

SimuPhys: An Interactive Toolkit for Visualizing Classical and Quantum Physics Simulations

Abstract:

SimuPhys is an open-source, interactive simulation toolkit designed to visually demonstrate key physics phenomena across classical and quantum domains. The project focuses on making complex concepts accessible through user-driven, dynamic visualizations built with Python.

The toolkit covers vector field operations like gradient, divergence, and curl, time-evolving solutions of the Schrödinger wave equation, and simulations of electromagnetic waves and Laplace's potential fields. Classical dynamics are explored through rich visual models of forced, damped, and undamped oscillations, as well as projectile motion with air resistance. A dedicated module simulates RLC circuits, visualizing transient responses and phase relationships. Furthermore, the toolkit features a Quantum Fourier Transform visualizer, leveraging IBM's Qiskit to demonstrate fundamental concepts of quantum computation.

The application is built using Python with libraries such as Plotly, NumPy, SciPy, Matplotlib, SymPy, Qiskit, and PyQt5 for a modular local GUI and may use Streamlit for Web-based GUI wherever required. All modules utilize exclusively open-source technologies to support transparency and accessible physics education.

Category: Undergraduate (UG) – Simulations & Visualization in Physics

Proposed Tools: Python, Plotly, Qiskit, Matplotlib, SciPy, SymPy, PyQt5 (for GUI)

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