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Feature-adjacent multi-fidelity physics-informed machine learning for partial differential equations

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Physics-informed neural networks have emerged as an alternative method for solving partial differential equations. However, for complex problems, the training of such networks can still require high-fidelity data which can be expensive to generate. To reduce or even eliminate the dependency on high-fidelity data, we propose a novel multi-fidelity architecture which is based on a feature space shared by the low- and high-fidelity solutions. In the feature space, the projections of the low-fidelity and high-fidelity solutions are adjacent by constraining their relative distance. The feature space is represented with an encoder and its mapping to the original solution space is effected through a decoder. The proposed multi-fidelity approach is validated on forward and inverse problems for steady and unsteady problems described by partial differential equations.