Stability of water waves in the presence of surface tension

Olga Trichtchenko and Bernard Deconinck
Department of Applied Mathematics, University of Washington, Seattle, WA 98195-2420
email: ota6@uw.edu

Abstract:

The aim of the project is to examine the perturbative effect of surface tension on the slow-growing oscillatory instabilities that are present with emphasis of stability in finite depth and possible change in stability behaviour in shallow water, specifically on the bubble instabilities found by Deconinck and Oliveras [5]. Recently, Ablowitz, Fokas and Musslimani presented a reformulation of the surface water wave problem [1]. This formulation uses only surface variables, allowing for greatly improved computational efficiency. Building on previous work [2,4], we use this formulation to compute stationary periodic solutions of the one-dimensional problem, in the presence of small surface tension. The spectral stability of these solutions is examined, using Hill's method [3,4].

References:

1. M. J. Ablowitz, A. S. Fokas and Z. H. Musslimani, *On a new non-local formulation of water waves.*. J. Fluid Mech., Vol.562 (2006), pp. 313-343.
2. B. Akers and D. P. Nicholls, *Traveling waves in deep water with gravity and surface tension*. SIAM J. Appl. Math., Vol. 70 (2010), pp. 2373-2389.
3. C. W. Curtis and B. Deconinck. *On the convergence of Hill's method*. Math. Comp., Vol. 79 (2010), pp. 169-187.
4. B. Deconinck and J. N. Kutz. *Computing spectra of linear operators using Hills method*. Journal of Computational Physics, Vol. 219 (2006), pp. 296321.
5. B. Deconinck and K. Oliveras, *The instability of periodic surface gravity waves*. J. Fluid Mech., Vol 675 (2011), pp.141-167.