Large Language Model (LLM)-based agent for CFD

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This presentation explores the development of a Large Language Model (LLM)-based agent to advance Computational Fluid Dynamics (CFD) workflows. CFD simulations often involve intricate configurations, including solver selection, boundary condition setup, and iterative adjustments, which require substantial expertise and manual effort. The proposed LLM-CFD framework integrates natural language processing capabilities with CFD tools, such as OpenFOAM, to assist users in navigating these complexities more efficiently.

The LLM agent employs retrieval-augmented generation (RAG) on domain-specific datasets to provide accurate, context-aware guidance. Key functionalities include interactive solver configuration, adaptive parameter optimization, and error diagnostics, allowing users to focus on analysis and decision-making. Reliability is a central focus of this work, addressing challenges such as potential hallucinations and uncertainty in LLM-generated outputs. The framework incorporates validation mechanisms and benchmarks to ensure dependable performance.

The integration of LLM technology into CFD workflows has the potential to enhance productivity by automating routine tasks, reducing human error, and improving accessibility for non-specialists. It also provides opportunities for interdisciplinary collaboration by bridging the gap between domain experts and computational tools. The presentation will highlight use cases demonstrating the agent's capabilities, discuss methods to mitigate reliability risks, and outline future directions for applying LLMs in CFD research and industry.

This work aims to contribute to the ongoing discourse on AI applications in CFD, fostering innovation in simulation-based engineering and expanding the scope of fluid dynamics research.