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Author: Mrs. PRATIBHA SRIVASTAVA
Indian Space Research Organization (ISRO), India, pratibha@ursc.gov.in

Mr. Partha Bandyopadhyay
ISRO Satellite Centre (ISAC), India, parthab@isac.gov.in
Mr. Sudhakar S
U R RAO SATELLITE CENTRE (URSC), India, sudhakar@ursc.gov.in
Mrs. Parul Gupta
Indian Space Research Organization (ISRO), India, parul@ursc.gov.in

REAL TIME AUTONOMOUS ON BOARD TIMER DRIFT ESTIMATION AND CALIBRATION IN DEEP SPACE MISSIONS

Abstract

The Onboard Computer (OBC) in the satellite systems acts as the main controller of the spacecraft bus performing all the attitude and orbit control, navigation and guidance operations for deep space missions. In addition all the payload operations, time tag operations sequencing also are carried out by the OBC system .All the operations are carried out based on the clock timer running in the OBC computer hardware. Any drift in this time leads to incorrect computational results or advance/lag of time tagged based operations. As the spacecraft is in continuous motion, a small time error can lead to incorrect orbital state vector estimation and corrections.For landing mission, initial position estimation beyond a certain threshold can get catastrophic for the mission.Hence it is needed to correct this time offset and drift before carrying out any time critical operations either autonomously or from ground intervention.

The conventional earth observation satellites have GPS / IRNSS based Satellite positioning systems (SPS) onboard that keep monitoring the drift in the On Board clocks and keep periodically correcting. For mission with continuous ground visibility, the ground stations take the task of periodically monitoring and up linking the drift in the On-Board clocks. However for deep space missions where there are challenges of limited visibility, no SPS systems and possibility of errors induction at ground stations due to signal path delays, it becomes challenging to estimate the OBT drift on ground and uplink the corrections. This paper presents a new algorithm for autonomous Onboard OBT drift estimation and corrections for such missions. In this research, clock source used for onboard timer is SPXO /TCXO in the OBC subsystem. However, this clock is prone to frequency deviation because of the various source categorized based on their impact. The algorithm presented aims to estimate the frequency deviation due to the major sources and perform autonomous corrections for the on Board timer .

The algorithm has been rigorously tested on ground and shall be flying as part of ISRO's AdityaL1 OBC subsystem autonomous software.

Keywords : On Board Computer , On Board Timer , drift , deep space missions , autonomous , frequency deviation