20th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations - 20th IAA SYMPOSIUM ON SPACE DEBRIS (IP)

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EFFICIENT SENSOR TASKING FOR SPACE SITUATIONAL/DOMAIN AWARENESS

Abstract

The proliferation of space objects and the increasingly contested nature of space makes the Space Situational/Domain Awareness (SSA/SDA) problem important to enable effective space operations and to prevent collisions. With the increased burden placed on sensor networks performing SSA/SDA missions, it is important that sensing assets are used efficiently to track high-priority objects and maintain a high-quality catalog.

Orbit Logic's Heimdall SSA/SDA tasking software performs intelligent sensor network tasking so that operators can efficiently obtain high-quality tracks on objects they care about while maintaining a high-quality catalog. Heimdall creates cooperative schedules for ground- and space-based sensors to optimize an SSA/SDA-specific figure of merit (FOM), that reflects catalog and/or mission objectives, while obeying user-specified planning constraints. Heimdall can run several optimization algorithms in parallel to generate different sensor schedules and choose the schedule that scores best in terms of the FOM. The FOM components and constraints can relate to sensors and/or collection data gathered on space object(s), identified by NORAD ID or a provided ephemeris, for factors such as observation timing (within specific time windows, around orbital events, or at a given cadence), sensor phenomenologies, sensor preferences, viewing geometry, weather, viewing conditions (e.g., object apparent visual magnitude), clearing radius, collection duration, radar cross section, other sensor parameters, and, now, expected orbit accuracy at given time(s) given the current track and planned observations.

To ensure coverage and prevent redundancy, Heimdall can ingest plans from external sensor networks so that the Heimdall operator can condition their sensor scheduling around the data they expect to receive from partners. In addition, Orbit Logic's Heimdall SDA sensor tasking software now supports planning for expected orbit accuracy after data fusion is performed, allowing operators to specify required levels of expected orbit accuracy for space object tracks at user-specified times. Orbit accuracy is quantified by a user-specified function (e.g., the determinant) of the expected posterior track error covariance matrix obtained when the current track and planned sensor collects are combined using a specified filter (e.g., the Extended Kalman Filter) by a module developed by the University of Texas, Austin. This can be

leveraged to achieve high-accuracy tracks on high-value targets more efficiently. In addition, it can be used to intelligently reduce sensing on low-priority objects so that sufficient accuracy is maintained with fewer collects.