**Ships Advancing near the Critical Speed in a Shallow Channel with a Randomly Uneven Bed**

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Unlike a transonic flow in compressible aerodynamics, a ship cruising steadily in a channel at nearly the linearized long wave speed generates unsteady wave motion. In a channel of limited width, solitons are radiated periodically upstream. Such waves may have been the cause of a fatal accident at the Port of Harwich, England, and were described by a witness " like the white cliffs of Dover " [Hamer (1999)]. Although noted long ago in tank experiments by [Thews & Landweber(1935)], scientific interest was renewed by laboratory observations of ship-induced solitons by [Ertekin, Webster & Wehausen (1986)].

Upstream soliton due to a slender ship in a channel is a three-dimensional problem. Asymptotic theories have been given by [Mei(1986)] for a thin strut and for a slender ship in a channel with a flat bottom by [Mei & Choi(1987)]. Their study was confined to a narrow channel so that the disturbances both fore and aft are one dimensional. [Choi & Mei(1989)] further studied a wide channel in which the waves in the wake are fully two dimensional and must be treated by the Kadomtsev-Petviashvili (K-P) equation .

In this presentation we examine ship-generated waves in a shallow channel with a randomly uneven bed, when the ship speed is near-critical. The present work is a combination of [Mei(1986)] and [Mei & Choi(1987)] on upstream radiation of solitons over a smooth bed, and of [Mei & Li(2004)] on soliton propagation over a randomly rough bed. Our objectives are to examine how disorder affects the stochastic mean quantities such as the free surface profiles and the wave forces on a ship. Results are discussed for an isolated ship as well as a caravan of identical ships traveling at the same speed. Invoking Boussinesq approximation in shallow waters, it is shown that the wave evolution is governed by an integro-differential equation combining features of Korteweg-deVries and and Burgers equations. For an isolated ship the bottom roughness weakens the transient waves radiated both fore and aft. When many ships advance in tandem, a steady mount of high water can be formed in front and a depression behind. Wave forces on both an isolated ship and a ship in a caravan are obtained as functions of the mean-square roughness, ship speed and the blockage coefficient.

# References

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