Reliability for aerospace systems : Methods and applications

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Editorial

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Aerospace systems pose a wide diversity of problems in terms of disciplines and complexity, which includes rocket and its propulsion, satellites, unmanned aerial vehicles (UAV), and other kinds of space flying equipment including even the traditional aircraft. Such systems carry out complex missions such as space exploration, telecommunication, weather forecast, search and detection, and so on. These systems are not only safety critical but also mission critical and have very high performance requirements. Even though the research of aerospace systems have long history and is relatively mature in some advanced countries, there are still strong demands and vibrant efforts for the new development or improvement in this highly sophisticated systems, which are particularly pronounced in the new developing countries. Owing to the recent progress in the science and technology such as computational multi-physics analysis, information and sensing technologies, new materials development and fabrications, there have been further advances and new contributions in the recent research of aerospace systems.

In the design and development of the aerospace systems, the reliability and safety is one of great important issues that needs to be taken seriously due to the extreme requirement of mission success under the harsh and unpredictable conditions. To achieve this goal, recent research efforts in the aerospace design have been directed to incorporate the elegant reliability analysis technique to evaluate the risk and safety in quantitative way at the components as well as the systems level. Furthermore, the efforts are being extended to the reliability of the system in operation by developing the prognostics and health management (PHM) technique, which is to monitor the fault progression of the system during the operation and predict its remaining useful life (RUL).

With these motivations and needs, the special issue has covered the recent research and its applications for the reliability study over the various stages including the design, manufacturing, and operation of aerospace systems. A total of 30 papers on the broad field of topics were submitted to the special issue, from which only 9 papers are accepted for the sake of the high quality. In terms of technology over different stages, the papers are classified into three categories. First is the component reliability analysis including the safety envelope of aircraft structural parts, effect of vibratory stress relief on the fatigue life of aluminum alloy, and estimation of aircraft damping derivatives for flight simulator and aeroelasticity design. Second is the system reliability that address the conflict resolution of UAVs in the air, the fault tree analysis of electromechanical actuator for UAV, and conceptual design of microsatellite constellation to save the launch cost. The third is the reliability of system in operation, which are the gas-path fault diagnosis of aircraft engine, usage-based prognosis of fatigue crack growth in aircraft panel, and prognosis of battery capacity degradation. In terms of applications, the nine papers consist of the five papers for the aircraft components or systems, two papers for the UAV, and one for the satellite and the battery respectively.

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