Assessing Hydraulic Performance of Anura3D for Dam-Break Flows

Emre Dumlu, Yavuz Ozeren, Luc Rébillout

Dam failures can lead to flooding, and significant damage to life and property. Accurate prediction of hydraulic behavior during dam-break flows and the acquisition of reliable data from advanced numerical models are crucial for mitigating associated risks. This study aims to evaluate the performance of Anura3D in modeling dam-break flows, focusing on its ability to capture the underlying mechanisms. To achieve this, MPM simulations were performed using both single point and double point formulations with Anura3D. Single point simulations were compared with two different experiment studies with both dry and wet downstream conditions at varying the initial reservoir heights. The simulations were performed on a 2D domain with a fixity representing the gate in the laboratory experiments, which was removed to initiate the dam-break. The upstream water level, and the wave front were captured and compared with the corresponding laboratory measurements. For the double-point overtopping simulations an earthen dam was placed in the 2D domain. Dam dimensions were kept as 0.2 m of height, 0.15 m of crest width, and a slope of 1V:3H. Each dam was modeled in fully saturated conditions and consisted of cohesive materials. A reservoir was placed upstream of the dam to control the inflow discharge while overtopping flow was drained using the excavation feature. Each simulation was initialized with 12 material points per triangular element representing the water and dam material. Two different discharge estimation methods were developed and compared at selected locations in the domain. The effects of various simulations parameters on the results were also discussed.

Keywords: MPM method, Anura3D, Modeling, Dambreak, Overtopping, Discharge.