SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Engineering - Methods, Processes and Tools (2) (4B)

Author: Dr. Vladimir Ten
Ghalam LLP, Kazakhstan, vladimir.ten@gmail.com

Mr. Arman Bekembayev
Ghalam LLP, Kazakhstan, a.bekem@gmail.com

ANALYSIS OF THE SPACECRAFT UPLINK AND DOWNLINK PERFORMANCE IN RANDOM TUMBLE SAFE MODES

Abstract

The paper is the follow-up of the IAC-16 work “Absolute passive mode peculiarities and applications for LEO missions” started as the mathematically strict analysis of the so-called passive safe mode where the spacecraft is left powered off in random tumble.

This paper analyzes Radio Frequency (RF) uplink and downlink aspects of absolute passive safe mode i.e. spacecraft behavior in the absence of active or passive control (even without magnetic or gravitational stabilization). Analysis involves Monte-Carlo based approaches and provides some common patterns and rules discovered in the process.

The RF subsystem characteristics combined with antennas’ radiation patterns and the allocation on a spacecraft structure becomes one of the most important design driving factor for the space missions using random tumbling safe modes as the contact with the spacecraft after anomalies led to passive safe mode is the mission critical task.

The research aims to provide the tool and definite design and development recommendations for systems engineering teams decided to use passive safe mode on a LEO mission.

The research takes advantage of using orbit and design data from two different missions: KazEOSat-2 (launched in 2014) and KazSTSat (to be launched in 2018) for the analysis.

Following mission characteristics and preconditions are taken into consideration:

- RF profile of spacecraft antennas
- influence of orbit parameters
- spacecraft inertia properties

The paper also provides an approach to find driving design cases from the simulation range.