A Descent Algorithm for the Optimal Control of ReLU Neural Network Informed PDEs Based on Approximate Directional Derivatives

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We propose and analyze a numerical algorithm for solving a class of optimal control problems for learning-informed semilinear partial differential equations. The latter is a class of PDEs with constituents that are in principle unknown and are approximated by nonsmooth ReLU neural networks. We first show that a direct smoothing of the ReLU network with the aim to make use of classical numerical solvers can have certain disadvantages. This motivates us to devise a numerical algorithm that treats directly the nonsmooth optimal control problem, by employing a descent algorithm inspired by a bundle-free method. Several numerical examples are provided and the efficiency of the algorithm is shown.

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