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Jump reconstruction in diffusive shallow water modeling

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It can be shown that diffusive approximation generally provides an excellent reconstruction of the water profile inside the river, and the model solution has a much smaller sensitivity to the topographic error with respect to the solution of the fully dynamic one. In a relatively small number of computational sections, where jumps occur and the corresponding energy dissipation is neglected, the error is much larger. The following procedure is proposed to localize the jump and compute a good approximation of the corresponding energy dissipation, in the context of a MArching in Space and Time (MAST) approach [1]:
For each reach between two computational sections inside the river, the Froude number and the total momentum in the upstream and downstream section are computed at the beginning of each computational step. The jump is located in the reach where the Froude number is greater than one in the upstream section and the total momentum attains a minimum in the downstream section. In the prediction step, discharges are computed using the upstream gradient of the energy line in the upstream section and the downstream gradient in the downstream section. In the correction step, diffusion flux is neglect in the reach where the jump is localized. The results of a jump reconstruction in a monitored flume close to San Paolo are shown.

[1] C. Aricò and T. Tucciarelli. A Marching in Space and Time (MAST) solver of the shallow water equations. Part I: the 1D model. Advances in Water Resources, 30(5), 1236-1252, (2007).