DEVELOPMENT OF AN ACCURATE PROCESS WORKFLOW FOR SIMULATION OF A GAS LIQUID CYCLONE SEPARATOR IN AN OPEN-SOURCE ENVIRONMENT

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Cyclone separation is a technique to separate particulate matter or a given gaseous phase from a fluid jet using rotational effects and gravitational forces. They are employed in sawmills, oil refineries, cement industries and is also the fundamental principle of several everyday appliances such as vacuum cleaners. The widespread utilization of Cyclone separators has prompted a deeper understanding of an otherwise complex phenomena. With the advent of advanced CFD approaches and enhancement of computational resources, fluid flow in a cyclone separator can be understood beyond basic analytical methods such as Stokes' law. The paper discusses the intricacies of generation of a process work-flow for 3D fluid flow simulation in a Gas Liquid Cylindrical Cyclone Separator (GLCC) using open-source environment such as Salome, OPENFOAM and Paraview. The main idea is to generate a robust work-flow which addresses the uncertainties in the boundary conditions, turbulence models and other flow parameters, thereby seeking to achieve improved correlation between experiment and CFD simulation. The process includes several stages of complexity identification, model evaluation, simplified model development and Best FIT design identification. The overall results show highly accurate agreement between experiment and simulation and could pave way for greater understanding of the physical phenomena in GLCC separator. Moreover, the implemented methodology is designed to serve as a benchmark for design development and flow optimization studies.

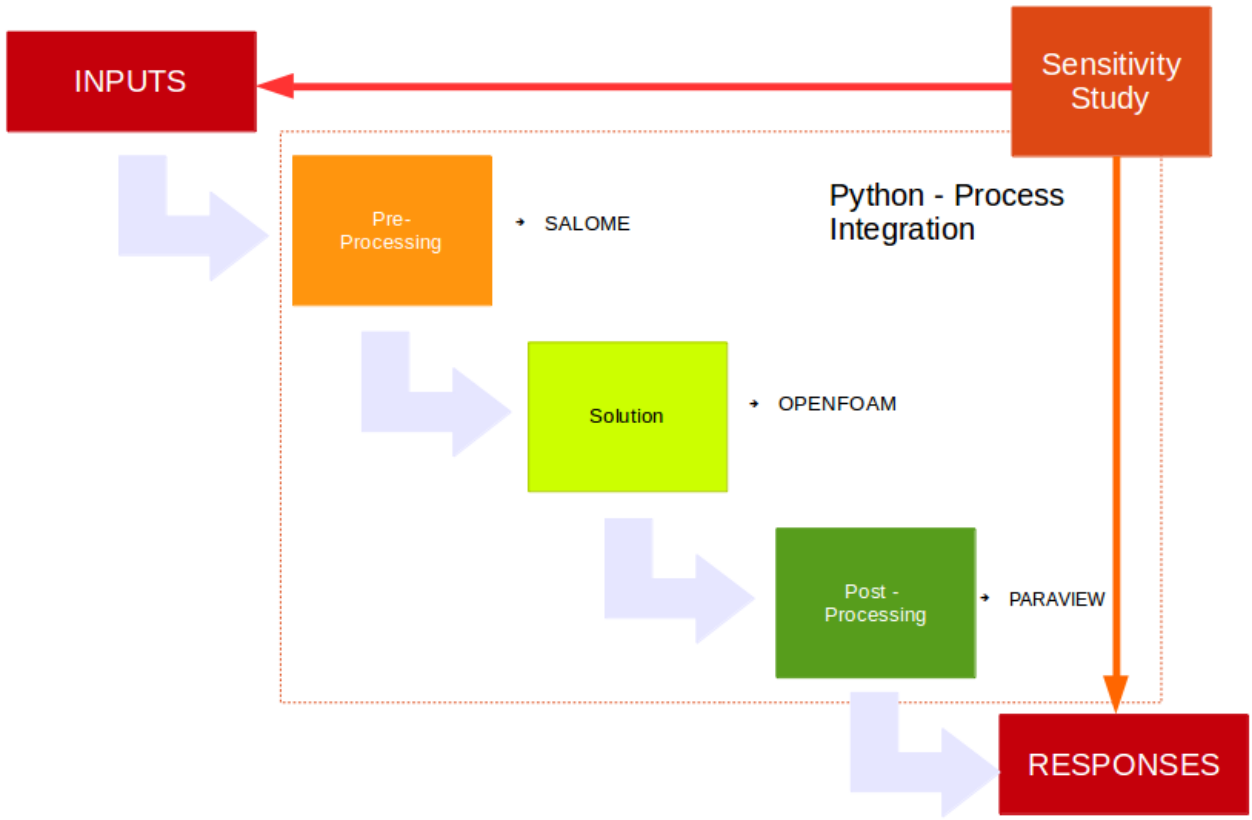

Figure 1: Process Flow Chain for 3D GLCC Simulation

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PROCESS DESCRIPTION

The current proposal aims to create a stable and accurate workflow for simulation of a Gas Liquid Cylindrical Cyclone Separator. The study carefully scans through the various stages of a numerical fluid dynamics simulation process with special focus being on arriving at appropriate turbulence models for the current application. The basis of the workflow is the correlation of simulation results in open-source environment with experimental results and results from commercial software. Since the focus is on achieving reliable results with open-source tools, the various steps of a numerical simulation, i.e. Pre – processing, Solver and Post – processing, are all executed using open-source software such as Salome, OPENFOAM and Paraview respectively. Additionally, the current study delves deeper in the domain of Parameter Calibration through a Sensitivity study using numerical optimization software Dakota to determine the error deviation of resulting simulation values with experimental results. In the defined design space, a locally optimized or best fit design is found out and the resulting optimized parameters are furnished.