

Whitham modulation theory in two spatial dimensions and applications

Prof. Gino Biondini

State University of New York at Buffalo
Department of Mathematics

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Abstract

This talk is aimed at presenting an overview of recent results on the development and application of Whitham modulation theory for two-dimensional nonlinear evolution equations, focusing primarily on the Kadomtsev-Petviashvili (KP) equation.

The first part of the talk will be a brief review of the recently-derived Whitham modulation equations for the KP equation and their integrability properties. Next, the talk will discuss the applications of these modulation equations to characterize (i) the stability of the cnoidal wave solutions of KP, (ii) the temporal evolution of soliton stems, (iii) the oblique interactions between soliton stems, rarefaction waves (RWs) and dispersive shock waves (DSWs), and (iv) Riemann problems for the stationary reduction of the KP equation, which describe steady fluid flow past an obstacle.

The last part of the talk will discuss the temporal dynamics generated by wedge-shaped initial conditions in the KP equation. Various asymptotic wave patterns are identified, classified and characterized in terms of the incidence angle and the amplitude of the initial step, which can give rise to either subcritical or supercritical configurations, including the generalization to DSWs of the Mach reflection and expansion of viscous shocks and line solitons, and an eightfold amplification of the amplitude of an obliquely incident flow upon a wall at the critical angle.

Ref: G. Landolfi