Modulation Theory for Line Soliton Interactions

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Abstract

Line solitons are exact solutions of the Kadomtsev-Petviashvili II (KP) equation that are ubiquitous in shallow water, plasmas, and internal waves. Despite this, no general analytical methods for the evolution of their interactions and modulations have been found. This talk will utilize KP soliton modulation theory to model various interactions, such as solitons incident upon inward and outward oblique corners. By interpreting these scenarios as Riemann problems in the modulation variables, we obtain analytical descriptions for line soliton dynamics that are both tractable and numerically verified. In addition, we find that the well-known resonant Y soliton solution to the KP equation can be modeled as a shock solution to an infinite family of modulation conservation laws. This leads to a new interpretation of Mach reflection and sheds light on a related phenomenon which we have termed “Mach expansion”