The 2025 World Congress on
Advances in Structural Engineering and Mechanics (ASEM25)
BEXCO, Busan, Korea, August 11-14, 2025

Turbine-Less Jet Engine Powered by Solid Oxide Fuel Cell (SOFC) for Aircraft Propulsion

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Abstract
This paper introduces a patented turbine-less jet propulsion system for aircraft, based on Norwegian Patent No. 346132 [1], which integrates a Solid Oxide Fuel Cell (SOFC) with a jet engine to achieve high-efficiency, low-emission thrust generation. The innovation lies in the complete elimination of the gas turbine, replaced by an electric motor powered by the SOFC's electrical output to drive the compressor. Simultaneously, the SOFC's thermal output is used to heat the compressed air, which is then expanded through a nozzle to produce thrust. This configuration simplifies engine architecture, reduces weight and cost, and significantly enhances environmental performance, especially when operated with hydrogen fuel, eliminating carbon emissions.

A comprehensive thermodynamic analysis based on a modified Brayton cycle demonstrates that the system achieves an overall efficiency of approximately 73%, surpassing conventional jet engines [2]. The analysis incorporates isentropic flow assumptions, ideal gas behavior, and energy balances across the compressor, heat exchanger, and nozzle. Derived expressions for air mass flow rate and jet velocity confirm the feasibility of subsonic thrust generation with high energy utilization.

The environmental impact of this system is particularly relevant for Arctic operations, where aircraft emissions have prolonged lifespans and contribute significantly to climate change [3]. By eliminating combustion and utilizing clean hydrogen fuel, the proposed system addresses two critical challenges in aviation: energy conservation and reduction of atmospheric pollution.

Potential applications include commercial and military aircraft, unmanned aerial vehicles (UAVs), and high-altitude long-endurance platforms. The system's modularity and scalability also make it suitable for hybrid-electric propulsion systems and future hydrogen-powered aviation architectures.

Keywords— Fuel Cell, Jet Propulsion, Hydrogen Energy, Aircraft Emissions, SOFC, Thermodynamic Analysis, Sustainable Aviation

References

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