PHYSICAL MATHEMATICS SEMINAR

Resonant Wave Signature of a Moving Disturbance in a Two-layer Density Stratified Fluid

MOHAMMAD-REZA ALAM

Massachusetts Institute of Technology

ABSTRACT:

This talk is on the problem of resonant (nonlinear) wave generation in the wake of a moving disturbance in a two-layer density stratified fluid. We will show that disturbance wake waves, upon nonlinear interaction among themselves and/or with ambient waves that caused the motion, may generate resonant free waves at the second order as part of a triad of wave components. The resonant wave can form in the upstream or downstream of the disturbance and may propagate toward or away from the disturbance. Evolution of the resonant wave is studied analytically using perturbation theory.

For the more general case of multiple incident and radiated wave components that may be resonantly interacting, a high-order spectral method is developed that can take into account a large number of waves components and arbitrary high order of nonlinear interactions. As an illustration of the effect of multiple resonances, it is shown that nonlinear interaction between a narrow band incident wave and the radiated waves from a moving and oscillating disturbance can result in an isolated high-frequency peak in the downstream spectrum, which may facilitate its quantification by remote sensing. We also show that the sensitivity of resonance offers a useful scheme for precise estimation of ocean physical properties such as density stratification. Finally we show that when a moving disturbance oscillates at multiple frequencies, ensuing multiple wave-wave resonances may lead to energy spread across a broader spectrum, resulting in the loss of information about the body motion; a phenomenon not present in a homogeneous fluid or within the context of linearized theory.

TUESDAY, OCTOBER 26, 2010
2:30 PM
Building 2, Room 105

Refreshments at 3:30 PM in Building 2, Room 290

Massachusetts Institute of Technology

Department of Mathematics
Cambridge, MA