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MACHINE LEARNING BASED THERMAL FAILURE DETECTION IN THERMAL VACUUM TESTING

Abstract

Detection of early thermal spacecraft failure is of great importance to ensure a successful space mission. Most missions require spacecrafts to be exposed to extreme and rapid temperature variations. Therefore, it is necessary to conduct thermal vacuum tests to identify failure caused by the harsh space environment. However, thermal vacuum testing can be time consuming and expensive. Moreover, a base made of Teflon must be manufactured for every type of spacecraft to be tested in the thermal vacuum chamber. Furthermore, the thermal vacuum chamber would require a long time to reach to the desired vacuum level in which functional testing would take place. Minimizing thermal vacuum testing time will hugely benefit the spacecraft development process, especially with the rapid surge of constellation projects. Thus, this paper proposes a machine learning based model for real-time thermal failures detection. As a result, this research helps in preventing major damage to the spacecraft during thermal vacuum tests. This paper outlines the evaluation of different machine learning techniques using the thermal vacuum tests data of previous missions that were conducted on various commercial off-the-shelf components. The outcomes show a promising result for temperature profile prediction with the model's accuracy reaching 97%.