Automated Policy-based Scheduling for the OCO-3 Mission
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Summary
The Orbiting Carbon Observatory-3 (OCO-3) is a NASA instrument for measuring atmospheric CO₂. OCO-3 launched on May 4, 2019 to the ISS (International Space Station) on a SpaceX Falcon 9 rocket as part of a resupply mission. It is mounted on the International Space Station on the Japanese Experiment Module – Exposed Facility (JEM-EF). It is expected to begin nominal science operations in August 2019 and its planned mission duration is three years. OCO-3 will enable identification of CO₂ sources and sinks and study changes in CO₂ levels over time.

Automatic scheduling is being deployed for operations of OCO-3. The OCO-3 scheduling process begins with a mostly-automated dynamic science priority assignment that is input to an automated scheduling of area targets, calibration targets, nadir, and glint mode. It is also being used to schedule observations for the calibration of the pointing mirror.

Pointing Mirror Assembly Calibration
To calibrate the Pointing Mirror Assembly (PMA), observations are taken from a set of polygons. While the current OCO-3 scheduler does not schedule fine instrument pointing (this is controlled in flight software), technology exists in the Eagle Eye system to construct detailed pointing plans to cover arbitrary polygons.

Agile pointing
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Checking Visibility
OCO-3’s field of view is limited due to obstructions by other components of the ISS. The scheduling software must account for the limitation without sacrificing too much runtime or precision. The occlusion mask is defined as a set of polynomials for several longitude segments. We currently check visibility for area map mode, target mode, and glint mode.

To check if a target is visible at a particular point in time, we project the target onto the unit sphere around the satellite. This gives us an azimuth/elevation point that can be checked for inclusion in the visibility set.

For glint mode, this approach is satisfactory. But for area map and target mode, we do not know exactly where the PMA is pointed at any time. We consider three approaches to addressing this complication:

- **Centroid**: Project the centroid of the target and check visibility set
- **Corners**: Project the corners of the target and check visibility set
- **Configuration space**: Define a configuration space that characterizes all points on the unit sphere that represent the centroid of a visible target. Project only the centroid of the target on the unit sphere and check if that the point falls within the configuration space.

Operational Modes

- **Nadir mode**: Default mode over land in the daytime
- **Glint mode**: Measurements taken over water near the glint spot to maximize the signal
- **Area Mapping mode**: Measurements taken over regions of interest, such as a city
- **Target Mapping mode**: Measurements taken over a specific point, such as a validation site

References: