
SALAH IDBELOUCH, Polytechnique Montréal

Separable PGD-Based Solution Approximations of Parametric PDEs Using Physics-Informed Neural Networks

Solutions of parametric initial and boundary-value problems using deep-learning approaches, such as Deep Operator Networks (DeepONets) or Green Operator Networks (GreenONets) [Aldirany et al., CAMWA, 159, 21-30, 2024] have been proposed in recent years. However, achieving high accuracy in the approximations obtained from these methods often remains a significant challenge. In this work, we consider neural-network formulations based on separable representations of the solutions and train them with PGD-like optimization. PGD-like techniques in deep learning were introduced by Ghnatios and Chinesta [Mathematics, 12, 2365, 2024]. We build on this idea, examine several variants of the alternating training strategy, and evaluate their efficiency in terms of accuracy and computational cost. The methodology is further combined with the multi-level neural-network approach [Aldirany et al., CMAME, 419, 116666, 2024] to reduce numerical errors. Numerical examples on representative model problems demonstrate the efficiency of the proposed method.