Paper ID: 63890
student

IAF ASTRODYNAMICS SYMPOSIUM (C1)
Attitude Dynamics (1) (8)

Author: Mr. Michele Pagone
Politecnico di Torino, Italy, michele.pagone@polito.it

Mr. Mario Virdis
Politecnico di Torino, Italy, mario.virdis@studenti.polito.it
Dr. Simone Vidano
Politecnico di Torino, Italy, simone.vidano@polito.it
Mr. Dario Ruggiero
Politecnico di Torino, Italy, dario.ruggiero@polito.it
Prof. Carlo Novara
Politecnico di Torino, Italy, carlo.novara@polito.it
Dr. Jonathan Grzymisch
European Space Agency (ESA-ESTEC), The Netherlands, jonathan.grzymisch@esa.int
Dr. Valentin Preda
ESA-ESTEC, The Netherlands, valentin.preda@esa.int
Dr. Elisabetta Punta
Italy, elisabetta.punta@ieiit.cnr.it

THE LISA DFACS: EFFECTS OF MICRO-METEOROID IMPACTS IN THE DRAG-FREE MODE

Abstract

This paper presents the modelling and simulation results of the micro-meteoroid impacts that may affect the drag free mode of the next LISA space mission. This activity was carried out during the preliminary prototyping study LISA Drag Free and Attitude Control System (DFACS) under the ESA Technology Development Element (TDE) program of the European Space Agency. LISA is a gravitational wave interferometer that consists of a constellation of three spacecraft connected by bidirectional laser links. Each spacecraft carries two cubic test masses, that are the gravitational reference bodies over which the drag-free control must be performed. This is necessary to guarantee the free fall condition that is required to carry out the scientific experiment. However, as already experienced in-flight by LISA Pathfinder, micro-meteoroid streams can collide with the spacecraft and determine attitude perturbations. In LISA, it is important to analyze this aspect and evaluate how the drag free control is affected in terms of stability and performance. It is also important to evaluate if the constellation laser links could be lost thus requiring a time-consuming constellation re-acquisition maneuver. Micro-meteoroid impacts can be modelled as impulsive forces acting on the spacecraft surface. Therefore, they can be described by three main elements: i) modulus, ii) direction, iii) coordinates of the impact point in the spacecraft frame. The perturbation torque can be easily derived from these quantities. Preliminary simulation results show that higher attitude perturbations occur in case of impacts on the solar panel perimeter with a force modulus >2.3 mN, or when the spacecraft is at End of Life (lower inertia due to empty propellant tanks). In some cases, the laser links could be lost.