Structure-preserving discretizations for Ostrovsky-type nonlocal nonlinear wave equations

Tony Sheu
Department of Engineering Science and Ocean Engineering, National Taiwan University, Taiwan
email: twhsheu@ntu.edu.tw

Abstract:

In this paper a three-step scheme is proposed to solve the Camassa-Holm equation, which contains only the first-order derivative terms, in conservative form. Reduction of the differential equation order facilitates us to develop scheme in a stencilof comparatively fewer points. For accurately predicting the unidirectional propagation of shallow water wave, the modified equation analysis is conducted to eliminate several leading discretization error terms and the Fourier analysis is performed to minimize errors of the wave-like type. In this study, the three-point seventh-order spatially accurate combined compact upwind scheme is developed for the first-order derivative term. For the purpose of preserving Hamiltonian and multisymplectic geometric structures in Camassa-Holm equation, the time integrator should conserve symplecticity. One emphasis of this study of Camassa-Holm equation is to shed light on the conserved Hamiltonian property by the u- P-alpha formulation in simulating the peakon-antipeakon and soliton-anticuspon head-on collision problems. Another aim is to reveal the propagation wave natures of the Camassa-Holm equation subject to different initial wave profiles, whose peaks take the smooth, peakon, and cuspon forms. The transport phenomena for the cases with/without inclusion of the linear first-order advection term in the CH equation will be specifically addressed.