# Simulating the generation of waves from landslide impacts with PFEM

**Ryan P. Mulligan*, W. Andy Take*, Alessandro Franci† and Miguel Celigueta†**

* Department of Civil Engineering, Queen's University
58 University Ave., Kingston, ON, Canada
e-mail: ryan.mulligan@queensu.ca, andy.take@queensu.ca, web page: https://civil.queensu.ca/

† Centre Internacional de Mètodes Numèrics en Enginyeria (CIMNE)
Universitat Politècnica de Catalunya (UPC)
Campus Norte UPC, 08034 Barcelona, Spain
e-mail: falessandro@cimne.upc.edu, maceli@cimne.upc.edu, web page: http://www.cimne.upc.edu/

## ABSTRACT

Tsunami generated when landslides transfer momentum to water [1] are major natural hazards in coastal areas of lakes, reservoir and fjords. In this study landslide waves are investigated using experimental observations and numerical predictions of this problem from the release of source material to wave generation and evolution.

The experiments are conducted in a large landslide flume [2], using high-speed digital cameras to measure the landslide properties at impact with water in the reservoir. The slide material is water [3], which represents an avalanche or debris flow with high mobility. The reservoir depth is varied, thereby achieving a range of different near-field wave conditions from breaking waves to near-solitary waves. In-situ observations of fluid velocity and surface water levels are obtained using cameras, acoustic sensors and capacitance wave probes in the experiments.

The Particle Finite Element Method (PFEM) is applied in the present study to simulate landslides and the dynamics of the free-surface and fluid velocity evolution at the laboratory scale. PFEM is a Lagrangian numerical technique that combines the Finite Element Method with an efficient remeshing algorithm [4,5]. The model is validated using the laboratory observations, and the model results help to understand and quantify variability in the water surface and the velocity distribution during the generation of these highly nonlinear waves. Most tsunami risk assessments use empirical wave predictions to determine boundary conditions for numerical wave models, however PFEM provides a modelling framework to simulate the entire problem from landslide motion, to impact with water, to wave generation and propagation.

## REFERENCES

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