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Sandia National Laboratories

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SPACE SITUATIONAL AWARENESS (SSA) OBSERVATORY
AUTONOMOUS COTS SYSTEM FOR UNMANNED SSA DATA COLLECTION

AUTONOMOUS SSA DATA COLLECTION

The SSA Observatory seeks to capture and produce nightly SSA data. Satellite observation tasks are generated during the day and automatically executed after sundown. Target tracking and imaging are fully autonomous. A robust safety monitoring systems enables operations without a human-in-the-loop. Image products are fused with extensive metadata, such as observing conditions, capture times, and pointing angles, for informed processing.

Nightly tasks are automatically generated from the NORAD catalog, based on anticipated visibility. Object visibility is determined from the flyover geometry and the expected brightness of the object. To generate tasks, the visibility conditions are checked for every object in the NORAD catalog for the proceeding night, and a task is created for each predicted visible object.

A webapp accompanies the system, where users may submit a task request for a desired target. When a user submits a task request for a target, the webapp presents a list of time windows for which the target is expected to be visible. Each time window is coupled with weather data from National Weather Service to inform the user of forecasted weather activity. An unfavorable weather forecast will not prevent a task from being submitted, but unsafe weather conditions detected during the task time window will prevent the task from being executed.

SSA Observatory, 2016

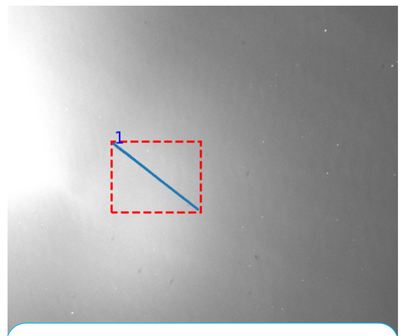
COMMERCIAL OFF-THE-SHELF

- ASTRO HAVEN 12' DOME
- ASTRO-PHYSICS 1600 GTO TELESCOPE MOUNT
- ASI 1600MM IMAGER
- FOCUSLYNX FOCUSER
- STARLIGHT XPRESS FILTER WHEEL
- BOLTWOOD CLOUD SENSORII WEATHER STATION
- NFOV SENSORS
  - 80MM
  - 11IN
  - 16IN

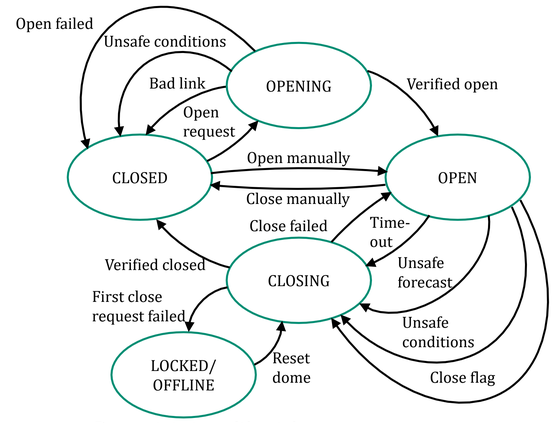
STREAK PROCESSING

Streak detection software can extract satellite position data, which is needed for orbit determination and closed-loop tracking.

Raw frame of Oneweb-0646
Collected with 80mm sensor



Processed frame of Oneweb-0646
Streak midpoint: (676.41, 1551.95)
Streak slope: -37.95°

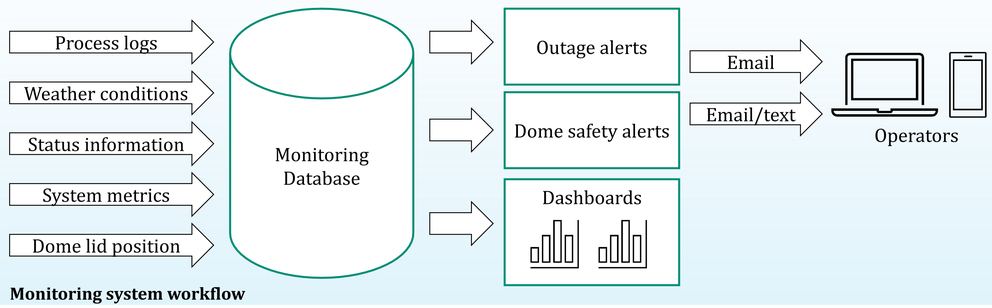


Dome state transition triggers

UNSUPERVISED & RESILIENT OPERATION

The SSA Observatory combines a local weather station, weather forecasts, and a connection monitor to ensure the dome is closed during hazardous conditions. As shown, the dome cannot open unless the weather is safe and the monitoring service is up. When the dome opens, a timer begins counting down. The local weather conditions and the weather forecast are periodically checked while the dome is open. If unsafe conditions are detected or the timer runs out, the dome closes.

The monitoring system, depicted below, actively gathers logs, system status, and host metrics from across the system. Email notifications are sent when systems go down or when logs stop flowing. Text notifications are sent when the dome remains open in the presence of unsafe conditions. The dashboards give operators the ability to view past and current system state and look at the specifics of previous events.



Monitoring system workflow

U.S. DEPARTMENT OF ENERGY
NNSA National Nuclear Security Administration

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