## Solving The Time-Dependent Schrödinger Equation Using Mimetic Differences

The time-dependent Schrödinger equation (TDSE) is a cornerstone of quantum mechanics, describing the temporal evolution of quantum systems. Analytical solutions to the TDSE are limited to a small class of problems, typically those with highly idealized or simplified potential functions. However, many practical quantum systems, such as those involving complex interactions or external potentials, do not admit exact analytical solutions. In such cases, numerical methods are essential for accurately modeling the behavior of these systems.This study uses mimetic finite difference operators using the MOLE library to solve the TDSE with arbitrary orders of accuracy. These operators are designed to preserve key physical properties, such as conservation laws, which are crucial for maintaining the fidelity of the simulation. By comparing our numerical results to known analytical solutions, we demonstrate the effectiveness and precision of the mimetic approach by achieving an infinity norm of 0.6%, offering a robust and flexible tool for exploring complex quantum dynamics beyond the reach of traditional analytical techniques.


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$$-i\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \omega(x,y)u$$

$$u(x,y,0) = x^2 y^2$$

$$u(0,y,t) = 0,$$
$$u(1,y,t) = y^2 exp(it),$$
$$u(x,0,t) = 0,$$
$$u(x,1,t) = x^2 exp(it)$$

$$\omega(x,y) = 1 - \frac{2}{x^2} - \frac{2}{y^2}$$