G. Milton Wing Lecture Series

April 2017

WITH GUEST LECTURER

Catherine Sulem, FRSC
University of Toronto

The Dynamics of Ocean Waves

Wednesday, April 5, 5–6 p.m., 1-101 Dewey Hall

PUBLIC LECTURE

The theory of ocean waves has been an important topic of research for more than 150 years due to the significance of the sea in human history. The motion of waves is a very complex phenomenon and its study has applications in every aspect of our lives. This lecture explores how methods of mathematical analysis combined with asymptotic theory and numerical simulations can contribute to a better understanding of propagation and interaction of large amplitude ocean waves both at the surface of the ocean and in its interior, in regular situations as well as in extreme events.

Nonlinear Waves: Solitons and Self-Focusing

Thursday, April 6, 3:30–4:30 p.m., 148 Hutchison Hall (Lander Auditorium)

Nonlinear partial differential equations provide powerful tools to model wave propagation in various physical contexts, such as nonlinear optics, interface dynamics, and plasma physics. A common characteristic of these problems is that they have the form of a Hamiltonian system with infinitely many degrees of freedom. Two main scenarios are central to nonlinear dynamics: on one hand, the formation of coherent structures often called solitons or solitary waves, and on the other hand the possible occurrence of singularity, a process in which a wave field becomes infinite in a finite time. This talk explores these properties for one of the key equations of mathematical physics, the nonlinear Schrödinger equation, which provides a canonical description of wave propagation in weakly nonlinear dispersive media.

Surface Water Waves over a Varying Bottom

Friday, April 7, 1:30–2:30 p.m., 1106A Hylan Building

We examine the effect of a rapidly varying periodic bottom on the free surface of a fluid. We consider the shallow water scaling regime and derive a model system of equations which consists of the classical shallow water equations describing the effective surface wave dynamics coupled with nonlocal evolution equations for a periodic corrector term. A rigorous justification for this decomposition is given in the form of a consistency analysis. The free surface can, however, exhibit the effect of resonances with the periodic bottom, which leads to secular growth and can influence the time interval of validity of the theory. Motivated by the need of analytical tools to address the dynamics of such resonant situations, we consider as a first step, the water wave system with a periodic bottom, linearized near the stationary state, and develop a Bloch theory for the linearized water wave evolution.

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