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**A Machine-Learning Method for Time-Dependent Wave
Equations over Unbounded Domains**

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Time-dependent wave equations represent an important class of partial differential equations (PDE) for describing wave propagation phenomena, which are often formulated over unbounded domains. Given a compactly supported initial condition, classical numerical methods reduce such problems to bounded domains using artificial boundary conditions (ABC). In this work, we present a machine learning method to solve this equation as an alternative to ABCs. Specifically, the mapping from the initial conditions to the PDE solution is represented by a neural network, trained using wave packets that are parameterized by their bandwidth and wavenumbers. The accuracy is tested for both the second-order wave equation and the Schrodinger equation, including the nonlinear Schrodinger. We examine the accuracy from both interpolations and extrapolations. For initial conditions lying in the training set, the learned map has good interpolation accuracy, due to the approximation property of deep neural networks. The learned map also exhibits some good extrapolation accuracy. Therefore, the proposed method provides an interesting alternative for finite-time simulation of wave propagation.