11th. World Congress on Computational Mechanics (WCCM XI)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

RECENT PROGRESSES ON VMS FOR TURBULENCE: PARTICLE LADEN FLOWS AND EDDY VISCOSITIES

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Key Words: *variational multiscale, finite element method, parallel computing, particle laden flows, residual-based eddy viscosities.*

We present an overview of finite element residual-based variational multiscale formulation applied to turbulent flows, particularly the numerical simulation of polydisperse particle-laden flows and the use of consistent eddy viscosities. We employ a Eulerian–Eulerian framework to describe the flows in which the mathematical model results from the incompressible Navier–Stokes equation combined with advection–diffusion transport equations. Special boundary conditions at the bottom are introduced to take into account sediments deposition [1]. We also address turbulence modeling using the Residual-Based Variational Multiscale Eddy viscosity approach (RBEVM [2]. We show that the implementation of this model on an unstructured grid finite element code is straightforward. When the eddy viscosity is computed using the residua of Navier-Stokes equations the resulting LES model is also consistent, vanishing in the flow regions where the solution is adequately represented by the approximate solution. To demonstrate the effectiveness of the proposed approaches we study the current initiation on a lock configuration, where sediment particles are endowed with a deposition velocity and are allowed to leave the domain in the moment they reach the bottom. This is intended to mimic, partially, as the bed morphology is not allowed to change, the deposition process, in which sediment deposits are no longer carried by the flow. The spatial pattern of the deposition and its correlation with flow structures are the main focus of this analysis. We also show numerical comparisons for the turbulent flow round a cylinder [3]. The numerical experiments have shown that VMS formulations captures most of the relevant turbulent flow features with reasonable accuracy, when compared with highly resolved numerical simulations and experimental data.

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