# Why Not Blender? Comparative Study of Blender and ANSYS for Educational Airflow Modeling

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## Introduction

In the world of computational fluid dynamics (CFD), high-fidelity simulation software such as ANSYS Fluent has been the gold standard. Yet, these advanced tools are characterized by unrealistic learning curves and out-of-reach pricing of tens of thousands of dollars and requiring membership in an institution to access. Conversely, Blender, a free, open-source 3D modeling package, includes fluid simulation functionality that is exploited almost exclusively by digital artists. This project poses a simple question: If a company like Pixar can simulate realistic airflow for animation, why can't engineers utilize similar streamlined tools for educational purposes that don't require the greatest precision?

As an undergraduate engineering student with absolutely no experience in Blender or ANSYS, I learned both from scratch. Through the use of online tutorials, community forums, ChatGPT, and the expert guidance of Dr. Nolan, I was able to simulate Von Kármán vortex shedding from a cylinder on both software packages. The objective was not only to compare their outputs in physical accuracy but also to evaluate their accessibility, learning curves, and integration into educational curricula. What began as a technical review evolved into more of a detailed exploration of the way that software design and associated cost influence learning access and airflow simulation.

## Objectives and Methodology

The primary goal of this project was to determine whether Blender, a free and open-source 3D animation software, can serve as an affordable substitute for traditional engineering software like ANSYS Fluent for airflow simulation in education. More specifically, the project aimed to evaluate the usability, accuracy, and overall learning experience of both software packages in simulating the Von Kármán vortex street generated by flow over a cylinder.

My procedure for each platform was as follows:

Blender:

1. I began by importing a pre-existing airflow domain mesh and appending a solid cylinder.
2. Through trial, error, and tutorials I learned how to simulate the fluid flow around the cylinder using Blender's built-in physics software
3. Blender does support vector field visualizations but to plot airflow velocity at the tail of the flow, I exported these results as VDB (volumetric) files.
4. These were then imported in to paraview to get vector field data, converted to CSV files through a python script created on ChatGPT, and finally plotted into MATLAB through X, Y, Z coordinates and a velocity magnitude.
5. Afterwards, this was replicated with an airfoil to prove this method's reliability.

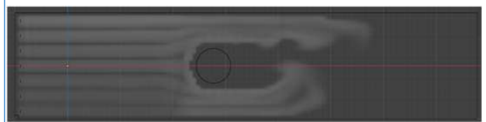
ANSYS Fluent:

1. I followed a Youtube tutorial to generate a Von Kármán vortex around a cylinder where I meshed and defined boundary conditions.

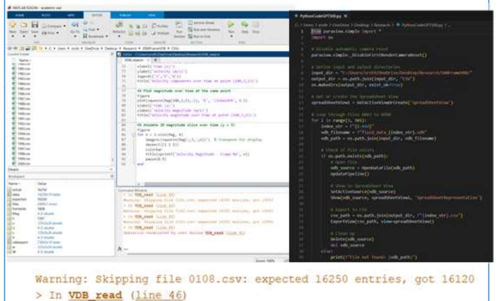
   There was another tutorial that provided instructions on creating a velocity plot in ANSYS Fluent's post-processing environment. Unlike Blender, ANSYS had built-in functionality for graphical data exportation; nevertheless, the overall experience was based significantly on compliance with certain procedural steps with little room for intuitive discovery.

Throughout the course of my research, I scrupulously timed the time, effort, and amount of conceptual knowledge needed to generate comparable outputs within various packages of software. Blender was far more easy to investigate on my own, as much of its functionality could be unraveled through experimentation with its interface. ANSYS was akin to entering a locked room without a key; without explicit tutorials, advancement was nearly impossible. By directly comparing the two tools in terms of quality of output, accessibility, and potential for learning, this project demonstrates how free, intuitive tools like Blender can make it possible for more students to engage with difficult physical concepts—

## Blender



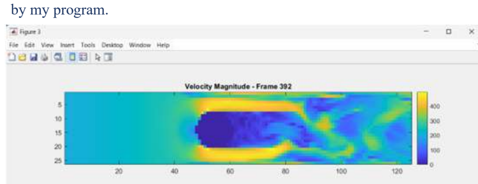
Original view of Von Kármán vortex on Blender software's physics engine.



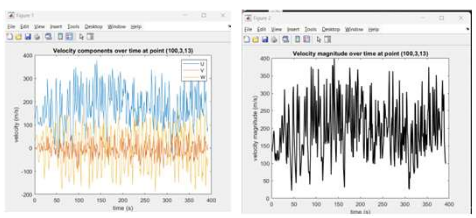

*(Left)* Code developed by Dr. Nolan alongside myself in order to plot velocity on MATLAB.

