Improving Archimedes: the water wave pressure problem

I will discuss a method to recover the water-wave surface elevation from pressure data obtained at the bottom of a fluid. The method requires the numerical solution of a nonlocal nonlinear equation relating the pressure and the surface elevation which is obtained from the Euler formulation of the water-wave problem without approximation. From this new equation, a variety of different asymptotic formulas are derived. The nonlocal equation and the asymptotic formulas are compared with both numerical data and physical experiments, demonstrating excellent agreement, significantly beyond what is obtained using Archimedes' $p=\rho g h$.