Distinguished Lectures

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Neural Network Methods for Scalar Hyperbolic Conservation Laws

by

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Date: 8 December 2023 (Friday)
Time: 2:00pm – 3:00pm
Venue: Y5-302, Yeung Kin Man Academic Building

ABSTRACT

Solutions of nonlinear scalar hyperbolic conservation laws (HCLs) are often discontinuous due to shock formation; moreover, locations of shocks are a priori unknown. This presents a great challenge for traditional numerical methods because most of them are based on continuous or discontinuous piecewise polynomials on fixed meshes. By employing neural network (NN), recently we proposed two NN-based methods for solving HCLs. One is a space-time approach (least-squares neural network (LSNN) method), and the other is an explicit approach (evolving neural network (ENN) method) that emulates the underlying physics. Both the methods show a great potential to sharply capture shock without oscillation, overshooting, or smearing. The ENN method in one dimension is super accurate and efficient comparing with existing, well-developed mesh-based numerical methods. In this talk, I will give a brief introduction of NN as a class of approximating functions with "moving meshes" and use a simple example to show why the NN is superior to piecewise polynomials on fixed meshes when approximating discontinuous functions with unknown interface. I will then describe both approaches and discuss their pros and cons and related open problems.

~ALL ARE WELCOME~