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Author: Dr. Raja Pandi Perumal
University of Luxembourg, Luxembourg

Prof. Holger Voos
University of Luxembourg, Luxembourg
Mr. Florio Dalla Vedova
LuxSpace Sarl, Luxembourg
Dr. Hubert Anton Moser
LuxSpace Sarl, Luxembourg

DESIRA: A DECISION SUPPORT SYSTEM FOR INCORPORATING RISK ASSESSMENTS IN EARLY DESIGN STAGES

Abstract

Reliability is the probability that the system performs as intended under specified environmental conditions for a specified period. In recent years, Commercial-off-the-shelf (COTS) components are substituting space-grade components, especially in small satellites, to reduce their cost. In these events, designers must prioritize reliability estimation and growth strategies from the beginning of satellite design to ensure its reliability. Early understanding of system reliability helps in selecting more dependable and cost-effective design choices. However, due to the lack of component/subsystem failure information and uniqueness of every satellite's design, analyzing system reliability at the preliminary design stage is not invariably performed. This study focuses on addressing this issue by developing a DEcision support System for Incorporating Risk Assessments (DESIRA) during the early design stages. By combining statistical data, heritage data, and expert opinion, DESIRA enables early-stage reliability analysis. It employs reliability apportionment techniques, Monte-Carlo simulations, and reliability optimization to improve system reliability. DESIRA runs in Python, and its Graphical user interface is built using PyQt5. The data for the analysis are modelled in a graphical database management system, Neo4j. This paper demonstrates the DESIRA's capability to provide the first reliability analysis of a complex satellite system in the conceptual phase. Initially, the paper describes a brief overview of the tool's design methodology and architecture. Then it presents a detailed report on how the tool is applied to ensure system reliability. In summary, with DESIRA, it is possible to perform an initial reliability analysis as well as develop further reliability requirements and growth strategies starting from the satellite's early design phase.