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Prediction error certification for PINNs: Theory, computation and application

Monday, March 2, 2026 6:18 PM (3 minutes)

We present two residual-based a posteriori error estimators for physics-informed neural networks (PINNs) that are applicable to the approximation of solutions of partial differential equations (PDEs) on complex geometries. Building on the semigroup-based framework introduced previously, we incorporate the concept of input-to-state stability (ISS), or suitable modifications thereof, to quantify how boundary residuals contribute to the overall prediction error. All quantities required by the estimators (semigroup decay rates, ISS gains, etc.) are extracted from a standard spatial discretization of the PDE and its associated operators. The approach is illustrated on two problems: the heat equation on a line, where the required parameters can be verified against analytically derived bounds, and the Stokes flow around a cylinder.

Authors: UNGER, Benjamin (Karlsruhe Institute of Technology); HILLEBRECHT, Birgit (KIT)

Presenter: HILLEBRECHT, Birgit (KIT)

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