Paper ID: 39965
oral

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Environmental Effects and Spacecraft Protection (6)

Author: Dr. jianwei zhang
Beihang University (BUAA), China, zjw@buaa.edu.cn

THERMAL FATIGUE ANALYSIS OF THE SPACE STATION'S CABIN STRUCTURE

Abstract

For long-term in the orbit, the thermal fatigue undergone by a space station cabin is a major structural safety issue, because it could threaten the structural safety of the space station. Currently, there is scant research on this essential topic. A space station cabin fluctuates periodically due to thermal loading and a resulting non-uniform temperature field that can form in the structure which can induce thermal stress and may lead to thermal fatigue damage. In this paper, this problem was evaluated using thermal-structural coupling analysis and the finite element method. Based on the typical cabin, like that on the International Space Station, we established a three-dimensional simulation model. To replicate the environmental characteristics of the Earth's low orbit, we utilized a simplified model of the cabin to calculate the space radiation flux that is absorbed by different parts of the cabin's outer surface. In addition, we utilized the indirect coupling analysis method by determining the thermal analysis results for each moment. We also measured and analyzed the thermal deformation and stress of the cabin. Finally, based on the thermal stress results, we utilized the classical fatigue analysis method to measure the structural thermal fatigue in the cabin. This will be the basis for a safety and reliability study to better understand the long term integrity of the space station's pressurized cabin in orbit.