



A strong-coupling, multiphysics and AI-aware simulation library

IDP or Semester Project: Build an AI-Assisted Natural Language Interface for Multi-Physics Simulation

Project Overview and Goal

Would you like to work at the intersection of simulation, artificial intelligence, and software engineering? In this project, you will help make advanced multi-physics simulation easier to use by developing a natural language interface that can translate user intentions into validated simulation settings.

The project focuses on the open-source Python simulator **SPHinXsim**, which provides an LLM and Python interface for the C++ multi-physics library **SPHinXsys**. Instead of manually writing complex configuration files, users should be able to describe a simulation task in natural language and obtain structured, reliable settings that can be checked, edited, visualized, and eventually used by the simulator.

What You Will Do

- **Design a structured JSON-based domain-specific language for simulation settings.**
- **Explore how large language models can generate and modify simulation configurations.**
- Use Pydantic to validate the structure of generated settings.
- Develop semantic validation methods that check whether generated settings are physically and logically meaningful.
- Create a workflow that supports both direct editing and AI-assisted interaction with simulation setups.

What You Will Learn

This project offers hands-on experience with LLM-based interfaces, JSON schema design, Python software development, validation strategies, and modern simulation workflows. It is well suited for students interested in computational engineering, scientific machine learning, AI-assisted software tools, or open-source simulation.

References: To explore SPHinXsys and SPHinXsim, please visit the repository:
<https://github.com/Xiangyu-Hu>