Geophysical Research Abstracts, Vol. 9, 03719, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03719

Numerical modelling of tsunami generation and run-up, and the surf similarity of solitary waves

David R. Fuhrman and Per A. Madsen

Department of Mechanical Engineering, Technical University of Denmark (drf@mek.dtu.dk).

The first part of this work will focus on recent extentions to the state-of-the-art high-order (fully nonlinear, finite difference) Boussinesq-type model (described by Madsen et al. 2002, 2006; Fuhrman & Bingham 2004), to allow both a moving shoreline for tsunami run-up onto beaches and islands, as well as tsunami generation from bottom motion (e.g. from earthquakes and landslides). The Boussinesq model is capable of accurately simulating water waves out to approximately (wavenumber times depth) kh = 30, eliminating depth limitations conventionally associated with this type of approach, for most practical circumstances. It is therefore capable of simulating tsunami events where dispersion is important, while maintaining reasonable computational expense. The implemented run-up algorithm (similar to Lynett et al. 2002) has been systematically tested in both one and two horizontal dimensions, and the present work will focus on the 2HD results. These include simulations involving long wave resonance in a parabolic basin, as well as the run-up of solitary waves on conical islands. Additionally, recent numerical results demonstrating tsunami generation from earthquake events and landslides (e.g. based on the recent 3D experiments of Enet 2006 and Enet & Grilli 2007) will be presented.

In the second part of this work, we investigate the notion of surf similarity for solitary waves running up a plane beach. The currently accepted solitary wave surf similarity parameter is that of Kobayashi & Karjadi (1994), who utilized the concept of a representative wave period within the standard parameterization for periodic waves. We demonstrate that their methodology is unnecessarily complicated and flawed, as it forces a periodic notion onto a non-periodic phenomenon. We demonstrate that when the surf similarity parameter for solitary waves is properly identified, it leads to identical fundamental run-up dependencies as for sinusoidal waves, in both breaking (based on data compiled e.g in Hughes 2004) and non-breaking regimes.

References

1) Enet, F. 2006 *Tsunami generation by underwater landslides*, PhD Thesis, University of Rhode Island.

2) Enet, F. & Grilli, S.T. 2007 Tsunami generation by underwater landslides. Part I: Laboratory experiments for rigid slides. *J. Waterw. Port C-ASCE* (in press).

3) Fuhrman, D.R. & Bingham, H.B. 2004 Numerical solutions of fully non-linear and highly dispersive Boussinesq equations in two horizontal dimensions. *Int. J. Numer. Meth. Fluids* **44**, 231—255.

4) Hughes, S.A. 2004 Estimation of wave run-up on smooth, impermeable slopes using the wave momentum flux parameter. *Coast. Eng.* **51**, 1085—1104.

5) Kobayashi, N. & Karjadi, E.A. 1994 Surf-similarity parameter for breaking solitar-wave runup. *J. Waterw. Port C-ASCE* **120**, 645—650.

6) Lynett, P.J., Wu, T.-R. & Liu, P.L.-F. 2002 Modeling wave runup with depth-integrated equations. *Coast. Eng.* **46**, 89—107.

7) Madsen, P.A., Bingham, H.B. & Liu, H. 2002 A new Boussinesq method for fully nonlinear waves from shallow to deep water. J. Fluid Mech. 462, 1—30.

8) Madsen, P.A., Fuhrman, D.R. & Wang, B. 2006 A Boussinesq-type method for fully nonlinear waves interacting with a rapidly varying bathymetry. *Coast. Eng.* **53**, 487—504.