CFD Visualization Using Augmented Reality

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Research Question

How can visualization using augmented reality be used to examine the development of flow parameters around an object?

Introduction

When flow across an object is studied, several properties of the flow can be computed using different numerical solvers. However, interpreting and visualizing this flow process rather remains a little difficult. As a result, Augmented Reality (AR) visualization has gained popularity amongst researchers in various fields to visualize large data sets. This helps understand complex phenomena by getting an interactive and immersive experience. In this project, flow past a propeller is studied.

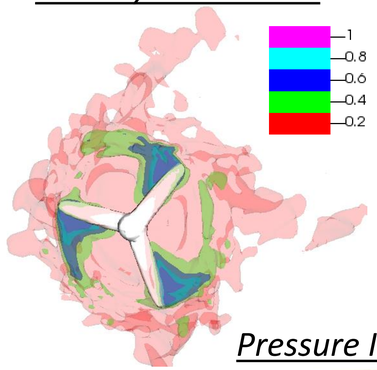
Methodology

The model for the propeller is first created in SolidWorks and the mesh for the surface is created using Gmsh. Using this, simulations are performed in the laminar regime using the NGA flow solver on Agave supercomputer. Data is exported to VisIt where iso-contours of velocity, pressure, and vorticity are constructed. These models are then exported to Blender where the models are rendered, and surface colors are assigned. The results are then imported into Unity, where the Augmented Reality visualization is set up and customized as desired.

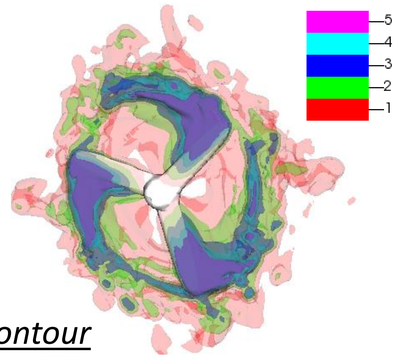
Data and Results

Below shown are the iso-contours of velocity, pressure, and vorticity. Each color represents a certain magnitude for a given parameter.

Velocity Iso-contour



Vorticity Iso-contour



Pressure Iso-contour

QR codes shown can be used to view AR visualizations:

Velocity | Vorticity | Pressure | Combined

Conclusions and Future Work

As seen, the Augmented Reality visualizations of the iso-contours helps get a better understand of the process taking place. Using this in industries can help in optimizing and understanding complex designs. Incorporating the theme of education, such visualization techniques would be beneficial in outreach programs, where eager students can be exposed to Fluid Mechanics concepts and widen their scope of knowledge. Building on this visualization, the next step would be to generate models for a range of time-steps and examine the changing iso-contours as a movie in AR. Then using similar methods, complex models can be analyzed.

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