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Waves - floating structure interactions in Boussinesq regime

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In the context of nearshore wave energy facilities, we have tackled, with David Lannes and Lisl Weynans, the interaction of waves with a floating structure immersed in a 2D fluid. Some difficulties come from the presence of several surfaces: the surface of the sea and the contact surface between the structure and the fluid. The horizontal plane is decomposed into two regions: the exterior region where the surface of the fluid is in contact with the air, and the interior region where it is in contact with the bottom of the object. In the exterior region, we have the standard wave equations, where the surface is free but the pressure is constrained (equal to the atmospheric pressure). In the interior region, the opposite happens: the pressure is free but the surface is constrained, which changes the structure of the equations. Finally, coupling conditions between both regions are needed. We show how to implement this program in the case where the waves are described by the nonlinear dispersive Boussinesq equations. The difficulties related to the computation of the contact surface are overcome by considering an augmented formulation: in addition to the usual equations, we find two hidden ODEs of the water column at the contact points between the waves and the structure. Finally, we propose a numerical method that exploits the added-mass effect, the dispersive boundary layer and this two hidden ODEs.

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