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Influence of Wind and Dissipation on the Modulational Instability

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Among phenomena explaining the occurrence of rogue waves, the modulational instability is considered to be of major importance (Kharif & Pelinvosky (2003)). This instability corresponds to the nonlinear evolution of Stokes waves travelling in infinite depth, in the presence of perturbations. While no dissipation is considered, the nonlinear wave train encounters a series of modulation-demodulation cycles, called the Fermi-Pasta-Ulam recurrence phenomenon. Segur *et al.* (2005) revisited the Benjamin-Feir instability when dissipation is taken into account. These authors showed analytically and experimentally, within the framework of Nonlinear Schrodinger equation, that for waves with narrow bandwidth and moderate amplitude, the presence of dissipation stabilizes the modulational instability in the sense of Lyapunov. In the space of wavenumbers, the region of instability shrinks as time increases. As a result, any initially unstable mode of perturbation would finally become stable. This results were later confirmed by fully nonlinear simulations conducted by Wu, Liu & Yue (2006). These results would question the role of modulational instability on the generation of freak waves in open seas.

In a recent work, Kharif *et al.* (2010) revisited analytically Segur's approach, studying the effect of wind on the result described above. Within the framework of the nonlinear Schrodinger equation, they derived a new marginal stability criterion and showed that the modulational instability of the wave group depends on both the frequency of the carrier wave and the strength of the friction velocity (or the wind speed). They gave for fixed values of water surface roughness the marginal curves separating stable states from unstable states. As a result, the occurrence of modulational instability would be possible in open seas. In this work, we investigate numerically this new marginal stability criterion. The fully nonlinear behavior of the wave train and modulation are simulated numerically by means of a High Order Spectral Method (HOS). The effect of wind is introduced in the model through the Miles mechanism (Touboul *et al.* (2008)), whereas dissipation is introduced in accordance with Wu, Liu & Yue (2006). The stable/unstable behavior of the wave train in these conditions is observed, and compared to the marginal stability criterium derived by Kharif *et al.* (2010).

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