Physics-informed multi-fidelity neural networks for parameter estimation in low-data or large-noise regimes

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We present a multi-fidelity approach for the estimation of partial differential equations (PDEs) parameters from limited and noisy data. The proposed method combines a low-fidelity solution, approximated by a first artificial neural network (ANN) trained on a dataset based on numerical simulations of a parametrized PDE, with a correction term provided by a second physics-informed ANN. This latter is trained by minimizing the distance of the ANN output from the available data and a regularization term based on the PDE residual. We perform numerical experiments based on an advection-diffusion-reaction equation, a parabolic equation, and the Bueno-Orovio ionic model. In particular, we test different configurations characterized by partial and noisy data. Numerical results show that the developed multi-fidelity strategy provides a flexible and efficient approach for solving optimization problems: it improves both the convergence speed and the accuracy in estimating unknown parameters.

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