Translational AI Center (TrAC) Seminar – Spring 2022

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https://iastate.zoom.us/j/92178103551?pwd=dlNCa2l0ckVBTEVyR1JEN2Y3b21XQT09

Cell-average based neural network fast solvers for time dependent partial differential equations

Abstract

In this talk, we present the recently developed cell-average based neural network (CANN) method for time dependent problems. CANN method is motivated by finite volume scheme and is based on the integral/weak formulation of partial differential equations. A simple shallow feed forward network is applied to learn the solution average difference between two neighboring time steps. Well trained network parameter can be interpreted as scheme coefficients of an explicit one-step finite volume like scheme. While convergence orders are observed, quite a few unusual properties are found with CANN method that are not common to conventional numerical methods. CANN method is found being relieved from explicit scheme CFL restriction on small time step size. Large time step size can be applied which makes the method an extremely fast and efficient solver. CANN method can sharply evolve contact discontinuity with almost zero numerical diffusion. Shock and rarefaction waves are well captured for nonlinear hyperbolic conservation laws. The method has been successfully applied to high dimensional parabolic PDEs and high order PDEs like KdV equations.

Short Bio

Dr. Yan is an associate professor of Mathematics at the Iowa State University. Her research focuses on the development, analysis and implementation of novel numerical methods for PDEs arising in physics and engineering applications. Specifically, her interest is on discontinuous Galerkin finite element method for gas dynamics applications. Her research has been continuously supported by NSF and Simons Foundation. Dr. Yan received her Ph.D from Brown University in 2002 and spent four years as a postdoc at UCLA before joining ISU.