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HELICOPTER'S ENGINES IN AVIATION INDUSTRY

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A procedure is proposed that allows the designer to optimize the engine cycle for minimum fuel consumption during a helicopter mission. The approach takes into account changes in the efficiency of turbomachinery components and engine weight due to changes in engine inlet airflow. Constraints on turbine rotor inlet temperature, boost margin and pressure ratio are imposed. The turbine cooling/sealing flows are set according to the turbine rotor inlet temperature.

For a particular engine-rotor-mission combination, the total combustion benefit ranged from 5.8% to 9.4%, depending on the maximum turbine rotor inlet temperature that could be tolerated.

Although the optimization study is implemented in a specific simulation environment, it can also be exported as an executable file (with or without graphical user interface), DLL or C/C++ source code. All aspects of the analysis can be specified externally by the user, including engine design parameters (including turbomachinery component maps and fluid model properties), helicopter attributes, mission description, change in engine weight and turbomachine component efficiency as a function of inlet flow correction, change in turbine cooling flows as a function of turbine rotor inlet temperature, optimization algorithm, constraints and target function.

In addition, given that the helicopter performance model is implemented as a function, it can be replaced by another one (e.g., more accurate), provided that the final interface remains the same.

Thus, the proposed approach is universal and allows to optimize both engine and helicopter for different combinations of engines and helicopters, different missions or combinations of missions and according to the goals and constraints set by the developer.

Aerodiesels are the "new kid on the block" in the world of aircraft propulsion and, in our opinion, have a great future. Diesels have the highest efficiency of any practical heat-conversion engine in existence. They are reliable, durable and safe and have several distinct advantages over gasoline engines in terms of higher efficiency, better performance, flight safety and fire safety due to the combustion of heavier fuel with low flammability. The use of greener biodiesel and cheaper aviation fuels is easily adaptable. Combined with custom-designed FADEC systems, single-unit aero-diesel engines from 50 to 2,000 hp can be produced today to cover the operating range of light and medium airplanes and helicopters. Aerodiesels are also becoming the engines of choice for UAVs. In particular, combining an aero diesel with a HERS power boost system can provide attractive benefits to helicopters by eliminating the "no man's land" in the height-to-velocity (H/V) curve and increasing service altitude. We believe that in the low to medium power range, aero diesels can provide many advantages over other aircraft engines in general and business/commercial aviation. It's not hard to imagine that within the next 30 years, half of all reciprocating IC aircraft engines worldwide will be diesel.

Due to their use in helicopters, turboshaft engines are usually small, often using at least one centrifugal compressor, sometimes in parallel with two or more axial stages. Since helicopters become much more inefficient as their size increases, there is no need for extremely powerful turboshaft engines; even the largest helicopters can use 2 or, in some cases, 4 turboshaft engines connected by a gearbox. Two Soviet Lotarev D-136s power the largest helicopter ever produced, the Mi-26, and produce 11,400 horsepower per shaft (a power-to-weight ratio of over 10!). Typically, engines of 1,000 hp and below have power to mass ratios in the range of two to three. Engines between 2,000 and 3,000 hp usually have a ratio of three to four.

Almost all turboshaft engines use a twin spool design. One to two high power turbines drive the compressor, and the rest of the power takeoff is usually done by 2 free power turbines. Larger engines, such as the D-136 and GE38, use 3 FPTs. Early versions such as GE's T58 and T68 used a fully axial turbine, now almost every turboshaft uses a combination of at least one centrifugal turbine. In fact, some engines, such as the Turbomecas Ardiden and RR CST800, use only a dual centrifugal compressor, and still achieve pressure ratios around 14. The highest value found for this report was 18.6 for the GE38 engine (a combination of 5 axial and 1 centrifugal). Older turboshaft engines have specific fuel consumption in the 0.5-0.6 kg/kWh range, while newer engines have a figure approaching 0.39 (GE38).

New possibilities for the use of vibration technologies for helicopter diagnostics at different stages of its life cycle, providing an increase in the efficiency of production and operation, are proposed. Taxonomy and brief description of VDTs applicable to the majority of critical machines, mechanisms and helicopter structures are presented. Some improved variants of VDT application on helicopter engines exceeding vibration limits during delivery tests are considered. The capabilities of the above VDTs have been verified by experimental application of operating systems. Early detection of faults provides a reduction in rework, operating costs and life-saving, as well as increased operability.

Further application of the considered VDT is possible as a part of the helicopter condition monitoring and in-flight use systems. A general approach to HUMS development using vibrodiagnostic technologies and application of HUMS for condition-based maintenance to increase helicopter life cycle efficiency in terms of reliability/cost criterion is proposed.

If your airfield has a mobile engine preheater and a generator or mobile power supply to support the battery, take advantage of them.

Starting the engine is the most wear-and-tear phase of the flight cycle, so any effort to bring the engine to average temperature before it starts will avoid significant metal deterioration.

A cooled engine also puts more strain on the starter, and thus on the battery, which has already lost power due to the cold.

Also, don't be tempted to overspend when starting, since excess fuel creates an additional risk of fire.

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