Docket #: S24-237

SHIRT: Satellite Hardware-In-the-loop Rendezvous Trajectories Dataset

The Satellite Hardware-In-the-loop Rendezvous Trajectory (SHIRT) dataset consists of images and pose labels associated with two rendezvous trajectory scenarios (ROE1 and ROE2) in Low Earth Orbit (LEO) created from two different sources. One is the OpenGL-based computer graphics renderer to create the synthetic images, and the other is the Testbed for Rendezvous and Optical Navigation (TRON) facility at the Space Rendezvous Laboratory (SLAB) of Stanford University which captures real images of a satellite mockup model illuminated with the diffuse light boxes to simulate Earth albedo light encountered in LEO.

In ROE1, the servicer maintains the along-track separation typical of a standard v-bar hold point while the target spins about one principal axis, whereas in ROE2, the servicer slowly approaches the target tumbling about two principal axes. The sequential images of the SHIRT dataset can be used to evaluate the robustness of machine learning models and vision-based navigation filters over time across domain gap.

Applications

- The data set can be used for any space rendezvous applications including but not limited to:
  - **Space Logistics**
  - On-Orbit Servicing
  - Debris Removal
  - Autonomous Rendezvous and Docking
  - Planetary Exploration
  - Teleoperation and Remote Sensing

Advantages

- **Novel** - First of its kind
- **Open Source**
- Domain Gap Bridging
- Enhanced Realism
- Improved Accuracy
- Cost-Effective Development
- Diverse Training Data
- Standardization:

Publications

- Park, T. H., D'Amico, S. Adaptive Neural-Network-Based Unscented Kalman Filter for Robust Pose Tracking of Noncooperative Spacecraft, Journal of Guidance, Control, and Dynamics, Vol. 46, No. 9, pp. 1671-1688 (2023).
- Park, T. H., D'Amico, S. Online Supervised Training of Spaceborne Vision during Proximity Operations using Adaptive Kalman Filtering. 2024 IEEE International Conference on Robotics and Automation (ICRA), Yokohama, Japan (2024).

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