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A mathematical formulation for the imaging and communication scheduling problem for super-agile Earth observation satellites

Earth Observation Satellites (EOSs) are designed to collect images of Earth's surface for a wide range of applications, such as disaster response, environmental monitoring and resource management. With the increasing number of orbiting EOSs, efficient scheduling of satellite operations has become a critical challenge. To ensure effective use of these complex systems, it is essential to develop advanced scheduling methods that manage both image acquisition and data transmission. However, due to the rapid development of new generations of satellites, Super-Agile EOSs (SAEOSs), capable of dynamic maneuverability and real-time attitude control, existing scheduling approaches must be revisited. Thus, the literature on SAEOS scheduling is growing to meet these new demands. Still, current studies focus only on image acquisition, neglecting that all collected data must be transmitted to the ground. Furthermore, when realistic constraints such as multiple SAEOSs, diverse imaging targets, and energy and memory limitations are considered, the problem becomes even more complex. In this sense, this paper investigates and formally defines the imaging and communication scheduling problem for SAEOSs in multi-type target scenarios, while considering energy and memory constraints. This work lays a foundational step toward the development of efficient optimization strategies for this emerging class of NP-hard scheduling problems.

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