TriDAR Model Based Tracking Vision System for On-Orbit Servicing

Stephane Ruel

Neptec Design Group Ltd

Ottawa, Canada

Outline

- TriDAR 3D Vision System Overview

- Active 3D Sensor Overview

- Targetless Tracking Approach

- TriDAR STS-128 DTO Mission Overview

- Way Ahead

TriDAR 3D Vision System Overview

- Model Based Tracking 3D Vision System
  - Uses geometry, no cooperative targets
  - Range up to ~3km
  - Full 6DOF relative pose up to ~200m
  - Applications in rendezvous & docking, robotics, navigation and landing
- Combines an active 3D sensor, thermal imager and embedded tracking software
  - Provides 6 DOF state vector out of the box in real-time
- Results from 6 years of R&D w/NASA & CSA
  - Originally developed for the HRV program
  - Flight Tested on STS-128
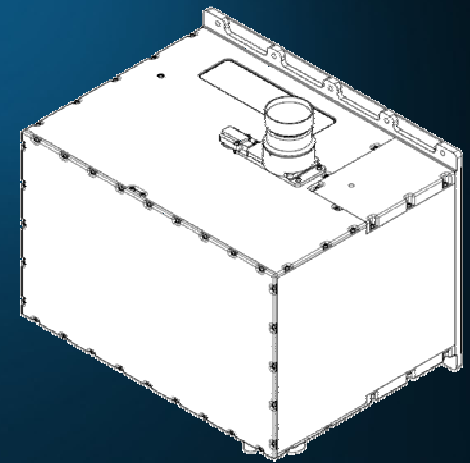
TriDAR 3D Active Sensor Overview

- Combines triangulation and LIDAR 3D imaging in a single optical path
  - Takes advantage of the complementary nature of triangulation and TOF
  - Optimal performance at both short and long range
  - Overlap range provides dual data source (1-15m)
- Fully random access
- Immune to lighting conditions
- Largely based on Neptec's Laser Camera System (LCS) flight hardware
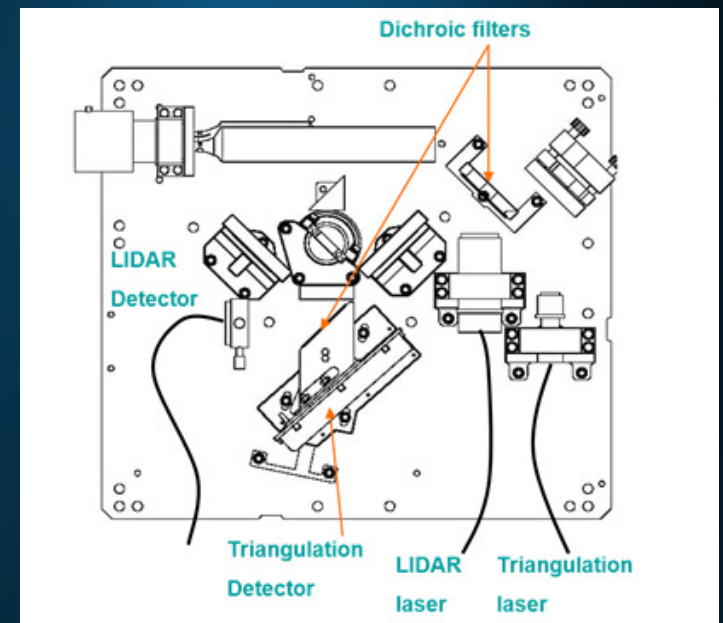
Targetless Tracking Approach

