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CRYOSAT-2 LI-ION BATTERY DEGRADATION PREDICTION BY ESTIMATING KEY PARAMETERS USING COMMON IDENTIFICATION TECHNIQUES

Abstract

CryoSat-2 was launched from Baikonur on 8th of April 2010 aboard a modified Dnepr ICBM, the so-called SS18 Satan. Since then the Flight Operations Segment (FOS) in ESOC, Darmstadt is operating the satellite in cooperation with the Payload Data Ground Segment in ESRIN, Frascati, ensuring that all the mission objectives are reached. Cryosat-2 electrical power system is composed of a power control and distribution unit (PCDU), two body-mounted solar arrays and a Li-Ion battery with a BOL capacity of 78 Ah. The continuous power availability is a key to a successful mission therefore it is necessary for the Flight Control Team (FCT) at ESOC to have a close look at subsystems such as solar arrays and battery which have a natural tendency to degrade over mission lifetime. The satellite is in a non-sun-synchronous orbit, so there is not a constant illumination profile, which results in a nominally varying depth of discharge of the battery over the repeat cycle. This makes it very difficult to assess the expected state of charge of the battery and hence to determine any degradation using standard methods. This paper will apply widely used identification techniques (recursive least squares and extended Kalman filtering) to estimate key battery parameters such as internal resistance and open circuit voltage otherwise not available as ordinary house-keeping telemetry. It will be shown how the evolution of these parameters over mission lifetime can improve the knowledge of the battery health with a good degree of confidence and thus provide the FCT with an important instrument to predict battery degradation and react upon it to extend the satellite's life time in orbit.