

# MORPHOLOGICAL CHANGE SIMULATION USING A GPU-BASED PLATFORM

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## INTRODUCTION

With the advancement of parallel computing in hydrodynamic models, computational burdens have significantly decreased compared to the past. Modelling based on Graphics Processing Unit (GPU) is one noteworthy method in achieving this improvement. Moreover, GPU computing can be an attractive tool not only for hydrodynamic models but also for morphological simulations. Several trials of sediment transport model using GPU shows advanced performance in terms of computational efficiency.

## MODEL DESCRIPTION

In this study, we developed the sediment transport model to simulate the movement of sediment and morphological changes based on the GPU based platform Celeris Advent (Tavakkol and Lynett, 2017). Celeris Advent is a coastal wave solver capable of real-time numerical simulation and visualization using GPU acceleration.

The two-dimensional shallow water equations were employed as a hydrodynamic model to simulate fluid motion. The depth-averaged advection-diffusion equation, with a source term reflecting the erosional and depositional fluxes was employed as a sediment transport model to simulate sediment movement. Morphological change can be reflected by solving the bed evolution model. A second-order well-balanced positivity preserving scheme (Kurganov and Petrova, 2007) is applied for the discretization and analysis of the governing equation.

The model validation was performed using dam-break benchmark cases. One case involved a 1D dam-break flow (Fraccarollo and Capart, 2002) over an erodible bed, while others involves 2D dam-break flows (Goutiere et al., 2011; Xia et al., 2010) resulting from the sudden expansion of width over an erodible bed. The water surface and bed elevation were compared with experimental data, and the overall results showed good agreement.

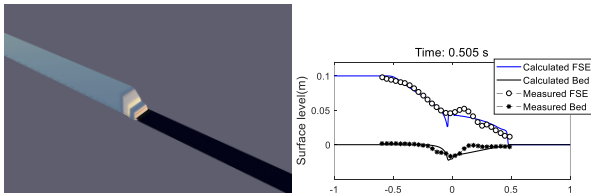


Figure 1 - 1D Dam-break case modelling and results

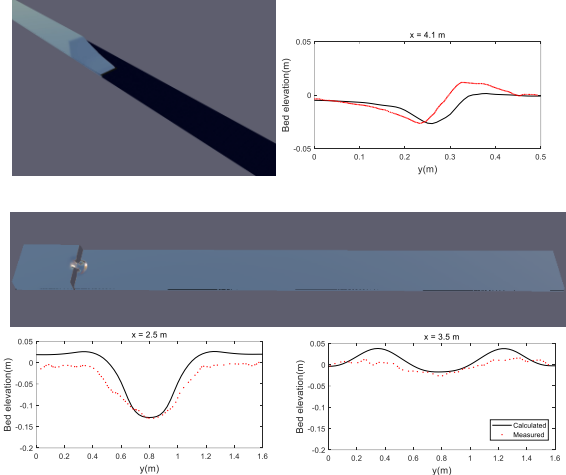


Figure 2 - 2D Dam-break cases modelling and results

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## REFERENCES

- Tavakkol, S., and Lynett, P. (2017): Celeris: A GPU-accelerated open source software with a Boussinesq-type wave solver for real-time interactive simulation and visualization, *Computer Physics Communications*, vol. 217, pp. 117-127.
- Kurganov, A., and Petrova, G. (2007): A second-order well-balanced positivity preserving central-upwind scheme for the Saint-Venant System, *Communications in Mathematical Sciences*, vol. 5, pp. 133-160.
- Fraccarollo, L., and Capart, H. (2002): Riemann wave description of erosional dam-break flows, *Journal of Fluid Mechanics*, vol. 461, pp. 183-228.
- Goutiere, L., Soares-Frazão, S., and Zech, Y. (2011): Dam-break flow on mobile bed in abruptly widening channel: experimental data, *Journal of Hydraulic Research*, vol. 49, pp. 367-371.
- Xia, J., Lin, B., Falconer, R.A., and Wang, G. (2010): Modelling dam-break flows over mobile beds using a 2D coupled approach, *Advanced in Water Resources*, vol. 33, pp. 171-183.