National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: A Unified Framework of Analytical and Local Discontinuous Galerkin Techniques for Nonlinear Partial Differential Equations
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Venue	: Seminar Room, MA dept
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Abstract	: Nonlinear structures have fascinated numerous researchers with their intriguing characteristics observed across a wide range of domains, including physical chemistry, ecology, geochemistry, wave propagation, fluid dynamics, nuclear physics, statistical physics, chemical kinetics, thermodynamics, and quantum mechanics, among others. Nonlinear partial differential and nonlinear evolution equations play a significant role in comprehending the evolution of numerous complex nonlinear physical phenomena in various areas of science and engineering. The present thesis aims to develop and implement an efficient numerical local discontinuous Galerkin finite element method and some analytical techniques, such as the improved G'/G-expansion, the exp(-Q(\xi))-expansion, and the Kudryashov techniques, for solving a class of nonlinear higher-order mathematical models. This thesis is primarily divided into two parts. The first part investigates the analytical and numerical solutions of various second-order, third-order, and third-order mixed derivative nonlinear partial differential and evolution equations, while the second part of the thesis delves into second-order and third-order coupled nonlinear models. The proposed numerical framework incorporates a higher-order total variation diminishing Runge-Kutta scheme and explicit three-stage, four-stage third-order strong-stability-preserving Runge-Kutta discretization schemes for the temporal derivative alongside a discontinuous Galerkin finite element discretization scheme for the spatial derivative. The numerical technique has also been proven to be L2 stable, and an a priori error estimate is acquired for smooth solutions (in some cases) through the careful selection of interface numerical fluxes. Extensive numerical experiments are conducted for some test problems in each chapter to validate the efficiency and applicability of the implemented technique.