Chaotic dynamics in nonlinear waves–computational and physical

Mark J. Ablowitz
Department of Applied Mathematics Box 526
University of Colorado
Boulder, CO 80309, USA
Mark.Ablowitz@colorado.edu

Abstract

Computational chaos associated with a class of nonlinear wave problems with periodic boundary conditions can be generated by truncation or round-off errors. The underlying mechanism for the chaotic dynamics is traced to certain sensitive regimes referred to as homoclinic manifolds. It is found that the dynamics in the neighborhood of these regions execute "homoclinic transitions". This phenomena is also found in physical problems; e.g. water waves and nonlinear optics. In water waves this phenomena is responsible for the experimental irreproducibility of the periodic Stokes wave in deep water. The theory describes the long time dynamics of the Benjamin–Feir instability. Similar scenarios apply to the evolution of modulated periodic waves in nonlinear fiber optics.