

Domain decomposed Agentic RAG-based pipeline for OPENFOAM case synthesis.

Abstract Submitted by
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Abstract

This presents an automated **OpenFOAM** case generation pipeline using an **RAG**-based (Retrieval-Augmented Generation) framework. The primary objective of this work is to reduce the manual effort involved in setting up **OpenFOAM CFD** simulations by integrating **LLMs** (Large Language Models) with structured domain data extracted from OpenFOAM tutorial cases. The system consists of a multi-agent pipeline comprising various components for solver detection, case planning, document retrieval, generation and validation. The retrieval system is implemented through **FAISS** vector stores. The database is created using the default OpenFOAM tutorial files and is properly classified into five types based on their relative sizes and functionality within the OpenFOAM case. Since the system uses a stateless LLM for generation, the quality of the files generated would depend on the underlying LLM. The results demonstrate that the pipeline is capable of generating minimal, solver-runable cases for a range of incompressible flow problems. This work highlights the potential of combining retrieval-based techniques with generative models to develop intelligent engineering tools, thereby improving **accessibility** and **automation in CFD workflows**.

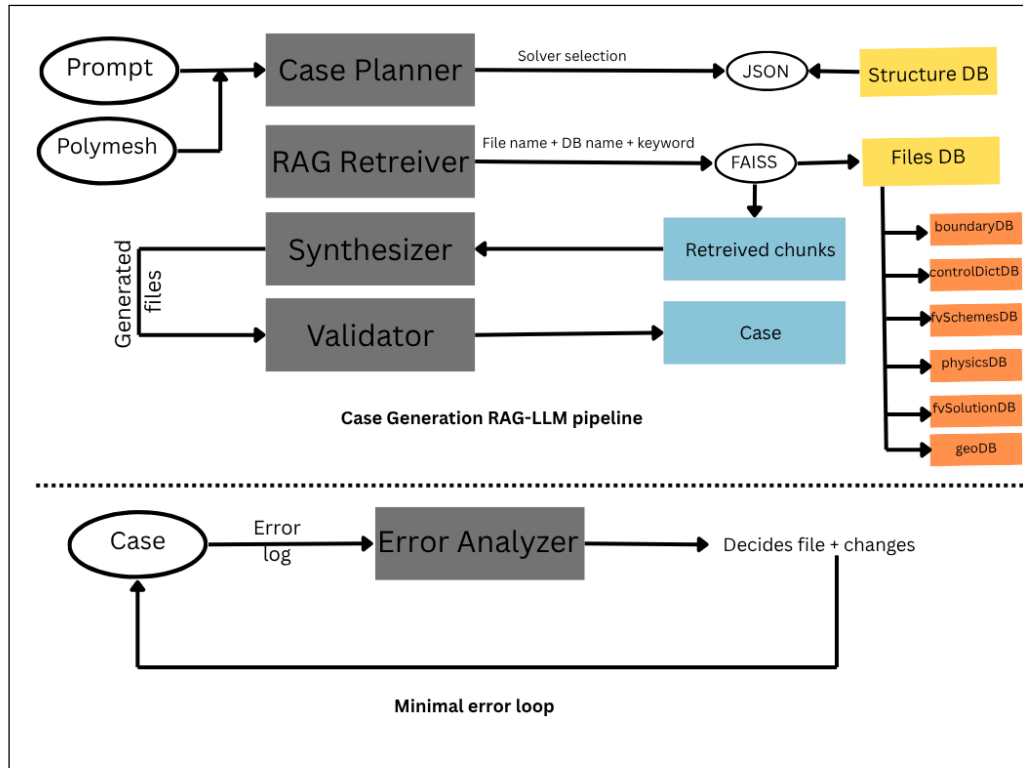


Figure 1: Architecture of the system