ISS Geocam Project: On-Orbit Digital Still Camera Pointing System (DSCPS)

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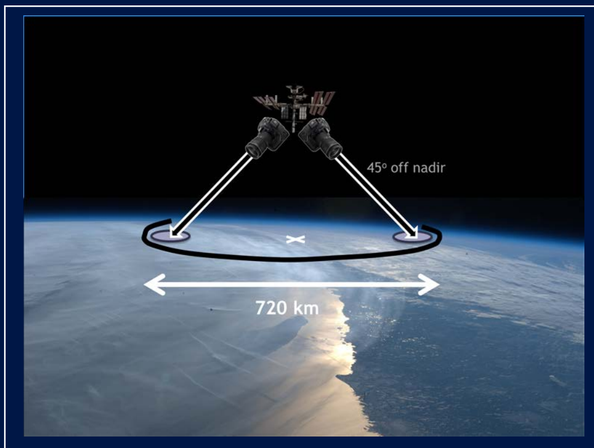
Project Drivers

- Current geolocation of ISS astronaut photo products (image centerpoint) **does not meet modern user expectations for image data** – fully geolocated (all pixels have geographic coordinates) data is now the norm
  - **Data delivered to USGS is available to International Disaster Charter requestors but not useful without full geolocation**
  - Spatial analysis, time series change detection analysis
  - Media outlet use with maps, animations
- Manual full geolocation of handheld imagery is labor-intensive (<1 hr – 2 hrs per image) using current software; **Geocam system provides an innovative and more efficient approach**



Astronaut photography from ISS is collected using COTS digital cameras with no native geolocation information. Camera look direction and viewing angle is unconstrained (left image); therefore the ISS nadir point is only useful as a starting geographic reference point.

Determination of the correct image centerpoint location within the envelope of uncertainty (right image) currently requires manual comparison of image features with other geolocated images or maps.

Project Objectives/Status

- **Improve quality** of geolocation to enable map overlays
- **Improve speed** of manual process; enable registering all new Priority 1 photos (~80/day)
  - Current process provides low-precision “center-point only” information
  - Slow manual process geolocates < 10% of 400+/day photos
- Provide **automated rough geolocation** data for all new photos; lay groundwork for **automated precision geolocation**
- **Funded by ISS Program to Phase I/II – development of ground system (MapFasten software/server configuration, and proof-of-concept calibration camera hardware demonstration (Spring 2015)**

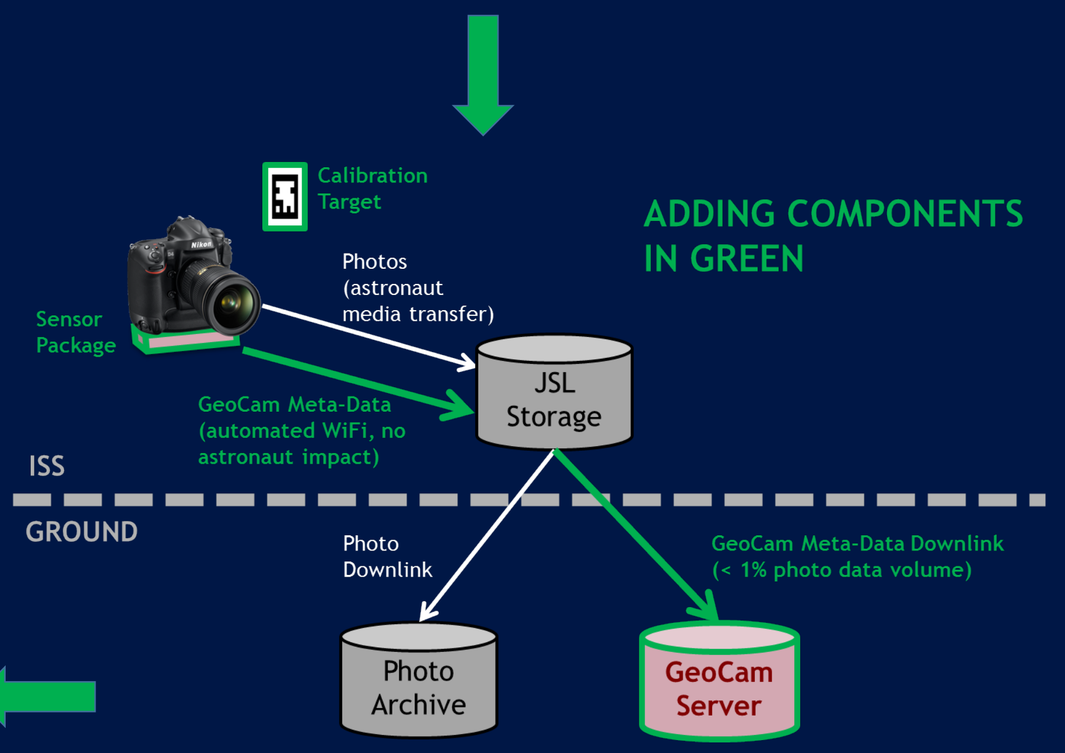
(Zoom @ 400 mm)

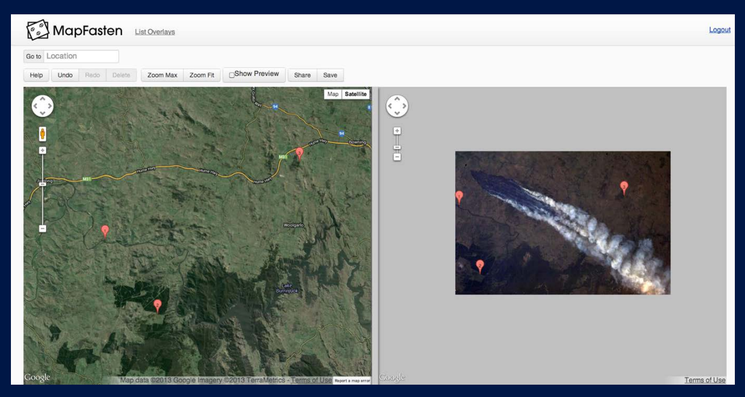
Condition	Pre-Geolocation Error	Worst-Case Geolocation Search	Post-Geolocation Error
Current	45° (360 km)	191x area (60 minutes)	1200 pixels (7500 m)
GeoCam (Minimum)	15° (120 km)	21x area (7 minutes)	50 pixels (330 m)
GeoCam (Ideal)	5° (33 km)	3x area (1 minute)	10 pixels (65 m)

Development Pathway

- Pointing Calibration Targets mounted in cupola
  - Ideally, semi-permanent mounting to avoid recurring setup time
- During photography, ensure some calibration target is occasionally in view of secondary camera
  - (Example: In view for at least 1 second every 5 minutes)
  - Given proper target placement, this may happen without explicit astronaut attention
  - Sensor package can use an audible tone to indicate rare cases when astronaut attention is needed
- Trade-off: More targets vs. higher chance calibration activity is needed

- Our approach is to record the sensor package timestamp when the camera shutter is released
  - Sense shutter release via Nikon 10-pin connector
- Later, on the ground, timestamp will be combined with ISS position history to infer camera position
  - At ISS orbital speed, one second time error = about 7 km position error
  - Sensor package clock should have subsecond absolute accuracy
- Currently determining easiest approach to receive accurate clock corrections via WiFi
  - Impact should be minimal





MapFasten software developed by NASA Ames Intelligent Robotics Group will be modified for rapid tie-point geolocation of astronaut photographs and hosted on the Geocam server to reside at JSC. The software will be integrated into the existing processing flow established for astronaut photographs by the Earth Science and Remote Sensing Unit.