Solving Nonlinear Schrödinger Equations Using Improved Physics-Informed Neural Networks

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This paper proposes an innovative Physics-Informed Neural Network (PINN) architecture that integrates adaptive activation functions and Latin Hypercube Sampling, significantly enhancing the efficiency of solving complex mathematical-physical problems [1]. The improved framework has been successfully applied to solve the three-dimensional nonlinear Schrödinger equation, accurately simulating the propagation dynamics of optical pulses in nonlinear media and capturing their evolution across spatial and temporal scales [2].

The enhanced PINN demonstrates superior convergence and computational efficiency. The stable reduction in loss indicates its effectiveness in learning physical laws and performing data fitting. Key innovations include: physics-constrained layers that ensure compliance with fundamental physical principles; a multi-objective loss function for balancing constraints; and efficient computation for high-dimensional problems. This work provides a powerful tool for modeling optical pulse transmission, studying soliton dynamics, and simulating wave propagation [3].

References

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