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## **A MESHLESS METHOD BASED ON MOVING LEAST SQUARES FOR THE SIMULATION OF FREE SURFACE FLOWS**

**Key words:** Meshless method, Moving least squares (MLS), Free surface flows, Finite pointset method (FPM), Dam-breaking flows, Solitary wave propagation, Liquid sloshing of tanks



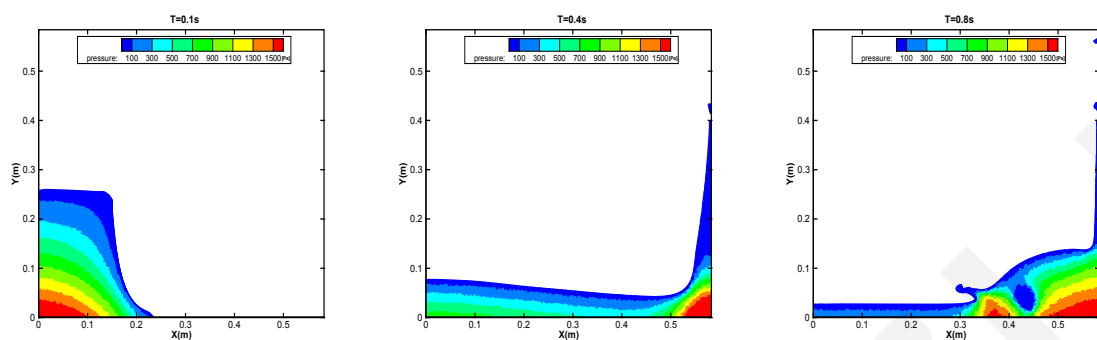
- *Mathematical model*
- *Projection method*
- *Moving least squares (MLS)*
- *Derivatives approximation by MLS*
- *Free surface treatment*
- *Time step selection*



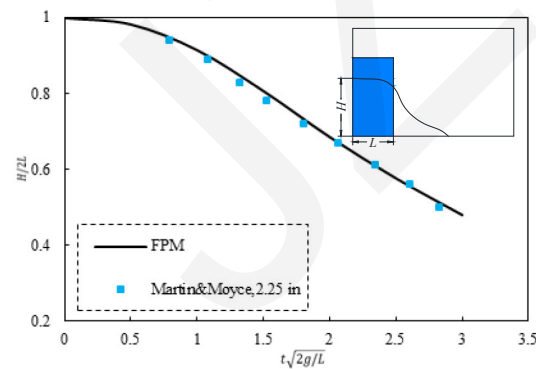
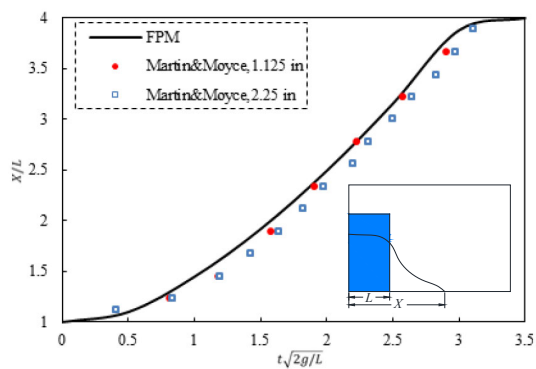
# NUMERICAL EXAMPLES



