27th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Missions Global Technical Session (9-GTS.5)

Author: Ms. Madina Kalel
Ghalam, Kazakhstan

Mr. Arman Bekembayev
Ghalam, Kazakhstan
Dr. Vladimir Ten
Ghalam, Kazakhstan
Mr. Damir Bikmukhanov
Ghalam, Kazakhstan
Mr. Sergey Prokudin
Ghalam, Kazakhstan

SYSTEM MODEL VERIFICATION USING IN-FLIGHT KAZSTSAT DATA

Abstract

Kazakhstan Science and Technology space system KazSTSAT – Earth observation microsatellite was launched on 3rd December 2018 and currently successfully performs in-orbit operations. The work under the system model was started during KazSTSAT design process, and, at the moment, represents a high-performance, integrated, flexible, user-friendly comprehensive tool for detailed design and analysis of LEO space missions. Developed in the Matlab & Simulink software environment, the model provides a full-featured engineering analysis of a space mission for all design levels. Thus, presenting a complete visual picture and calculation tool of the programmed scenario, the system model performs:

- high precision orbit propagation;
- day-in-the-life scenario simulation;
- throughput budget calculation;
- power budget analysis;
- thermal balance analysis;
- orbit maintenance simulation;
- attitude and orbit control subsystem simulator;

This paper is dedicated to the system model verification. Research aims to confirm the efficiency of the system model by achieving high level of conformity with practical results of collected telemetry data and modelling outputs. Collecting and processing telemetry data of a certain day by planned and implemented scenario for KazSTSAT makes a basis of the verification methodology, as it shows the real parameters of the spacecraft functioning a given life cycle period taking into account accepted degradation factors. The AOCS simulator contains orbit models based on TLE, Earth's magnetic field, solar ephemeris, external and internal disturbing factors. AOCS simulator approbation is based on comparing telemetry data with following output parameters:

- how long do angular velocities quench in Detumbling mode;
- in what time is achieved speed around the Y axis;

- standard nadir attitude deviation according to orientation angles and angular velocities in operational AOCS modes;
- AOCS modes transient time;
- maneuvers stabilization time.

Spacecraft thermal model correlation will be performed based on the energy consumption scenario implemented using the power budget analysis, also the temperature difference between actual readings from temperature sensors and the data obtained by thermal analysis will be revealed, taking into account the heaters duty cycle. Thus, if the difference between values obtained by computational & analytical methods and actual spacecraft operation results lay in the predetermined margin, the system model considered as verified. Being a universal and tested heritage tool, the system model significantly reduces the economic costs of space systems design in future.