Bifurcations, stability and collapse of internal solitary waves

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We study both supercritical and subcritical bifurcations of internal solitary waves propagating along the interface between two ideal fluids. We derive a generalized nonlinear Schrödinger equation that describes solitons near the critical density ratio corresponding to the transition from a subcritical to a supercritical bifurcation. This equation takes into account gradient terms associated with the four-wave interactions, the so-called Lifshitz term and a nonlocal term analogous to that first found by Dysthe for pure gravity waves, as well as the term representing six-wave nonlinear interactions. Within this model we find two branches of solitons and analyze their Lyapunov stability. A stability analysis shows that solitons below the critical ratio are stable in the Lyapunov sense in the wide range of soliton parameters [1]. Above the critical density ratio solitons are shown to be unstable. The nonlinear stage of this instability results in collapse of solitons.

References

[1] Agafontsev D.S., Dias F. and Kuznetsov E.A., *Deep-water internal solitary waves near critical density ratio*, Physica D, **225**, 153-168 (2007).