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IAF SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic Air-breathing and Combined Cycle Propulsion, and Hypersonic Vehicle (7)

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CONCEPT DESIGN OF A COMBINED CYCLE HYDROLOX ENGINE FOR COMMERCIAL SUBORBITAL SPACEFLIGHT APPLICATIONS

Abstract

The FAST (Fast AeroSpace Transportation) team, with the help of PoliSpace (Politecnico di Milano's first student space association), aims to design a multi-platform engine allowing different suborbital spaceflight applications to reduce flight times and make space more accessible. Such an engine would provide unprecedent travel times, flexibility, reusability, and it would run on liquid hydrogen to comply with new sustainability standards and to be competitive in today's economy.

To fulfill these requirements, the FAST team recognized certain essential features in already existing high TRL technologies: the turbofan's low fuel consumption and its ability to take off and land using ordinary runways; the ramjet's capability of reaching supersonic speeds with a low thrust specific fuel consumption, and the rocket's ability to operate outside the atmosphere for the suborbital part of the flight. The new engine merges these strengths into a single propulsion system in a compact nacelle, using an inline configuration allowing savings in terms of volume, weight, and frontal area.

The first possible application of such an engine, among many, would be carrying up to 100 people across 10,000 km in less than 2 hours. The flight profile of this SuperSonic Transport (SST) would consist of an ascent phase powered by the turbofan, followed by a long supersonic cruise with the ramjet in the stratosphere and a final suborbital ballistic trajectory with the rocket, to shorten the flight time. This

system could also be used for microgravity experiments and space tourism.

Another very promising application is the ability to power an SST that could accommodate air-launched rockets deployable in space like a second stage, with significant fuel saving. This would allow companies to launch satellites more independently and regardless of their geographical position, as the SST could take off from anywhere in the world using ordinary runways, opening new frontiers for the space economy as well.

This innovative engine design concept could help revolutionize supersonic flight and space payload deployment, being fully reusable and running on carbon-free fuels, all key factors in meeting sustainability standards and achieving competitiveness, making Earth smaller and bringing space closer.