

Hybrid Hydrogen Turbo Fan Engine

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Remanufacturing

- The hybrid turbofan integrates an electric motor to power the fan alongside a standard turbojet core. This combination allows the engine to achieve higher fuel efficiency, reduced emissions, and quieter operation by utilizing the electric drive for supplementary, flexible thrust, particularly during constant-altitude cruising, leading to a more sustainable future for flight.

3D printing technology was used to design the engine's outer casing in SolidWorks software and provide a platform for the electric motor to completely convert the engine from a turbojet to a hybrid turbofan.

CONTROL UNIT

The microcontroller plays a key role in this hybrid propulsion system. It manages the entire transition cycle between the combustion engine and the electric motor. During takeoff, the turbojet provides full thrust, but once the aircraft reaches cruise altitude, the controller reduces the main engine load and activates the electric motor, which drives the fan until the battery is depleted. When the battery becomes low, the turbojet automatically takes over again, and the electric motor switches into generator mode as airflow spins it, recharging the battery back to 100%. This cycle repeats continuously, and the microcontroller ensures every transition happens smoothly, safely, and efficiently.

CFD SIMULATION

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The figure provides evidence of hydrogen combustion stability of combustion of hydrogen during the whole operation.

Subheading

A mathematical model was created to evaluate the performance of the hybrid hydrogen engine by optimizing thrust within the project's real design limits. The model used mass flow rates of air and hydrogen along with the exhaust and flight velocity to calculate engine output and find the best operating point. After applying the system constraints, the model showed that the engine reaches its highest thrust output when both air and hydrogen flow operate at their upper allowed limits. This helped confirm that the design is feasible and provided a numerical reference to support our final prototype decisions.