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A SINGULARITY IN RESONANT INTERFACIAL FLUID FLOW LEADING TO ROLE REVERSAL IN THE SPACE TIME CONTINUUM OF THE EVOLUTION EQUATIONS

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In memory of Professor Susan North Brown, 1937-2017, RIP.

ABSTRACT An investigation is made into the capillary-gravity waves which arise on the interface of two ideal fluids and which are due to the resonant interaction between two harmonics of the motion. We consider the particular case when the upper fluid moves with speed V and the lower with speed $-\rho V$ where ρ is the relative density of the fluids. This case is significant because previous analyses are invalid when the parameters have these special values. The method of multiple scales is employed to derive a pair of nonlinear partial differential equations which describe the evolution of the interface. These differ from the more usual nonlinear Schrödinger equations in that the roles of space and time are reversed. It is found that these equations possess a large number of solutions corresponding to sinusoidal waves. These waves are shown to be unstable.

Keywords: capillary-gravity waves, resonant interactions, evolution equations.