Kinematics and dynamics of a solitary wave interacting with varying bathymetry and/or a vertical wall

Christos Papoutsellis (1), Gerassimos Athanassoulis (1,2), and Alexis-Tzianni Charalampopoulos (1)
(1) National Technical University of Athens, Naval Architecture and Marine Engineering, Athens, Greece
(makathan@gmail.com), (2) Research Center for High Performance Computing, ITMO University, St. Petersburg, Russian Federation

In this work, we investigate the transformations that solitary surface waves undergo during their interaction with uneven seabed and/or fully reflective vertical boundaries. This is accomplished by performing simulations using a non-local Hamiltonian formulation, taking into account full nonlinearity and dispersion, in the presence of variable seabed [1]. This formulation is based on an exact coupled-mode representation of the velocity potential, leading to efficient and accurate computations of the Dirichlet to Neumann operator, required in Zakharov/Craig-Sulem formulation [2], [3]. In addition, it allows for the efficient computation of wave kinematics (velocity, acceleration) and the pressure field, in the time-dependent fluid domain, up to its physical boundaries. Such computations are performed for the case of high-amplitude solitary waves interacting with varying bathymetry and/or a vertical wall, shedding light to their kinematics and dynamics. More specifically, we first consider two benchmark cases, namely the transformation of solitary waves over a plane beach [4], and the reflection of solitary waves on a vertical wall [5]. As a further step, results on the scattering/reflection of a solitary wave due to an undulating seabed, and on the disintegration of a solitary wave travelling from shallow to deep water are also presented.

References: