Chair of Computational Modeling and Simulation
TUM School of Engineering and Design
Technical University of Munich

Modeling:	
Mathematics:	
Programming:	
Science:	

Software Lab:

Festo Plant for Discrete Manufacturing
Developing Simulation Models for Industrial Copilots

Description

The project proposal focuses on developing advanced simulation models for industrial copilots at the Festo Plant for Discrete Manufacturing (DM). The main objective is to enhance production efficiency and decision-making through precise simulations of forces applied on drilling tools, from which the energy consumption by the drilling process can be estimated. The project involves thorough research on empirical or simplified models, considering various factors such as workpiece material, drill tool specifications, and operational dynamics like speed and depth of the drill. Force and energy models are typically to be developed in Python and packed in a standardized format, e.g. Docker Containers or Function Mockup Units (FMUs). By leveraging the agent reasoning capabilities implemented in LangChain, the simulations may be integrated seamlessly with GenAI-based industrial pilots as *agentic tools*. This will allow the language models to reason and execute the necessary actions for real-time data processing, simulation and optimization without hardcoding an execution sequence.

A key component of this initiative is developing a comprehensive logic to estimate energy consumption during manufacturing processes. This logic will utilize insights gained from the empirical studies to predict and optimize energy use, supporting sustainability and cost-reduction goals.

The project also incorporates the development of a natural language interface through which the industrial copilot can configure, execute, and interact with the simulation results. This interface will significantly improve user interaction, making advanced simulation tools more accessible to operators without extensive technical backgrounds. Key features of this interface include the ability to ask questions related to energy requirements and the impact of different manufacturing setups on energy consumption. Through this intuitive communication platform, the copilot will engage in meaningful dialogues with the simulation tools, providing real-time insights that drive strategic decisions and enhance overall productivity.

Task

GENERAL INSTRUCTIONS:
- Research empirical or simplified models to estimate forces on drilling tools based on workpiece material, drill tool, drilling speed and drill depth
- Develop a logic to estimate the energy consumption of the manufacturing process
- Use LangChain to develop agentic simulation tools to be coupled with a GenAI-based industrial pilot*
- Copilot tasks: configure, execute, interact and interpret simulation results through natural language

Supervisor

Mohamed Khalil, Siemens AG, khalil.mohamed@siemens.com

References