Paper ID: 54268
oral

26th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Interactive Presentations:26th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (IP)

Author: Mr. Daniele Luchena
ARCA Dynamics, Italy, daniele@arcadynamics.com

Mr. Marco Moriani
ARCA Dynamics, Italy, marco@arcadynamics.com
Dr. Dario Spiller
ARCA Dynamics, Italy, dario@arcadynamics.com
Prof. Fabio Curti
Sapienza University of Rome, Italy, fabio.curti@uniroma1.it

ENABLING ATTITUDE ACTUATOR FOR SMALL SATELLITES PROXIMITY OPERATIONS

Abstract

In the so-called New Space Economy, proximity operations like rendezvous, docking, undocking, berthing, formation flying and capture are becoming essential for New Space companies to deliver their value proposal, with respect to missions of in-orbit servicing, in-orbit assembly, debris removal, TLC, Earth observation, and Space surveillance.

High precision, dependability, and power efficiency are key-requirements for an Attitude Control System (ACS) of a satellite designed for near null angular velocity maneuvers performed during proximity operations. Reaction wheels represent existing small satellite ACS technology available for such maneuvers. However, their performances still represent a technology limit, because: reaction wheels mechanics malfunctioning is still a major cause of mission failure; the use of an electric motor does not provide a clean torque for very low angular velocities.

In this scenario, it is demonstrated the enabling of such proximity operations by presenting the results of an extensive test campaign for a new cost-efficient attitude actuator, Fluid Wheel (FW), based on magnetohydrodinamics principle. The device, capable of providing clean torque for near null angular velocity maneuvers, was designed using a validated up-scalable model, built using COTS, and developed to be integrated in a picosatellite IOD mission by Sapienza University of Rome to be launched in 2020.

The FW proposed in this research is a cost-efficient and innovative attitude control device for spacecrafts: 3D printed, built using COTS, and based on the magnetohydrodynamics principle, instead of mechanisms, to generate the control torque. Thanks to its high performances and dependability, it is demonstrated that FW enables high precision maneuvers for proximity operations of small satellites, while ensuring a high degree of dependability and low-power consumption.

FW technology will allow space users and satellite integrator companies to design new cost-effective mission concepts involving proximity operations.