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Finite amplitude, axisymmetric, capillary waves in a cylindrical container

LOHIT KAYAL, SASWATA BASAK, RATUL DASGUPTA, Indian Institute of Technology Bombay — We obtain the solution to the initial value problem for a surface perturbation on a deep pool of liquid contained in a cylindrical container. The solution is formulated as a perturbative expansion up to third order in the wave steepness parameter $a_0k$. The initial surface perturbation is chosen to be an axisymmetric Bessel function i.e. $(r, 0) = a_0J_0(kr)$ with $k$ sufficiently large for gravity to be negligible. We solve the nonlinear initial-value problem under the inviscid, irrotational approximation using the Lindstedt-Poincare technique and the Dini series, solving the resultant equations up to $O(3)$, accounting for surface tension. The resultant expression for the time evolution of the interface $(r, t)$ is compared against numerical solutions to the incompressible Euler equation. We compare these results to those obtained recently from a second order expansion, where both capillary and gravity effects are taken into account (Basak, Farsoiya and Dasgupta, 2020, under review; https://gfm.aps.org/meetings/dfd-2019/5d764521199e4c429a9b2bd). The differences between the finite amplitude capillary wave and the capillary-gravity wave will be highlighted.

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