MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Vehicles – Mechanical/Thermal/Fluidic Systems (7)

Author: Mr. Vignesh Chandrasekaran
India, vignesh.chandrasekaran.100@gmail.com

Mr. Mollik Nayyar
Manipal Institute of Technology, Manipal University, India, mollik8@gmail.com
Mr. Srikanth Raviprasad
Manipal Institute of Technology, Manipal University, India, srikanthraviprasad@gmail.com
Mr. Yash Vardhan Gupta
Manipal Institute of Technology, Manipal University, India, yashvardhangupta1993@gmail.com

NUMERICAL STUDY OF ACTIVE COOLING TECHNIQUES OF A NANO SATELLITE USING CFD FOR PERFORMANCE ENHANCEMENT

Abstract

All nano satellites experience a transient thermal environment in space. The main challenge in a nano satellite is the design of the subsystems within dimensional and weight constrains with no compromise on its performance due to external temperature variations. There are various components like printed circuit boards (PCBs), global positioning system (GPS) receiver, integrated circuits, batteries, magnetorquer which have a very specific temperature range of working, outside which their functional capabilities are not achieved. Due to the varying heat loads due to the sun earth and albedo, the heat experienced by the satellite has to be modeled for obtaining the temperatures attained by the various components on board. The most common passive temperature control systems used are the multi-layer insulation and paint, which have been in use for a very long time in nano satellites. However for a payload that requires critical temperature conditions to be maintained, it would be very difficult to control using passive methods. In this paper, an active thermal control method using a regenerative turbine pump is suggested. The pump circulates fluid through the designed heat path, where maximum cooling has to be achieved. The major challenges are in the selection of a fluid based on fluid properties like viscosity, boiling and freezing point. The rate of heat transfer is based upon the heat transfer coefficient and the operating conditions of the pump. For the first time, this will be implemented on a nano satellite level. The geometric modeling is done on CATIA V5 R19, thermal loads are modeled on Transient Thermal Analysis standalone system of ANSYS 14.0 Workbench and the fluid analyses are performed on ANSYS FLUENT. The results are extracted for post processing and optimization. This will revolutionize the idea of thermal control on nano satellites and break the trend of using passive thermal control systems providing flexibility for the thermal designers to innovate under the system constraints.