Paper ID: 28535
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66th International Astronautical Congress 2015

SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems Concepts (1)

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NOVEL CONCEPT FOR REAL-TIME HIGH-ACCURACY ATTITUDE AND POSITION DETERMINATION SYSTEM THROUGH EARTH OBSERVATION SATELLITE PAYLOAD

Abstract

Earth Observation (EO) satellites capture precious details of the earth landscape. These details, also known as Ground Control Points (GCP), can be used to achieve high accuracy attitude and position determination of the satellite in real-time. Enabling this technique could replace the need for other high-accuracy sensors and reduce EO satellites cost, mass and volume. The technique is rarely used in real-time since it requires the On-Board Data Handling (OBDH) system to process image data and identify the GCP in high rate ($<$ 1 sec). The identification requires a ranges of 100 to 1000 Million Instruction Per Second (MIPS) from the OBDH, while current space qualified technology can handle up to 80 MIPS. This paper proposes to budget the processing on longer time scale to reduce the momentary requirement. The budgeting allows the OBDH to meet this technique and additional mission performance requirements but extends the overall processing time. This produces a delay between the time the data (image) was acquired to the time it was used to determine position and attitudes, which reduces the accuracy of the determination. In this solution different methods for handling the delays are implemented together with an Extended Kalman Filter (EKF) to determine the position and attitude from the images while maintaining the performance of the system. The system is tested with a dedicated simulator, with different delays and imaging rates. The results are presented as the attitude and position error. Finally two trade-off studies are presented. The first between the accuracy and the processing power and the second between on-board data processing and downlinked AOCS data to be processed on ground. The trade-offs can be used to choose better designs for upcoming EO missions. A future study will perform an in-orbit experiment on an EO satellite.