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DIRECT SELF-REPAIR CONTROL AND ACTUATOR FAILURES RE-PRESENT TECHNIQUES FOR CIVIL AVIATION AIRCRAFT

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Abstract. *The on-line direct self-repair control and actuator failures re-test and re-present techniques are proposed in this paper when the civil aviation aircraft (CAA) is under maintenance in grand and in high altitude and high speed respectively on occurrence of abrupt actuator failures. Direct adaptive control technique is used to achieve self-repair control for aircrafts with abrupt actuator failures, in order to assure its flight safety. When civil aviation aircraft returns, probability statistic approach based on double hypothesis/multiple hypothesis is used to cumulate summation experiment according to the related data provided by Flight data recorder (FDR), so as to identify whether the civil aviation aircraft has failures or not, and to determine the "failure type", "failure location" and "failure degree" of the civil aviation aircraft. The simulation results demonstrate the efficiency of the proposed method in this paper.*

Keywords: Civil aviation aircraft, Direct adaptive control, FDR, Re-test and re-present technique

1. **Introduction.** Fault detection and isolation (FDI) is becoming an increasingly important research field. A fault is deemed to occur when the system experiences an abnormal condition, such as a malfunction in the actuators or sensors. Sensor, actuator or process (plant) failures may drastically change the system behavior, resulting in performance degradation or even instability. Thus, fault tolerance is essential for modern and highly complex control systems. Fault tolerant control (FTC) systems are needed in order to preserve or maintain the performance objectives, or if that turns out to be impossible, to assign new (achievable) objectives so as to avoid catastrophic failures [1]. In general, fault tolerance can be achieved in two ways [2]: 1) passively, using feedback control laws that are robust with respect to possible systems' faults, or 2) actively, using a fault detection and isolation (FDI) and accommodation technique.

During the last decade, different approaches for dealing with this problem have been reported. Most of them belong to the following categories: pseudo-inverse [3], adaptive control systems [4,5], eigenstructure assignment [6], multiple-model methods [7], H_∞ control [8], model-matching [9], and compensation via additive input design [10]. The survey papers and the most recent bibliographical review give the state of the art in the field of reconfiguration and FTC. Up to now, most of the existing literature treats FDI problem and FTC problem separately. There are just a few papers that provide integrated FDI and FTC schemes for fault accommodation and for integration of control and fault detection. In [11,12], fault detection and accommodation was investigated using learning methods. The main idea behind this approach is to monitor the physical system for any non-nominal behavior in its dynamics using nonlinear modeling techniques such as neural networks. Boskovic *et al.* [13] modeled the flight control effectors failures. It is shown