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Multiscale Neural Networks for Approximating Green's Functions

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Abstract: Neural networks have been widely used to solve partial differential equations (PDEs) in the applications of physics, biology, and engineering. One effective approach for solving PDEs with a fixed differential operator is learning Green's functions. However, Green's functions are notoriously difficult to learn due to their poor regularity, which typically requires larger NNs and longer training times. In this talk, we address these challenges by leveraging multiscale NNs to learn Green's functions. Through theoretical analysis using multiscale Barron space methods and experimental validation, we show that the multiscale approach significantly reduces the necessary NN size and accelerates training. We also discuss the potential application of this framework for solving Helmholtz equations.

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