



# MASTS-PECRE Final Report:

Dr Yong Sung Park

**Title:**

Lattice Boltzmann modelling of breaking waves

**Duration:**

From 1 Apr 2015 to 31 May 2015

**Host and host Institution:**

Professor Stephan Grilli  
Department of Ocean Engineering  
University of Rhode Island  
Narragansett, RI 02882  
United States

**Overview of the project:**

Wave breaking is one of the key driving forces in the physical, chemical and biological processes in the coastal area. Accurate parameterisation of the effects of the wave breaking is very important in understanding and modeling nearshore processes. However wave breaking is inherently fully three-dimensional, highly turbulent and multi-phase, and there is a knowledge gap in our current understanding of the dynamics of breaking waves.

Professor Grilli at the University of Rhode Island is well-known for numerical simulations of breaking waves. Recently, his research team has developed a new Lattice Boltzmann model (LBM) that can reliably simulate breaking water surface waves [1, 2]. Thanks to the MASTS PECRE Fellowship, the applicant acquired and learned the model, which is subsequently used to compare with his experimental data [3].

<References>

- [1] Banari, A., Janssen, C., Grilli, S.T. and Krafczyk, M. 2014. Efficient GPGPU implementation of a Lattice Boltzmann Model for multiphase flows with high density ratios. *Computers and Fluids*, 93, 1-17.
- [2] Banari, A., Janssen, C., and Grilli, S.T. 2014. An efficient lattice Boltzmann multiphase model for 3D flows with large density ratios at high Reynolds numbers. *Computers and Mathematics with Applications*, (in revision).
- [3] Park, Y. S. and Liu, P. L.-F. 2014. Three breaking solitary waves. *Journal of Fluid Mechanics*, (submitted).

**Outputs:**

1. *Acquiring the LBM code:*

Thanks to the exchange visit, I had intensive training on the LBM model developed by Professor Grilli and his research team. Now the model is being used in my research group for further research on breaking waves.

2. *Widening collaboration network:*

During the visit, I came to know Dr Jeff Harris (EDF, France). Dr Harris is a former PhD student of Professor Grilli and developed a 3D Boundary Element Model for surface waves. Later (October 2015) I invited him to Dundee and also learned to use his model.

*3. Successful grant application:*

With the newly acquired numerical models (LBM and 3D BEM), I successfully applied for a research grant on breaking waves to Korean Institute of Ocean Science and Technology (£11K).

*4. Another grant application in preparation:*

Professor Grilli and Professor David Tappin (BGU) invited me for his NSF-NERC joint proposal on volcanogenic tsunami, in which the aforementioned models are to be used.

**Summary of Award and expenditure:**

Total award: £5200

Travel: £4000

Subsistence: £1200