Paper ID: 24951
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SPACE OPERATIONS SYMPOSIUM (B6)
New Operations Concepts, Advanced Systems and Commercial Space Operations (2)

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THE IMPACT OF ATTITUDE CONTROL SYSTEM AGILITY ON THE ACQUISITION CAPACITY OF REMOTE SENSING CONSTELLATIONS

Abstract

BlackBridge provides end to end solutions across the geospatial value chain. The backbone of these geospatial information services is the RapidEye satellite constellation, which consists of five satellites, owned and operated by BlackBridge. The satellites operate in a sun-synchronous low Earth orbit and have been operational for more than five years.

Continuous optimizations, such as of the memory management or of the ground infrastructure, have driven the system to outperform initial design requirements and led to an image acquisition capability of more than five million square kilometers per day. Further optimization potential is currently envisaged by modifying the attitude control system. Currently, the roll angle of a satellite cannot be changed during an imaging session. However, a more agile attitude control system is evaluated in the framework of this paper, which increases the acquisition capacity and thus, the coverage performance of the remote sensing constellation.

The RapidEye satellite tasking is based on a custom tile grid and the according individual tile scores. Depending on the latest weather forecast and the importance of an individual tile (e.g., due to customer orders), a tile score can be calculated. The tasking algorithm subsequently considers all tiles along the ground track of a RapidEye satellite and selects the roll angle that maximizes the sum of the scores along the path. The tile scoring system of the current daily planning was used as a performance benchmark and simulations were conducted that calculated the performance increase obtained by varying the maximum achievable rate of change of the roll angle between image takes. For simulating the performance of a more agile system a new satellite tasking algorithm was developed. The new algorithm is based on an optimization that uses genetic algorithms and allows for roll angle changes between image takes.

Using statistical cloud data to generate a representative cloud cover, the according agile satellite tasking system was used to simulate three imaging campaigns of large areas. The paper shows the acquisition capacity of the agile system for variable configurations as well as the capacity of the current system, validated by flight data. It further depicts that the magnitude of the performance increase depends on the geographical shape of the target area.