

Tehnologija za letenja s hibridnimi pogoni HYPSTAIR

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Abstract

Since 1970's there have been isolated attempts in flying with electric propulsion as an alternative to the conventional fossil-fuel thermal engines. In 2011, major recognition to electric flight was given in form of NASA/Google co-organised Green Flight Challenge with Airbus committing to pursue electric flight as a viable option for commercial aviation in early 2014. Pipistrel and partners lead development of the first Certifiable Hybrid Propulsion system for General Aviation (HYPSTAIR) where benefits of electric flight are joined with practicality and long-range capability of conventional powertrains. This contribution will present the technologies employed in the HYPSTAIR propulsion system.

1 Introduction

Electric flight is a term that describes flying of aircraft which use propulsion systems, where electricity is a medium of delivering power to a device which produces propulsive force i.e. thrust. There are two main types of recognised propulsion systems, which use electricity, an electric power unit and a hybrid-electric power unit.

An Electric Power Unit The EPU shall as a minimum consist of one electric motor, associated controllers, disconnects and wiring, means of EPU monitoring and a Human-Machine Interface (HMI). An Energy Storage Device (ESD), which may be a battery, or capacitor, or both, is a part of EPU and is optional.

The HEPU is a combination of a minimum one EPU and a minimum one Power Generating Device (PGD). PGD can be an engine or a device to create power to achieve propulsion by utilizing onboard-stored fuel. Onboard or ground-based charging devices, in-flight energy supplying devices or other technology may be included in the above definitions

2 System Architecture

The system architecture chosen for HYPSTAIR is a series hybrid, where the main electric motor continuously drives the single propeller. The energy to drive this motor is delivered either from the battery system, or the range-extending internal combustion engine, or a combination of both. This

architecture allows for all-electric, quiet and emissions-free, operation, as well as vastly increases the range of battery-powered electric aircraft.

The main motivator for such an architecture are not only performance and efficiency gains, but also considerable improvement of safety of flight. Such a powertrain can exhibit increased take-off power in comparison to conventional powertrain counterparts, improving safety of flight in this critical stage. Furthermore, as the power is delivered to the main motor electrically, the motor does not suffer from power loss at altitude, as thermal engines typically do. With the range-extender operating at peak efficiency, energy conversion losses between fuel and propeller are offset to a large degree. The largest improvement of safety is, however, the redundancy of the system. Not only is the redundancy built-in by design (electric motor receives power from either the range extender, or battery, or both), but HYPSTAIR includes novel technologies, which build-in redundancy in every component of the system, i.e. main motor, power inverters, main computers, propeller control, battery system, etc.

3 Human Factors

In course of HYPSTAIR development, attention is given to Human Factors and how pilots will understand the operation and interact with the novel Hybrid Propulsion System. Innovative principles of cockpit displays with layered information delivery are defined for the first time. A haptic feedback interface for the pilot is under development and will be used as part of the system to enhance pilot's interaction with the system and decrease their workload.

4 Conclusion

HYPSTAIR is the first certifiable hybrid propulsion system for use in General Aviation. The contribution outlines the system architecture and design features, as well as the proposed human-machine interface with emphasis on producing a new type of an aviation propulsion system, which merges the benefits of electric flight with practicality of conventional powertrains, producing an unprecedented combination of performance, efficiency, safety and ease of use of an aviation powertrain.

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