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Certifying physics-informed neural networks through lower error bounds

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Physics-informed neural networks (PINNs) bring together machine learning and physical laws to solve differential equations. While Hillebrecht and Unger (2022) provide rigorous a posteriori upper bounds for PINN prediction errors, certification requires complementary lower bounds to establish complete error enclosures. In this paper, we derive computable a posteriori lower bounds for PINN errors in ODEs under strong monotonicity conditions. These bounds rely solely on the neural network approximation and the ODE residual, requiring no a priori knowledge of the true solution. This work gives fully certified error bands for nonlinear ODEs and for linear ODEs satisfying structural assumptions, providing robust bounds without needing a lot of training data.

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