Preliminary Design of Hybrid Propulsion System for M12

Graduate

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Objective: A new developed helicopter is to be equipped with a hybrid propulsion system. Many factors regarding the strengths and risks of a hybrid propulsion system are still uncertain. The main risk of such a powertrain is the additional weight, which is critical for aerospace applications.
The goal of this project was to evaluate the requirements for a hybrid propulsion system, and to assess the feasibility. The preliminary design of a feasible system and its individu-al components was provided as output of this project.

Approach: A conventional powertrain consists of fuel tank, turbine and gearbox. In a hybrid propul-sion system, electric motors, a battery, power electronics and further gearboxes are part of the powertrain as well.
The project was separated into two parts. First, the properties of each individual compo-nent were investigated by research and procedures to specify the preliminary design of each individual component were derived. In the second part, different architectures of hybrid propulsion systems were investigated, based on the insights from the first part. The preliminary design was specified for the two most promising systems.
All calculations to specify the preliminary design parameters were coded in a python pro-ject. This made it possible to investigate the impact of input parameters on the entire sys-tem in no time.

Result: The weight of a hybrid propulsion system was estimated. It could not be determined very accurate, but it was found that a hybrid propulsion system can't outcompete a conven-tional powertrain design. However, the main gearbox, which is a very critical and mainte-nance intensive part in conventional propulsion systems, could be replaced by a much less complex gearbox driven by electric motors with a hybrid propulsion system. A bat-tery for powering the rotors during normal operations is not feasible.
Much more relevant than the results described in this report is the python code that specifies the preliminary design of a hybrid propulsion system based on some input pa-rameters. With this code, it is possible to simulate the requirements for different missions, to estimate the weight and to compare designs. By adjusting and improving the code with insights from further investigations, the results can become more and more accurate.
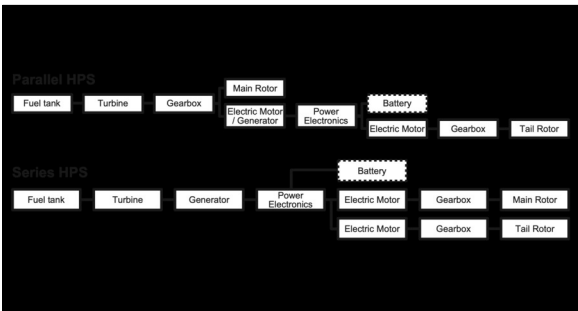
M12 Helicopter.
Own presentment
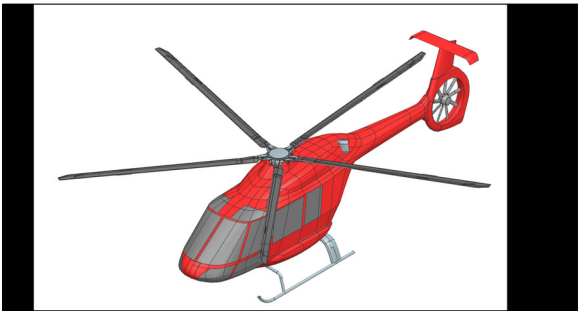
Components of a conventional helicopter.
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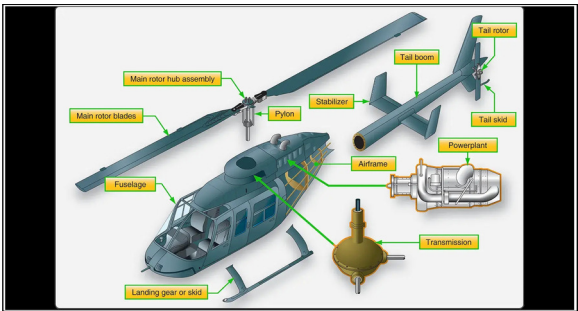
Components and architectures of hybrid propulsion systems.
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