Engineering and Computational Mechanics
Volume 167 Issue EM3

Editorial
Park and Farook

ice | proceedings

Proceedings of the Institution of Civil Engineers
Engineering and Computational Mechanics 167 September 2014 Issue EM3
Pages 97–98 http://dx.doi.org/10.1680/eacm.2014.167.3.97

Editorial

Yong Sung Park PhD
Lecturer & Royal Society of Edinburgh/Scottish Government Personal Research Fellow co-funded by the Marie-Curie Actions, Division of Civil Engineering, University of Dundee, Dundee, UK

Zeena Farook MEng, BA
Geotechnical Engineer, Arup, London, UK and Application Specialist, Oasys Software, Newcastle upon Tyne, UK

The tremendous damage caused by the 2004 Indian Ocean Tsunami and the 2011 Tohoku Tsunami is well-known, and now the word 'tsunami' is widely publicised. Assessing the risk caused by these formidable natural disasters and planning for them accordingly, however, are challenging for many reasons. The low frequency of tsunami occurrence, compared with other natural events such as storms, is directly responsible for the general lack of available field data. Researchers in this area therefore rely heavily on theoretical analyses for simplified problems as well as physical and numerical model studies for more realistic problems. However, tsunamis are inherently multi-scale (in the sense that the wavelengths exceed 100 km while millimetre-scale sediment transport sometimes needs to be considered) and multi-phase (incorporating water, sediment, air and many natural and man-made coastal structures), which pose great challenges in modelling.

This themed issue on tsunamis is in response to the surging interest in this important and challenging area. A call for papers was answered by 15 abstracts presenting a wide range of topics, including tsunami modelling, and hazard and risk assessment. After a long and difficult debate, five papers were invited, which are presented in the current issue.

Valle *et al.* (2014) presents simulation results of plausible large seismic events in the eastern Mediterranean Sea and the resulting coastal inundation from tsunamis. The method of splitting tsunami (the Most method) is used for the simulation, which is the standard model used at the National Oceanic and Atmospheric Administration Center for Tsunami Research (NCTR) and is developed by one of the co-authors of the paper. In addition to the valuable information presented on the tsunami risk faced by countries in the eastern Mediterranean, readers can see how regional forecasts on tsunamis are being performed using a well-established model.

In the UK, storm surges, rather than tsunamis, are of more concern. Noting that UK coastal structures are designed to protect against storms, McCabe *et al.* (2014) apply their numerical model, which has been well validated for modelling storm waves, to a type of wave that have been widely used to model tsunami waves, namely solitary waves. (Note that recently some concerns have been raised over the use of solitary waves and the authors of the paper are well aware of these. Here it is reiterated that the solitary wave is still useful in validating numerical models and most benchmarking data officially used by NCTR are based on solitary waves.) On a plane beach, they define a version of surf similarity parameter for solitary waves and compare run-up heights of solitary waves to those of storm waves. In general, solitary waves show greater run-up heights. In another comparison, the force on a vertical wall was calculated and again solitary waves exert greater force.

Non-linear shallow-water equations are the most widely used model for tsunami research. Amouzgar *et al.* (2014) show that the computation time can be significantly reduced by employing the power of graphics processing units (GPUs). A model previously developed and validated by one of the co-authors is newly implemented using compute unified device architecture (CUDA) and compared with the original version for two case studies. The computation speed is enhanced by 40-fold when GPUs were used.

Accurate modelling of breaking waves is extremely challenging; their interactions with structures are even more difficult. Cunningham *et al.* (2014) tackles this problem by combining smoothed-particle hydrodynamic (SPH) modelling of waves with finite-element structural modelling. The results of two-dimensional hydrodynamic modelling of waves impacting on a vertical wall are used to feed the subsequent structural modelling to calculate wall deflections. A three-dimensional example of tsunami wave loading on a cylindrical structure is also provided, although only the SPH results are presented.

This issue concludes with three-dimensional, two-phase modelling of tsunami waves. Based on a popular open-source numerical package, OpenFOAM, Dimakopoulos *et al.* (2014) provide their implementation of the relaxation method that can generate and absorb waves in the computational domain. A series of validation results demonstrate the promise of the new proposed model.

REFERENCES

Amouzgar R, Liang Q and Smith L (2014) A GPU-accelerated shallow flow model for tsunami simulations. *Proceedings of the Institution of Civil Engineers – Engineering and Computational Mechanics* **167(3)**: 117–125, http://dx.doi.org/10.1680/eacm.13.00024.

Cunningham LS, Rogers BD and Pringgana G (2014) Tsunami wave and structure interaction: an investigation with smoothed-particle hydrodynamics. *Proceedings of the Institution of Civil Engineers – Engineering and Computational Mechanics* **167(3)**: 126–138, http://dx.doi.org/10.1680/eacm.13.00028.

Dimakopoulos AS, Guercio A and Cuomo G (2014) Advanced numerical modelling of tsunami wave propagation, transformation and run-up. *Proceedings of the Institution of Civil Engineers – Engineering and Computational Mechanics* **167(3)**: 139–151, http://dx.doi.org/10.1680/eacm.13.00029.

McCabe M, Stansby PK, Rogers BD and Cunningham LS (2014) Boussinesq modelling of tsunami and storm wave impact. *Proceedings of the Institution of Civil Engineers – Engineering and Computational Mechanics* **167(3)**: 106–116, http://dx.doi.org/10.1680/eacm.13.00025.

Valle BL, Kalligeris N, Findikakis AN *et al.* (2014) Plausible megathrust tsunamis in the eastern Mediterranean Sea. *Proceedings of the Institution of Civil Engineers – Engineering and Computational Mechanics* **167(3)**: 99–105, http://dx.doi.org/10.1680/eacm.13.00027.