Paper ID: 12969
oral

ASTRODYNAMICS SYMPOSIUM (C1)
Guidance, Navigation and Control (2) (2)

Author: Mr. Stephane Ruel
Neptec Design Group, Canada

Mr. Timothy Luu
Neptec Design Group, Canada
Mr. Andrew Berube
Canada

FLIGHT TESTING OF THE TRIDAR RENDEZVOUS AND DOCKING SENSOR ON THE SPACE SHUTTLE

Abstract

This paper presents results from flight tests performed on the Space Shuttle of the TriDAR rendezvous and docking sensor during the STS-128, 131 and 135 missions. The TriDAR was developed as a proximity operations sensor for Autonomous Rendezvous and Docking missions to non-cooperative targets in space. The system does not require the use of cooperative markers, such as retro-reflectors, on the target spacecraft. It is therefore well suited for servicing applications where a target spacecraft may not have been designed to be captured and/or may be tumbling. TriDAR includes a hybrid 3D laser rangefinder along with embedded model based tracking algorithms to provide 6 degrees of freedom (6 DOF) relative pose information in real-time. The vision system includes a thermal imager that provides range and bearing information for far range rendezvous operations. In partnership with the Canadian Space Agency (CSA) and NASA, the TriDAR vision system was space qualified and integrated onboard Space Shuttle Discovery and Atlantis to fly as a Detailed Test Objective (DTO) payload on missions to the International Space Station (ISS). The objective of the flight test program was to evaluate the sensor's ability to automatically acquire and track a known target in space using only its shape as a reference. All operations were to be performed autonomously in real-time and the solution generated displayed to the Space Shuttle crew. With STS-135, the TriDAR sensor successfully completed its flight test program. The system autonomously generated position and attitude state vectors of the Space Shuttle relative to the ISS and displayed it to the crew in real-time. The solution generated agreed with other onboard sensors and was successfully used to cross check other Orbiter instruments. The system successfully operated during the rendezvous, docking, undocking and fly-around phases of each mission. Successful long range acquisition and tracking from the onboard thermal imager was also achieved. Finally, on STS-135, TriDAR produced a historical set of 3D and thermal infrared data from the last flight of a Space Shuttle around the ISS. Having successfully reach maturity through this test program, TriDAR technology has recently been selected to serve as a proximity operations sensor for the Cygnus ISS resupply spacecraft scheduled to fly in 2013.