- Model Based Approach
  - Uses 3D model(s) of target(s) as reference
- More Information Less Data Approach (MILD)
  - Key to real-time performance
  - Acquire only data necessary to extract desired information
  - Maximizes geometric information at minimal cost
- Requires only sparse disorganized 3D data
  - Flexible, sensor independent approach
- Best fit data to reference model
  - Uses novel algorithm developed by Neptec that allows real-time ops
 - Very good robustness
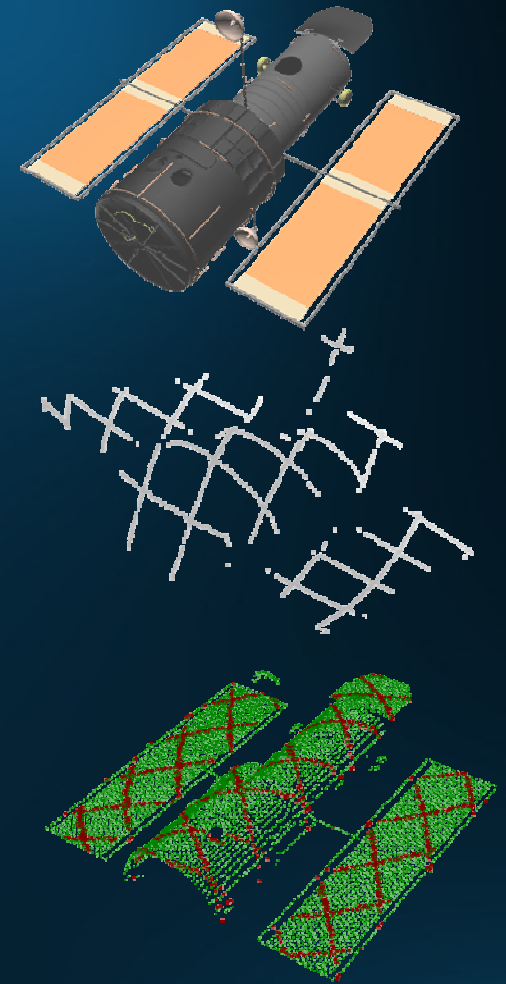
TriDAR STS-128 DTO Mission Overview

- "Evaluate "targetless" TriDAR Autonomous Rendezvous & Docking (AR&D) sensor technology in space"
    - TriDAR located on ODS next to TCS
    - Fully autonomous, real-time operations
        - Automatic target acquisition (ATA), Self monitoring and Re-acquisition
        - Automatic system re-acquire every 5 minutes to test ATA
- All processing performed locally on the sensor
- Data logged on a laptop computer in the crew compartment
    - Tracking solution displayed in real-time to the crew
- TriDAR met all primary mission objectives
    - Very good agreement with onboard navigation systems
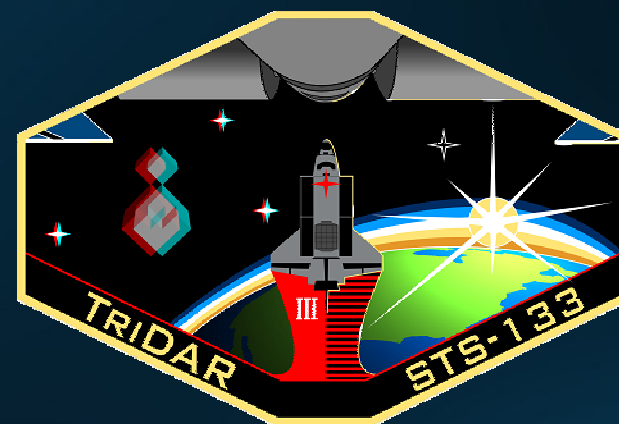   - Demonstrated advantage of direct relative measurements

