, 3D numerical simulations are carried out to determine flow properties around a rigid, impervious box based on the experimental setup of Kleefsman et al. (2005). Numerical results are compared with the experimental results at wave gauges along the channel and pressure gauges located on the box. Both experimental cases are also simulated using IHFOAM to observe the differences in the numerical solvers. It is seen that the results of numerical simulations conducted with ibmPorFoam are in fairly well-agreement with both experimental results and numerical results from IHFOAM. Acknowledgement: Support from TUBITAK, Turkey (Project No: 217M722) is acknowledged. References Higuera, Lara, Losada (2014a), 3D Interaction of Waves and Porous Coastal Structures using OpenFOAM®, Coastal Eng., 83, 43-258. Kleefsman, Fekken, Veldman (2005), A Volume-of-Fluid Based Simulation for Wave Impact Problems, J. Comp. Physics, 206, 363-393. Lin (1998), Numerical Modeling of Breaking Waves, PhD Thesis, Cornell University. Liu, X. (2013), Realistic Flow Simulations around and inside Porous Scour Protection, in proceedings of 2013 IAHR Congress, 1–8.

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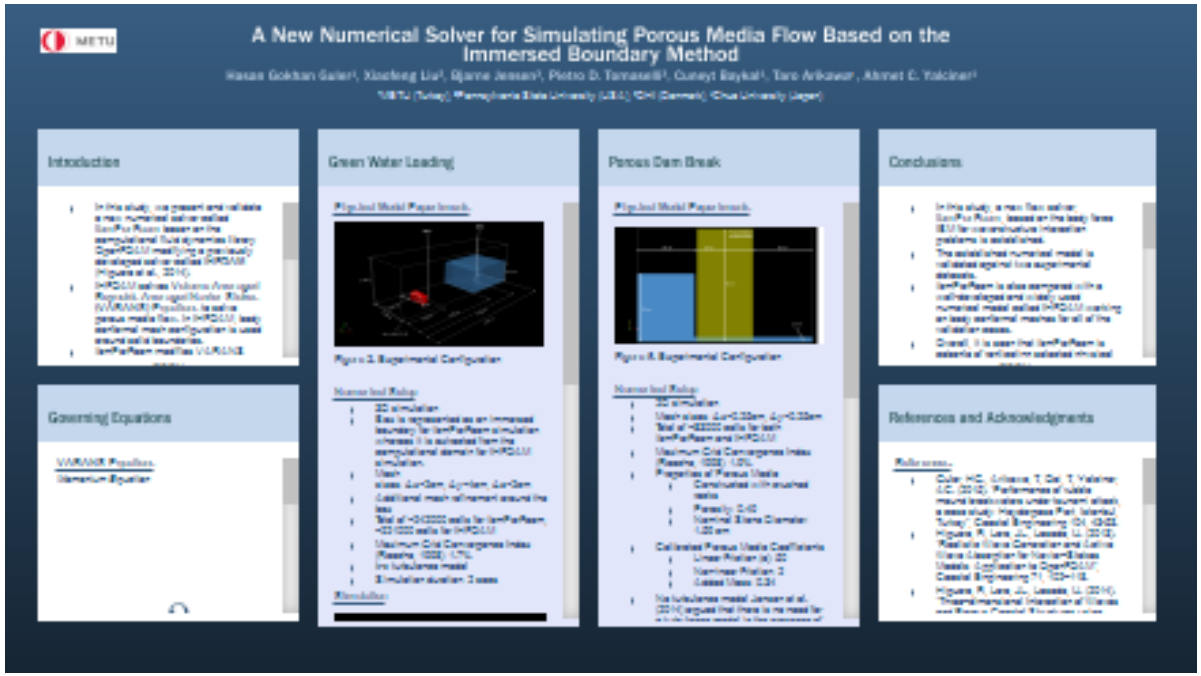

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