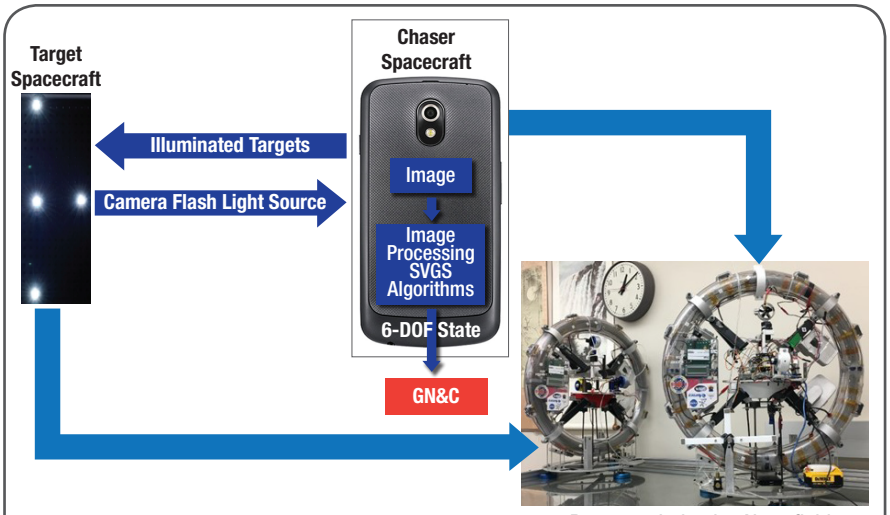
National Aeronautics and Space Administration

Smartphone Video Guidance Sensor (SVGS) for Small Sat Proximity Operations



Resonant Inductive Near-field Generation Systems (RINGS) RINGS/SVGS Demo.

Electromagnetic Formation Flying Closed-Loop Control Ground Demonstration

Overview

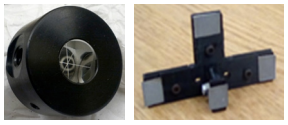
- Designed for cubesats snd small satellites, the SVGS is a low mass, low-cost COTS implementation of the Advanced Video Guidance Sensor designed for Automated Rendezvous and Capture.
- Based on an Android smartphone platform.
- Capture images using the smartphone camera and flash and analyzes the pattern of the illuminated retroreflectors on the target spacecraft using photogrammetry techniques to determine the range and relative orientation (6DOF state).
- Enables multi-spacecraft formation flying using cubesats or other small satellites.
- Size/Mass: 13.6 × 6.8 × 1.0 cm, 150 g (or smaller, platform dependent).
- Sensor Range: Up to 300 m, depending on target configuration.

Project Status

- Prototype testing performed in MSFC Flight Robotics Laboratory, currently at TRL 4 (2013).
- Implemented LED targets to improve accuracy and robustness (2017).
- Demonstrated formation flying in closed-loop control (3DOF) with RINGS ground demonstration at Florida Institute of Technology (FIT) (2017).
- Enabled demonstration of electromagnetic actuation for formation flying in RINGS ground demo at FIT (2018).
- Implemented on multiple platforms (2019).
  - Samsung Galaxy S8 Smartphone
  - Raspberry Pi3
  - INFORCE 6640-820 single board computer
- Camera calibrations to improve sensor accuracy (2019).
- Integrating SVGS/RINGS with Astrobee for flight onboard International Space Station (ISS) ~2022.

Target Options

Retro Reflectors



LED

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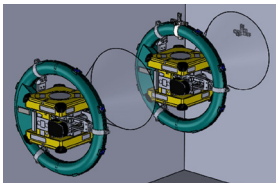
SVGS Output Rate (Platform Dependent)

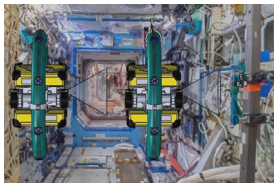
Platform	Output Rate
• Samsung S8 Smartphone	30 Hz
• INFORCE 6640-820	20Hz
• Raspberry Pi3	10Hz

SVGS Accuracy

	0–3 m	3–10 m	10–20 m	20–30 m
X, Y Lateral Position (m)	~0.02	<0.16	0.5	<1.5
Z Range Position (m)	~0.02	<0.13	<0.23	<0.47
RPY Attitude (deg)	~0.3	<2.0	<2.0	<3.0

SVGS/RINGS on Astrobee Onboard ISS (Target 2022)





Partnership between
NASA Marshall Space Flight Center
and Florida Institute of Technology

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