STS-128 TriDAR DTO Mission
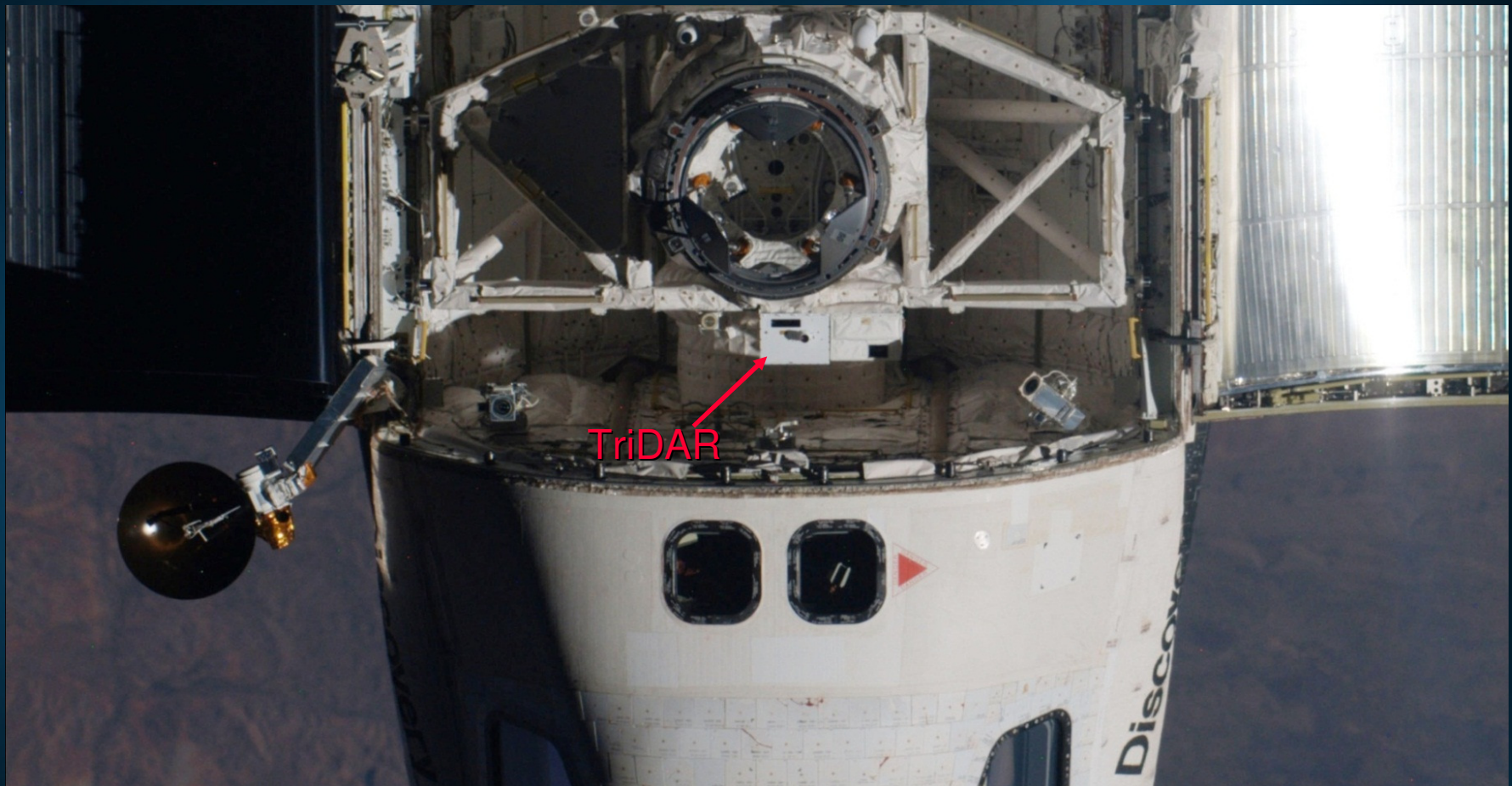
TriDAR

Way Ahead: STS-131 and STS-133 TriDAR DTO

- Improved model based tracking performance

- Improved tracking rate

- Real-time tumbling target tracking demonstration (during fly around)

- Targetless tracking using a passive thermal imager

- Improved real-time pilot displays

- Enhanced operational system configuration and validation process

Thank You!