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Novel Approach for Dam Break Flow Modeling Using Computational Intelligence

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ABSTRACT

A new methodology based on the computational intelligence (CI) system is proposed and tested for modeling the classic 1D dam-break flow problem. The reason to seek for a new solution lies in the shortcomings of the existing analytical and numerical models. This includes the difficulty of using the exact solutions and the unwanted fluctuations, which arise in the numerical results. In this research, the application of the radial-basis-function (RBF) and multi-layer-perceptron (MLP) systems is detailed for the solution of twenty-nine dam-break scenarios. The models are developed using seven variables, i.e. the length of the channel, the depths of the up-and downstream sections, time, and distance as the inputs. Moreover, the depths and velocities of each computational node in the flow domain are considered as the model outputs. The models are validated against the analytical, and Lax-Wendroff and MacCormack FDM schemes. The findings indicate that the employed CI models are able to replicate the overall shape of the shock- and rarefaction-waves. Furthermore, the MLP system outperforms RBF and the tested numerical schemes. A new monolithic equation is proposed based on the best fitting model, which can be used as an efficient alternative to the existing piecewise analytic equations.

Keywords: Dam-break flow; Artificial neural networks; Shockwave modeling; Multi-layer Perceptron (MLP), Radial Basis Function (RBF).