PLARE SEMINAR

Physics-driven Machine Learning · PDEs · Plasma & Fusion

Neural Networks for Solving PDEs: A Brief Review and Some Recent Explorations

TIME
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PLACE
36-106A

SPEAKER

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ABSTRACT

Partial differential equations (PDEs) are the language of modeling in science and engineering, yet classical numerical solvers are often computationally expensive and struggle with high dimensionality, multi-scale phenomena, and the need to solve repeatedly under varying conditions. Deep learning has recently emerged as a promising alternative, broadly organized along two complementary directions: approximating the solution of a single PDE instance, as in physics-informed neural networks; and learning solution operators that map between function spaces and generalize across an entire family of PDEs, as in neural operators.

In this talk, I will first give a brief and necessarily selective review of these ideas and their fundamental trade-offs—in particular, the tension among optimization difficulty, reliance on simulated data, and computational cost. I will then share a few of our own explorations along this line, which attempt to make physics-driven neural solvers more efficient to train, less dependent on costly simulation data, and more scalable through decomposition and parallelism. I hope to close with some broader thoughts on physics-driven machine learning, and on how such tools might connect to the PDEs encountered in plasma and fusion research.