"LADAR Vision Technology for Automated Rendezvous and Capture"

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LADAR Vision Technology at Autonomous Technologies Corporation consists of two sensor/processing technology elements: high performance long range multifunction coherent Doppler laser radar (LADAR) technology; and short range integrated CCD camera with direct detection laser ranging sensors. Algorithms and specific signal processing implementations have been simulated for both sensor/processing approaches to position and attitude tracking applicable to AR&C. Experimental data supporting certain sensor measurement accuracies have been generated.

Application of LADAR technology to rendezvous and docking was first addressed by ATC personnel in 1983 when Martin Marietta studied a LADAR system for Orbital Maneuvering Vehicle (OMV). A 10 Watt/5 inch CO_2 LADAR was shown to provide 50 km acquisition against a non-augmented Hubble Space Telescope sized target. Development issues were determined to be significant for such a system however, and advances in technology were desired. ATC was formed in 1985 and innovations in LADAR technology addressing AR&C were proposed via the Small Business Innovation Research (SBIR) Program from 1987 to the present.

A single sensor solution (1 cu.ft./50#) to AR&C has been proposed (1990) that meets the Laser Docking Sensor Flight Experiment Program requirements where target enhancements (retro-reflectors) are permitted. A high performance Carbon Dioxide (CO_2) laser heterodyne Doppler radar system has been prototyped under a NASA/JSC SBIR Phase II technology program. Hardware scaling to an LDS flight configuration was shown to be supported by current military programs. Simulations for this CO_2 LADAR has shown capability for LDS long range (100 nmi.) rendezvous acquisition and position tracking through close range 6DOF Pose tracking for proximity operations (near zero range) addressing capture/bearthing.

A 6DOF tracking approach not requiring target enhancements (skin track) is also being developed by ATC under SDIO SBIR sponsorship. This LADAR Vision Processor technology implements a CAD model based tracking approach utilizing the 3D geometry of objects. Robotic adaptive grasping based on 6DOF track of both object and end-effector has been demonstrated in a laboratory setting. Experimental evaluation of the sensor and processing technology is planned for simplified scenarios employing both enhanced and non-cooperative targets. Further development is required to extend this basic capability to address specific applications with complex configurations. Recent work is examining a much simpler, low cost approach for short range 6DOF tracking utilizing an integrated CCD camera and solid state or semiconductor laser rangefinder.

ATC proposes a program to simulate Cargo Transfer Vehicle (CTV) AR&C operations including evaluation of critical sensor/processor parameters critical to CTV/NLS requirements.