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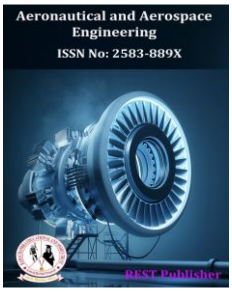


# Combustion Based Fluidic Propulsion System: A Novel Approach to Integrated Wing Propulsion

**Dhanush S, Udhayaprakash M, *J. Arivudainambi**
*Adhiyamaan College of Engineering, Hosur, Tamil Nadu, India.*
*Corresponding Author Email: nambiresearch@gmail.com

***Abstract:*** *This paper presents a novel combustion-based fluidic propulsion system designed for integration within an aerodynamic wing structure. [cite: 872, 873, 874] The system utilizes controlled combustion of fuel-air mixtures within the wing to generate thrust, capitalizing on aerodynamic principles and fluidic amplification. [cite: 875, 876, 877] A prototype system is developed, and key performance parameters, including thrust, pressure dynamics, and flame stability, are analyzed. [cite: 924, 925, 926, 927] The results demonstrate the potential of this integrated approach for enhancing propulsion efficiency and reducing drag in low-scale propulsion applications.*

***Keywords:*** *Wing Propulsion, Combustion, Fluidic Amplification, Integrated Propulsion, Aerodynamic Efficiency.*

## 1. INTRODUCTION

Traditional propulsion systems often present limitations in terms of weight and drag, impacting overall aircraft efficiency. Fluidic propulsion offers a potential avenue to overcome some of these drawbacks. Drawing inspiration from the fluidic amplification principles observed in the Dyson fan, this project explores the integration of a combustion- based propulsion system directly within an aerodynamic wing structure. This approach aims to capitalize on the synergistic relationship between aerodynamic shaping and thrust generation. The need for more efficient and integrated propulsion systems is evident in the pursuit of advanced aircraft designs. This project addresses some of the inherent challenges in conventional propulsion by investigating a novel method of generating thrust through controlled combustion within the wing itself. The overall aim of this project is to develop and analyse a novel integrated wing propulsion system. Specific objectives include designing a combustion system inspired by the Dyson fan concept, integrating combustion chambers within a wing structure, utilizing a tip nozzle for thrust generation, and conducting a preliminary analysis of thesystem's performance characteristics.

## 2. LITERATURE REVIEW

Existing research provides a foundation for this project. Studies in fluidic thrust vectoring and control have explored the manipulation of gas flows for directional control without mechanical parts. The technology behind the Dyson fan demonstrates the principle of fluidic amplification, where a small airflow can induce a larger secondary airflow. Furthermore, extensive literature exists on wing aerodynamics and airfoil design, crucial for understanding how the wing's shape influences lift and drag. The field of integrated propulsion explores concepts where the propulsion system is seamlessly incorporated into the airframe. Key authors and their findings in these areas provide valuable context for this innovative approach to wing propulsion.

## 3. DESIGN METHODOLOGY

The combustion-based fluidic propulsion system is designed to integrate seamlessly within the wing structure. The system comprises a combustion chamber, a fuel injection and ignition system, and a specifically designed tip nozzle. The wing structure utilizes an airfoil profile chosen for its aerodynamic characteristics. The materials selected for the wing and combustion chamber prioritize heat resistance and structural integrity to withstand the pressures and temperatures generated during combustion. The combustion chamber's geometry is carefully designed to facilitate efficient combustion and direct the high-pressure gases towards the nozzle. Fuel is introduced into the combustion chamber via strategically placed injectors, and ignition is initiated by a spark plug. The tip nozzle's geometry is critical for generating thrust and potentially achieving fluidic amplification, similar to the Dyson fan principle, by inducing airflow over the wing surface. Aerodynamic principles, combustion dynamics, and fluidic amplification are inherently linked in this design. Equations governing fluid flow and thrust generation, such as Bernoulli's equation and the basic thrust equation, are considered in the design process.

**FIGURE 1.** Design Methodology

## 4. EXPERIMENTAL SETUP AND TESTING

A working prototype of the combustion-based fluidic propulsion system was developed using appropriate materials and manufacturing processes. The prototype's dimensions and specifications were carefully documented. The experimental setup for testing involved securing the prototype and implementing sensors and instrumentation to measure key performance parameters. These included sensors for thrust measurement, pressure transducers to monitor the pressure variations within the combustion chamber, and potentially thermocouples to assess temperature. The testing procedure involved initiating controlled combustion under various operating conditions, such as different fuel-air ratios, and recording the corresponding measurements from the sensors.

**FIGURE 2.** Experimental Setup and Testing

## 5. RESULTS AND DISCUSSION

The experimental results yielded data on the thrust generated by the system, the dynamic pressure variations within the combustion chamber during the combustion cycle, and observations on the stability of the combustion flame. Graphs and tables were used to present this data clearly. Analysis of the results focused on evaluating the system's performance in terms of thrust output and efficiency. Comparisons were made with any theoretical predictions or expected values. The discussion addressed the effectiveness of the integrated design, the challenges encountered during the design and testing phases, and the potential mechanisms behind the observed thrust generation, including any evidence of fluidic amplification.

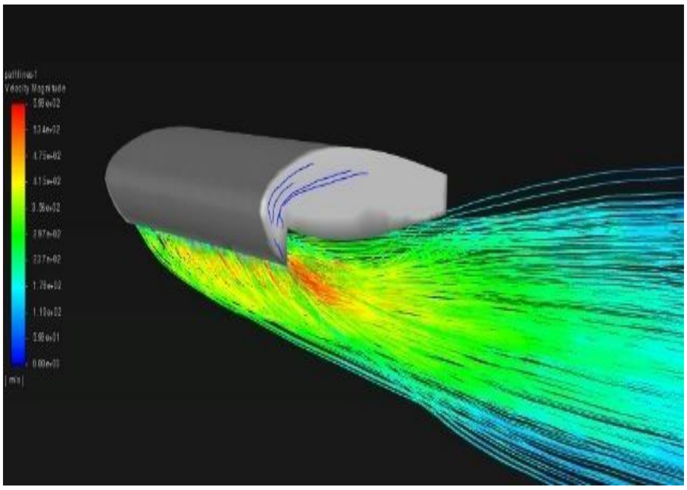

**FIGURE 3.**

## 6. CONCLUSION

This project successfully demonstrated the feasibility of a novel combustion-based fluidic propulsion system integrated within a wing structure. The key findings highlight the potential of this approach for generating thrust through controlled combustion and fluidic principles. The innovative integration of the propulsion system within the wing offers possibilities for enhanced aerodynamic efficiency and reduced drag in low-scale applications. Further research could focus on optimizing the combustion chamber design, nozzle geometry, and fuel injection system to improve thrust efficiency and explore specific applications for this technology.

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