Numerical solution for open channel flow with submerged flexible vegetation

Abstract

The purpose of this study is to explore the suitability of numerical models in estimation o f velocity and flow resistance (Manning n) in open channels with totally submerged flexible vegetation. A three dimensional (3D) numerical model based on arbitrary Lagrangian-Eulerian (ALE) approach has been employed to simulate the effects of various characteristics of selected flexible vegetations to the velocity distribution and flow resistance. The modeling involved simultaneous solution of Navier Stokes equation f or o pen channel flow, s tress-strain relationship for the vegetation structure and ALE algorithm for the moving vegetation boundaries. The numerical computation has been carried out with a n aid of a commercial finite element software package, COMSOL Multiphysics 3.4. The numerical results were validated using experimental data carried out in the laboratory using real vegetations. The accuracy of numerical model compared t o experimental results w as measured in terms of mean absolute error (MAE). The results show that the numerical model which combined the three applications as mentioned above able to predict the velocity and the flow resistance coefficient in open vegetated channel with reasonable accuracy. The MAE calculated for velocity and Manning n is ±0.02.

Keyword: Vegetated channel; Vegetative resistant coefficient; Numerical model; ALE