# Instabilities of Shallow Water Waves

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## Abstract

In the 1960s, Benjamin and Feir and, independently, Whitham discovered that a Stokes'
periodic wave in deep water would be unstable to long wavelength perturbations, namely
the Benjamin–Feir or modulational instability. In the 1990s, Bridges and Mielke analytically
confirmed the instability. But many important issues remain unanswered, for instance, the
spectrum of the associated linearized operator. I will begin by the modulational instability
in Whitham's model for shallow water waves; it was proposed to explain wave breaking,
combining the dispersion relation of water waves and a nonlinearity in shallow water theory.
But it cannot explain collisions of eigenvalues away from the origin, which the physical
problem does. I will propose a new, full-dispersion shallow water model, which extends
the Whitham equation to allow bi-directional wave propagation. I will discuss the wave
breaking and the modulational instability in the model and announce a preliminary result
on the spectrum of the associated linearized operator.