15th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Mitigation and Standards (4)

Author: Ms. Chaithra Krishnaraj
PES University, India

Ms. Navyata Gattu
PES University, India
Dr. Sharanabasaweshwara Asundi
Tuskegee University, United States
Mr. Shiva Kumar P
PES University, India
Ms. Yashaswi Gurumurthy
PES Institute of Technology, India
Mr. Vishwas N M
Sri Jayachamarajendra College of Engineering, India
Mr. Shrikanta Aradhya C S
PES Institute of Technology, India
Ms. Aishwarya Manjunath
PES University, India
Mr. Vinod Ravi
PES Institute of Technology, India
Mr. Swastik Nayak
PES Institute of Technology, India
Ms. Ananya Nair
PES Institute of Technology, India
Mr. Suraj Singh
PES University, India
Ms. Anushree C S
PES University, India
Ms. Priyanka T K
PES Institute of Technology, India
Mr. Yashwanth Amara
PES University, India
Prof.Dr. Vinod Agrawal
PES Institute of Technology, India
Ms. Amrutha Varshini S
PES University, India

DESIGN OF ELECTROSTATIC CHARGE GENERATOR FOR DEPLOYMENT AND REGULATION OF ULTRA-THIN WIRES DRAG-ENHANCEMENT SYSTEM (UWDES)

Abstract

To mitigate the issue of space debris, pico/nano/micro-satellites (PNMSats) have adopted largely pas-

sive methods involving drag sails/gossamers, electrodynamic tethers, etc. The complexity of deployment mechanism in comparison to the increase in effective area experiencing drag (EAED) has often limited the use of these methods. These limitations have motivated the design of the novel Ultra-thin Wires Drag Enhancement System (UWDES) comprising of electrostatically charged ultra-thin wires deployed to form large three dimensional (3D) web-like structures. The electrostatic-charging mechanism to deploy and regulate a tuft of ultra-thin wires to increase the host spacecraft's EAED is part of the novel design of UWDES. When the ultra-thin drag-wires are electrostatically polarized, due to mutual repulsion with each other and the spool, they unwind from the spool and unfurl into a large fully deployed 3D web. The ultra-thin wires are designed to be both actively and passively charged. When a spacecraft interacts with space plasma, the drag-wires experience passive charging where the wires and spacecraft structure (chassis) function as plasma collectors. The design of the electrostatic-charge generator (ECG), which is the focus of this article, provides the capability to actively charge the drag wires using on-board power. The ECG is designed to be hermetically sealed and EMI shielded, so it doesn't interfere with the remainder of the host spacecraft. The charging mechanism comprises a source, sink and a regulating module. The source is rich in charges while the sink is either deficient of charges or neutral. An external electron-gun is body-mounted to eject excess of charges acquired from space plasma. The drag-wires web can attain desired configuration for providing maximum EAED through regulation of charges from source to drag-wires by the regulating module. Both the ECG and the external electron-gun may need to be operated intermittently, in case of semi-active charging, to regulate the charge concentration on drag-wires as they may either gain or lose charges on interaction with space plasma. Positive charging of the wires is preferred as they encounter Van Allen belt radiation in low altitude Earth orbits.