Visualizing Fluid Dynamics Simulation in High-Performance Automotive Vehicles

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§1. Estimate the percentage of the overall project you have completed thus far.

The project is currently estimated to be 25% complete. This assessment is based on the substantial preliminary work of sourcing and preparing CAD models for computational fluid dynamics (CFD) simulations, which forms the groundwork for all subsequent project phases. The acquisition of these CAD models is a foundational step that allows the project to transition from its preparatory, preprocessing stage into the core simulation and visualization phases.

§2. What have you completed?

Below is an itemized list of milestones we have completed thus far:

1. Project Planning and Design — we completed the comprehensive planning and design phase of the project, which included defining the project's scope, objectives, and significance. This phase was crucial for establishing a clear roadmap and setting the stage for the technical work ahead.

2. Sourcing CAD Models — we have successfully sourced 9 different CAD models of iconic Formula 1 racing cars and the high-performance Porsche 911 from 1963—all procured from the internet. These models will prove essential for conducting accurate and meaningful CFD simulations, which will form the basis of our study.

3. Software Familiarization — we have begun to familiarize ourselves with `OpenFOAM`, the primary software tool for simulation. This step is crucial for ensuring that we can effectively utilize this tool to simulate fluid dynamics and create detailed visualizations. We have set it up on our systems and got it to run for some simple datasets. The usage of this software was not very straightforward and consumed quite sometime to set up.

§3. Create a list of what still needs to be done on the project and estimate the effort each item will take to complete.

The project's roadmap from this point forward includes several key tasks, each with its own set of challenges and required effort. Since we are a group of two, certain activities planned to be undertaken concurrently to optimize project timelines and resources.

1. `OpenFOAM` Initial Simulations — we need to complete our proficiency in using `OpenFOAM` for simulating fluid flow around the vehicle CAD models. This includes setting up the simulation environment, importing vehicle models, and running preliminary simulations. Effort: high, estimated time: 1 week.

2. Visualization Process with `Paraview` — starting the process of translating the raw simulation data into visual formats with `Paraview`. This task involves developing techniques for visualizing vector fields, pressure distributions, and vortices to highlight aerodynamic features. Effort: high, estimated time: 1 week.

3. Comprehensive Simulations and Visualizations — completing the simulations and visualizations for all vehicles, analyzing results, and developing dynamic visualizations that compare aerodynamic behaviors. This step is critical for achieving the project's objective of elucidating airflow interaction with vehicle surfaces. Effort: high, estimated time: 1 week.

4. Final Project Report — we will compile a comprehensive final report detailing the methods used, findings, visualizations, animations, and conclusions regarding the project. Effort: medium, estimated time: 3-4 days.

§4. Have you had to make any changes in your project description? If so, please list and justify the changes.

No changes have been applied to the project description as initially outlined in its design report. The project continues to focus on leveraging computational fluid dynamics (CFD) simulation with `OpenFOAM` and visualizing the results in `Paraview` to study the interaction between airflow and the surfaces of high-performance automotive vehicles.

§5. Any additional information?

N/A.