Waves and velocity field produced by a parabolic wave maker around a liquid-gas interface

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In a recent paper [1] it has been reported that a plunger moving periodically in the vertical direction can produce not only waves but also a large scale surface flow. This flow is different from the Stokes drift predicted two centuries ago. In this work, both the deformation of the interface liquid-gas and the velocity field inside the liquid have been investigated numerically. We consider that waves are generated by a parabolic wave maker moving sinusoidally in the vertical direction. To carry this investigation the Navier Stokes and continuity equations are solved in 3-D by direct numerical simulations with the Gerris flow solver. This software is well adapted to study flows with a free surface. According to analytical theories (geometrical optics, diffraction theory) and experimental results, this system exhibits caustics, dislocations and wave breaking.[2]. The motivation of this study is to investigate the streaming and the modifications that it induces on the wave field. In particular it has been observed that wave fronts are different from the prediction given by the geometrical optics if the forcing amplitude of the wave maker overpass a threshold. This behaviour is related to the formation of two recirculation cells on the surface which have non zero vorticity. We present data of the velocity field at different depths which show that velocity field differs from those of a pure wave field in the vicinity of the liquid-gas interface. We present also some result about the focusing of surface waves in this system.

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Références

1. Punzmann H, N Francois N, Xia H, *et al* , Generation and reversal of surface flows by propagating waves *Nature Physics*, **10**, 658–663 (2014).
2. G. Ruiz Chavarría & T. Rodriguez Luna , Singularities in Surface Waves *Selected Topics of Computational and Experimental Fluid Mechanics. Environmental Science and Engineering*, 209–226 (2015).