Nonlinear Instability of Rayleigh-Taylor Waves Subjected to Time-Dependent Temperatures

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The effect of time-dependent temperatures on surface waves is investigated. Nonlinear stability analysis is performed to describe waves propagating along the interface between two fluids in the presence of mass and heat transfer. Due to the presence of periodic forces, resonance interaction is balanced. The use of a multiple-scales method yields different nonlinear Schrödinger equations. Two parametric nonlinear Schrödinger equations are derived in resonance cases. One of these equations has not been treated before. Its stability criteria depending on linear perturbation are derived. A classical nonlinear Schrödinger equation is derived in the nonresonance case. Stability conditions are obtained analytically and investigated numerically. It is shown that the resonance point depends on the external frequency and that, for $\Omega \approx 2\omega$ and $\Omega \approx \omega$, where Ω and ω are the external and disturbance frequency, the external frequency has stabilizing and destabilizing effects, respectively.

Key words: Nonlinear Stability; Mass and Heat Transfer; Periodic Heat; Nonlinear Schrödinger Equation.