

Thesis Project Portfolio

Optimization of a Formula SAE Vehicle Intake Manifold

(Technical Report)

Navigating the Road Ahead: The Paradigm Shift from Internal Combustion Engines to Electric Vehicles

(STS Research Paper)

An Undergraduate Thesis

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In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Department of Mechanical Engineering

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Prospectus

Executive Summary

With the environmental effects of human technologies continually growing, one of the largest problems the modern world faces is finding more efficient forms of technology to combat global warming. Cars and the transportation sector alike account for a large portion of greenhouse gas emissions. With environmentally friendly technologies now in the public spotlight, how will the transportation sector change in the near future? We already see this change beginning as a new form of transportation has begun to arise, electric vehicles. However, many internal combustion engines have become highly optimized and provide better gas mileage.

The research paper in this portfolio will look into the growth of the electric vehicle market, and its projected future in order to answer the question, is it worth iterating on traditional internal combustion engines or should our resources be used towards spurring the electric vehicle movement forward? By applying Kuhn's framework of paradigmatic shifts in emerging technologies to our social technical problem, we can determine when electric vehicles will replace their internal combustion engine predecessors. Looking into scholarly papers, blogs, and public polls we can begin to analyze how the electric vehicle market has grown in recent years. In conjunction with that research, a look into government policies and automotive manufacturers will help us to understand what path electric vehicles will be taking in the near future. Once all of this information is analyzed and considered, an answer to whether or not iterating on current internal combustion engines can be made.

Formula SAE is a national competition in which colleges across the country design, build, race, and test their cars each year. For my senior design project, myself, and a group of 4 other mechanical engineering students designed, tested, and manufactured a new intake system for the UVA formula one car. The technical section of this portfolio will be a report on this project. To create a new intake, there were three components that needed to be redesigned. To comply with formula one guidelines, our intake must have a restrictor. This acts to limit the airflow into the engine and reduce the power it can produce.

A restrictor is required for safety reasons so that students are not driving at unsafe speeds. The restrictor attaches to the plenum which is the second part in our design. The plenum is a large body that has two main functions. It mixes air and gas together to create an optimal solution for the pistons inside the engine to fire. The plenum also creates a more laminar flow into the runners to force as much gas and air into the piston on each revolution. The final part in this system is the runners. They are fed an air gas mixture by the plenum and are what connects the system to the piston valve. Runner geometry can also be optimized by changing its geometry to increase the flow rate into each piston. The goal of the technical project was to design a new system that was lighter, stronger, and would be more optimized to create the maximum power output for our engine.

The work that I have done in this portfolio has proved to be very valuable to myself, and I hope to whomever may read this. By creating and optimized the intake system of an internal combustion engine I know first-hand how many resources and how much time it can take. I never want to work on something I don't think will matter and it made me wonder how long processes like the one in my technical report will be around for. Looking into the electric vehicle market and analyzing when we may shift away from our current form of technology was a way for me to value the work I have been doing. To offer any advice to future researchers, analyze other systems in the car besides the intake. This may lead to some insights that I had not seen as I was so focused on that specialized area of the combustion engine. I would also advise that when looking into the electric vehicle market to look outside of the United States, as I was mainly focused on policies and market growth within this country.