Absorbing Boundaries for Water Wave Problems

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Wave propagation in unbounded domains often requires the implementation of nonreflecting boundary conditions (bc's) on the domain computational boundaries. These 'do-nothing' bc's should ideally render the boundary invisible to outgoing waves, and can be surprisingly difficult to formulate. This talk concerns the treatment of artificial boundaries in water wave propagation. Using Fourier analysis, we identify the structure of left/right moving water waves and derive a one-way version of the water wave equation, which we implement as an absorbing layer near the computational boundary.

The one-way equation is a fractional pde, and can be viewed as a conservation law with a linear nonlocal flux involving a convolution with a singular integrable kernel. It lends itself to numerical technology from conservation laws, but introduces its own twists due to its nonlocality and singular kernel. We derive high order numerical methods, where the solution is approximated by piecewise polynomials, and the singular convolution is integrated exactly. In this talk, we will show how the equation arises, discuss the numerical method, and show numerical results.

This is joint work with G.I. Jennings and J.B. Rauch.