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Abstract
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Corresponding author: ANDRIANI Roberto
e-mail of corresponding author: roberto.andriani@polimi.it
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Title
Performance Analysis of a Hybrid Thermal-Electric Turboprop Engine

Authors
Roberto ANDRIANI [1], Antonella INGENITO [2]*

** Corresponding author*
[1] Politecnico di Milano, Energy Department, 20158 MILAN, Italy, roberto.andriani@polimi.it
[2] Università "La Sapienza", Scuola di Ingegneria Aerospaziale, 00138 ROME, Italy, antonella.ingenito@uniroma1.it

Abstract
The reduction of fuel consumption and pollutant emission have guided the aeronautic engineers in their work for decades to design always more efficient aircraft engines. Along with this, the reduction and, in the next future, the overcoming of fossil fuels has become one of the most important challenges in the engine development. Aircraft engines are responsible of about 12% of the total carbon dioxide produced by transportation, moreover, the aeronautical authorities impose for the next years stringent limits in the production of CO_2 and NO_x [1]. These limits are quite narrow, and it is difficult to respect them using only thermal engines. The introduction of electric engines in the aircraft power system is therefore unavoidable.

Now, the most feasible solution seems to be the hybrid system, since a fully electric engine does not seem to be attainable shortly, at least for long range aircraft. In fact, while for short range flight the battery weight can not be an obstacle, when the flight becomes longer the size and weight of the battery represent a problem that can not be overcome easily at the moment. For this reason, the hybrid thermal/electric engine seems to be the solution for mid range/long range flights [2]. Different hybrid system architectures can be considered. If both the thermal and the electric engine provide the aircraft thrust, the power comes from fuel and battery, in a mix that can be optimized as function of the mission profile. The two engines can work together or separately, using the electric engine in particular parts of the mission, for instance near cities, where it is important to reduce the pollutant emissions [3]. Another solution consists of an engine like a fan or a propeller, driven by an electric motor fed by batteries charged by a thermal engine. This solution allows a long endurance flight, and the possibility to reduce the pollutant emissions allowing the thermal engine work at its best operation point. In the present work a comparison between the behavior of a conventional turboprop engine and of a hybrid thermal-electrical propeller engine has been done. By means of zero-dimension thermodynamic program, developed on purpose and written in Fortran language, the performance and the characteristics of the two propulsion systems have been evaluated, computing the power, the thermodynamic efficiency, the fuel consumption of both solutions. It has been also evaluated the weight of the whole hybrid system, in particular the contribute of the batteries, making a trade off with the amount of saved fuel, since this represents the crucial aspect for what concerns the possibility to increase flight length and payload.

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