

Fault Diagnosis and Fault Tolerant Control of a Switched Reluctance Motor Propulsion Chain for Air Vehicles

ENTREPRISE

ESTACA, an engineering school that is part of the ISAE group, accredited by the CTI, is a major player in the training of engineers in the fields of transport. Located on 3 sites (Saint Quentin en Yvelines, Laval and Bordeaux), it welcomes 2500 students.

CONTEXT AND OBJECTIVES

The electric machines currently used in air vehicles are in most cases three-phase electric machines. These machines have very good performance in healthy operation mode, but they lack redundancy to ensure safety in faulty operation mode. Thus, the only material redundancy of the propulsion chain is to use a larger number of rotors than required for normal operation. Faced with the continued growth in the demand of vertical lift and other air electric vehicles, improving the reliability of air electric vehicles is necessary over their lifecycle. Switched Reluctance Motors (SRM), which have in-built redundancy by their design, respond well to this constraint with. Indeed, they have better robustness in the event of a breakdown (opening of a phase, opening of an arm of the power stage ...) and, as well as better power density. The proposed research project consists in the first step to develop a simulation of an air vehicle using four SRM actuating systems and to validate it in healthy operation mode using a flight mission. The second step consists of dealing with some fault diagnosis on one SRM actuating chain of an existing air vehicle and to study their impact on the dynamic behavior of the air vehicle during flight. Some faults will be selected and implemented on the simulation of a SRM actuating system for diagnosis. In the third step and based on fault diagnosis and performance evaluation in faulty operation mode, a fault tolerant control is developed and implemented in a single SRM actuating system to show its added value in terms of performance. Finally, in the last step, a validation is carried out on a test bench of one SRM actuating system in healthy and faulty operation modes where some faults will be created.

MISSIONS

1. State of the art of faults and fault diagnosis in electric propulsion chain of air vehicles
2. Modeling and simulation of an air vehicle with four SRM actuating systems
3. Fault diagnosis for detection and isolation of some created faults.
4. Choice of a fault-tolerant control strategy for the created faults and performance evaluation
5. Experimental validation by emulation in healthy and faulty operation modes using a test bench at ESTACA
6. Performances evaluation in healthy and faulty operation modes with a fault tolerant control strategy on one SRM actuating system.

PROFILE

Engineer or master's degree in Electrical Engineering and Control with a good knowledge of flight dynamics of multicopter air vehicles.

Languages for research: French and English with a good level.

COLLABORATION

Research Center of Aerospace Engineering, Cranfield University (UK)

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FUNDING

ESTACA

DURATION

Six months; from March 1st, 2023.