Joint CSA/ESA/JAXA/NASA ISS Increments 3&38 Science Symposium
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Optical PAYload for Lasercom Science

OPALS

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Laser Communication

• Ever-growing demand for data rate and data volume in space exploration
  – Increase in science return from interplanetary missions
  – Connectivity via high-bandwidth terrestrial near-earth networks
  – Earth science via high-resolution remote sensing and imaging instruments
  – Time-of-flight for high precision ranging
Investigation Objective

- Demonstrate the downlink of a video from ISS to ground terminal via an optical communications link

- JPL Phaeton/Early Career Hire (ECH) training project
- Implemented as Class-D payload
- Downlink at ~30 – 50 Mb/s
OPALS Architecture

Berthing & Robotic Installation

ISS

MOS Commands & Uploads

1553 bus

1553 bus

Telemetry & Health

Flight System (ISS payload)

optical downlink video

optical beacon

Dragon CRS3
KSC SLC-40

MOS commands & Uploads

RF (TDRSS)

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MOS commands
Internet (TReK)

Telemetry & Data Queries

Mission Operations System

Telemetry & Link data

Internet

Voice commands/ISS ephemeris predicts

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Investigation Approach

- Ground station illuminates rising ISS (Elevation > 20°)
  - Use updated ISS ephemeris to blind point laser beacon to ISS
- OPALS flight system (FS) camera acquires and locks on laser beacon (976 nm)
- FS initiates downlink for duration of ISS pass
- Ground receives and stores downlink to extract video with post-processing
Importance Reason for ISS

- ISS is an accessible low-Earth orbiting platform ideally suited for preliminary verification of lasercom
  - Representative LEO slew-rates
  - Space environment including disturbance
  - Frequent ground contacts with varying link geometry
  - Relatively low cost for validation of acquisition and pointing i.e. the physical optical link
  - Provides ground operational experience with variances in atmospherics and weather
Expected Outcome

- Multiple successful acquisition/tracking and downlink will verify link predictions
  - Measure performance correlated to prevalent atmospheric conditions
  - Evaluation of platform disturbance and its effect on design of future laser communication systems
  - Allow LEO missions to evaluate suitability for high-rate downlink on data-intensive missions
  - Provide insights for inter-satellite laser communications
Earth Benefits/Spin-off

- Streaming video and high-definition imagery from space
  - Education and public outreach
  - Engaging students
  - Atmospheric characterization from space

- High-precision ranging from LEO platforms
  - Use of transponding mode

- Promoting concept of optical node above Earth atmosphere for communication/light-science with near-Earth and deep-space spacecraft