*(Right)* Through the use of ChatGPT, I was able to convert VDB files from Blender to CSV files that could be imported to python.

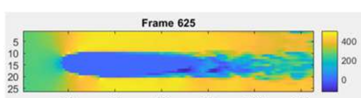
*(Bottom)* After receiving errors, I was forced to remove 108 VDB files that were too small through alterations in the code through ChatGPT. The code it produced was able to weed out files that were too small to be read by my program.




Von Kármán vortex viewed through MATLAB.

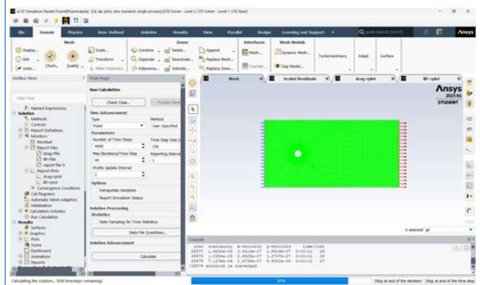



Airflow velocity plot (X,Y,Z) Airflow velocity plot (magnitude)

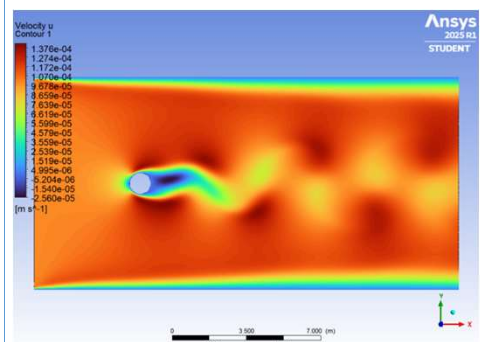



Recreation of alternate vortex with NACA 2412 airfoil.

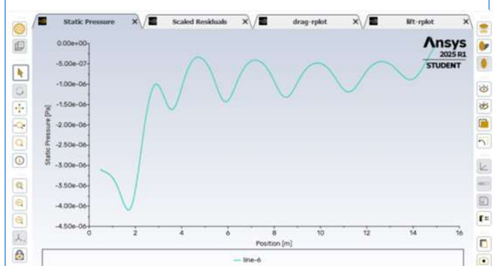
## Ansys



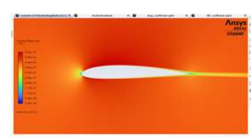
Creation of the mesh for the cylindrical hole.




Von Kármán vortex viewed through ANSYS.




Airflow velocity plot on ANSYS



Recreation of alternate vortex with NACA 2412 airfoil.

## Conclusion, Limitations, and Future Work

This project aimed to compare Blender and ANSYS Fluent as simulation software for airflow around objects, specifically with educational accessibility in mind. The outcomes were revealing: though both programs yielded recognizable Von Kármán vortex patterns, it was clear that ANSYS offered more realistic and detailed velocity field plots. The built-in graphing capabilities, solver transparency, and engineering-grade accuracy render ANSYS the more trustworthy option for professional or research-level simulations.

That said, Blender provided a more enjoyable and exploratory experience. Its GUI gave me great learning opportunities, albeit time-consuming, and enhanced my learning experience of airflow behavior, vector fields, and data wrangling. Blender's totally free and open-source status eliminates a significant barrier to entry for students or institutions that lack access to professional software.

The procedure was with real difficulties. ANSYS runtime was around 2 hours on my personal laptop, and the process of converting Blender's VDB simulation data into CSV files for plotting included ParaView and MATLAB and took over 5 hours. Both environments required persistence but in different ways: ANSYS required strict tutorial following, while Blender required creative problem-solving and trial-and-error.

This comparison is not flawless. Blender simulations are intended to be visually realistic, not scientifically precise, and the physics engine does not provide clear solver details. My procedures are less than optimal for high-accuracy research or large data sets. Further, the research was restricted to two geometries (airfoil and cylinder), and simulation validation was qualitative rather than quantitative.

Most significantly, the use of Blender in early engineering education would allow students to comprehend complex concepts of fluid dynamics without being limited by software limitations. In brief: ANSYS can be the gold standard, but Blender is the on-ramp and sometimes the best way to learn is to take the scenic route

## References

This project would not have been possible without the guidance and support of several individuals:

•**Dr. Kevin Nolan** – for his flexibility, patience, and the roadwork that made this project possible. His vast knowledge of every software imaginable was instrumental from start to finish.

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•**Orly Zuckerman** – for technical assistance with Blender's physics engine and simulation behavior, especially in the early learning stages.

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