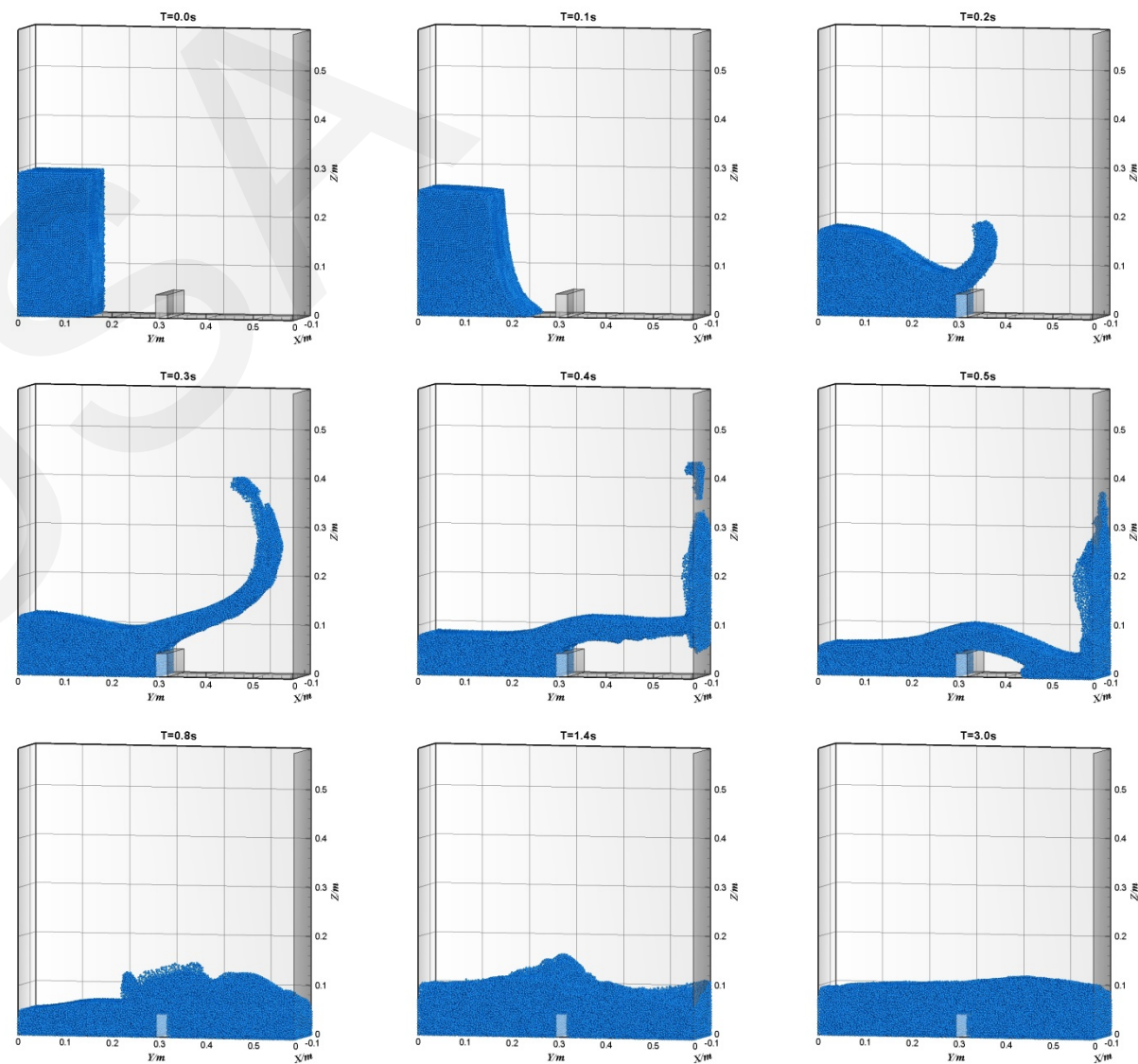
## ➤ Dam-breaking flows



Computed pressure fields for 2-D dam break flows



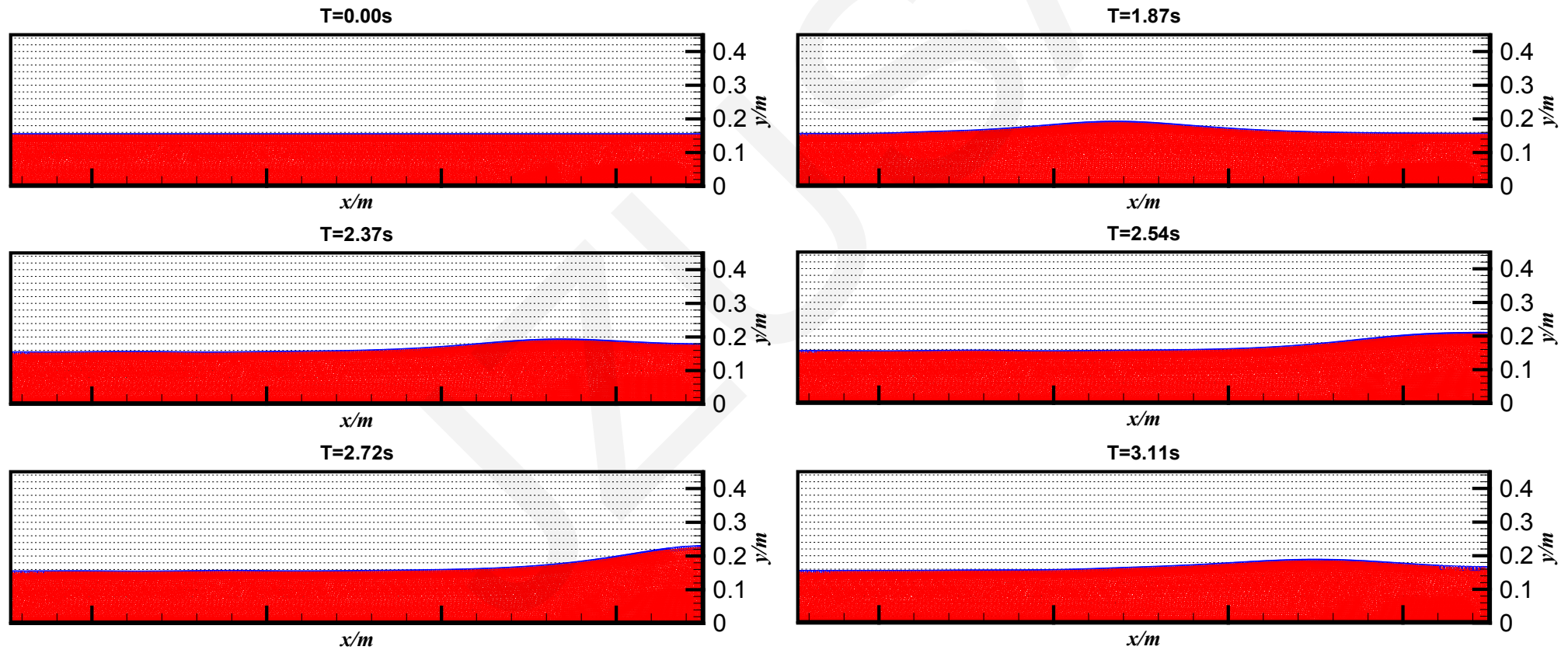
Validity study for 2-D dam break flows



Numerical simulation of 3-D dam break flows



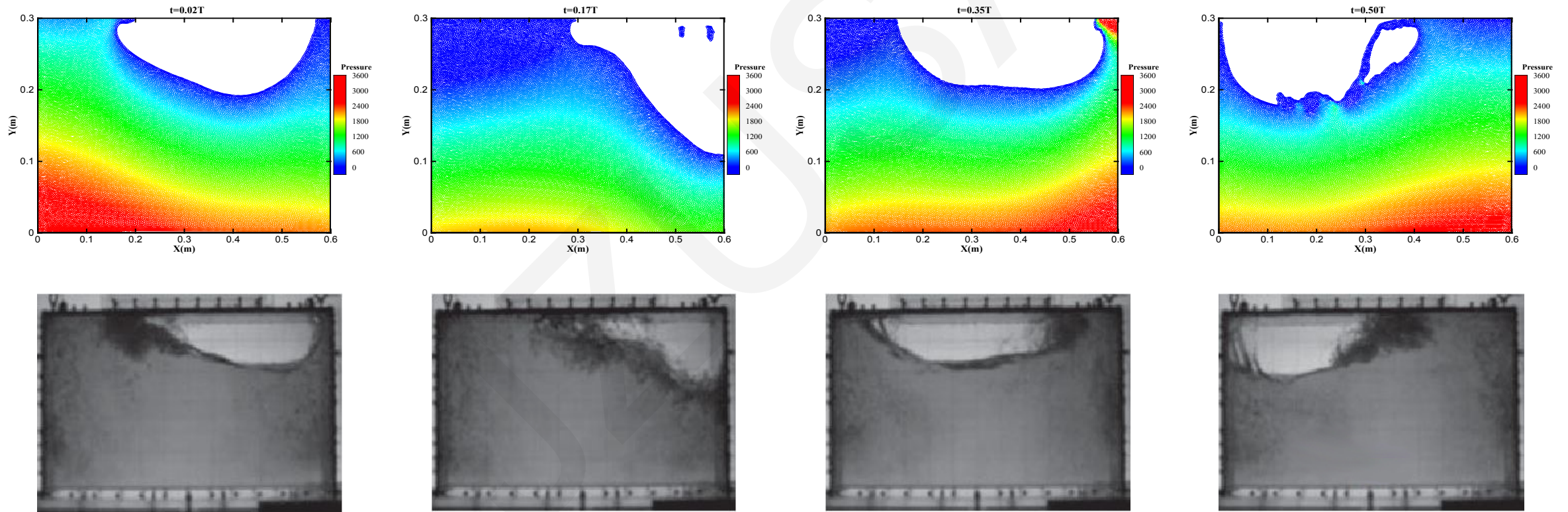
## ➤ Solitary wave propagation



Analytical results of solitary wave propagation at different time points



## ➤ *Liquid sloshing of tanks*



Qualitative comparison between FPM and experimental results of different time snapshots



# CONCLUDING REMARKS



*We have successfully implemented a meshless method (FPM) for the accurate simulation of free surface flows in this study. The incompressible Navier – Stokes equations of fluid flow are solved using the projection method. The MLS approach is adopted to approximate the spatial derivatives appearing in the governing equations. The pressure Poisson equation with Neumann boundary condition is handled by the bi-conjugate gradient method.*

*Numerical examples on free surface flows, including dam-breaking flows, solitary wave propagation, and liquid sloshing of tanks, are presented and compared with the experimental data to validate the proposed method. The results show satisfactory agreement, which indicates that FPM is an accurate and efficient numerical method for the meshless solution of complex free surface flows.*

*Furthermore, FPM can predict strongly nonlinear flow phenomena, such as water splashing, rolling, breaking, and intruding, more accurately, reflecting the advantages of the proposed method under the theoretical framework of Lagrangian particle schemes in simulating large deformation flow problems. Compared to the Eulerian methods strictly based on constructing a topological mesh, FPM is shown to have better flexibility and strong capability of simulating free surface flows.*