APPROXIMATION THEORY AND CLAUDIO HELP: A CERTIFIED WAVELET-BASED PHYSICS-INFORMED NEURAL NETWORK

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Abstract. Physics Informed Neural Networks (PINNs) have frequently been used for the numerical approximation of Partial Differential Equations (PDEs). In this talk, we present recent work on loss functions for PINNs along with a computable upper bound of the error, which is particularly relevant for model reduction of Parameterized PDEs (PPDEs). To this end, we suggest to use a weighted sum of expansion coefficients of the residual in terms of an adaptive wavelet expansion both for the loss function and an error bound. This approach is shown for PPDEs using both the standard variational and an optimally stable ultra-weak formulation, which allows for a representation of the error in terms of an appropriate dual norm of the residual. This approach is also suited for wave-type PDEs. Numerical examples show a good quantitative effectivity of the wavelet-based error bound.

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