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LARGE AREA COVERAGE USING ADAPTIVE AND ROBUST MULTI-AGENT SYSTEM

Abstract

High resolution Low-Earth optical observation satellites have a limited acquisition capability due to their narrower swaths. To better acquire a large area on a country or continental scale a set of heterogeneous satellites may be used. The coordination of these satellites during a long period of time is a complex task requiring assignment of a set of acquisitions for each satellite and each of their passes over the area to acquire. This work proposes the Glimpse algorithm based on a multi-agent approach to minimize the time required to cover a large area while taking into account real time feedback from mission planning centers. The most common way of performing acquisition missions of heterogeneous satellites leads to the waste of more than half of acquired images due to weather and inconsistency of acquisition geometries. Glimpse was tested on a set of representative use cases presenting different characteristics. In this paper, we validate Glimpse by comparing its results with those obtained using other acquisition approaches. Different problem criteria are considered such as heterogeneous optical sensors from different constellations and variable area sizes and weather conditions to assess the scalability and robustness of the algorithm. To cope with the heterogeneity of the sensors, Glimpse freely positions meshes and modifies their lengths to better adapt to weather forecasts and sensors from other constellations, whereas legacy approaches consider meshes of fixed sizes and fixed positions. Consistent results were obtained with experiments performed on areas of sizes ranging from small countries (e.g. Italy) to continents (e.g. Australia). Regarding weather conditions, several countries with different characteristics showing typical difficult weather patterns (e.g. monsoon) were evaluated. The obtained results show a reduction in acquisition completion time and satellites wasted time as well as the scalability and robustness of Glimpse. To conclude, accurate positioning of meshes improves the likelihood of validation for acquired images. Results show the robustness of the developed algorithm with consistent improvements compared to a state-of-the-art approach for solving large area acquisition problems. We also propose a tool based on Glimpse to assist operators in choosing the best constellations in order to cover a specific zone in a given time.