

ABSTRACT:

Texas A&M University LASR Laboratory Test-bed For DARPA's Phoenix Program

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LASR (Land, Air, and Space Robotics) Laboratory is an advanced robotics facility operated by the Department of Aerospace Engineering at Texas A&M University. LASR is a recently established national test-bed for conducting high fidelity 6-DOF space proximity research. The lab enables research in robotic sensing and control with a focus on fusing the various technologies to enhance proximity operation, human-robot interaction. These include stereo vision, computational vision, advanced sensor development, swarm robotics, and autonomous aerial vehicles. LASR has been under development from 2006-present with funding coming from AFRL, NASA, The Boeing Company, and the IC community. Conveniently located adjacent to Easterwood Airport, LASR Labs provides a world-class robotic test-bed. Our indoor robotics arena is the centerpiece of the lab that consists of: (1) 2000 sq. ft. of flat floor for conducting multi-vehicle robotic interaction studies; (2) 3 state-of-the-art metrology systems provide high accuracy navigation for motion measurement and anomaly resolution studies; (3) ~mm precise 6DOF position and rate information is available @ 100 HZ; (4) Reconfigurable wireless communication; (5) Autonomous interactions; (6) Un-tethered circumnavigation; (7) Large translational and rotational motions; (8) Contact dynamics; (9) Robotic manipulation; (10) Real-time control, with all sub-systems re-configurable in a realistic environment. Significantly, the main robotic systems are designed to be portable, and can be quickly moved from the unclassified environment of LASR laboratory to enable analogous research in other facilities. Of great importance for DARPA's Phoenix program, LASR provides key national hub of capabilities for supporting the maturation of critical technologies, V&V of software and hardware, as well as enabling comprehensive investigations into mission planning. The range of ground experimentation made possible by the LASR capabilities is vital to retire risk prior to flight. Finally, experimental capabilities to address anomaly resolution for both pre-flight studies and in support the missions while the systems are on-orbit, are a vital asset to ensure mission success.

Beyond robotic hardware developments LASR is conducting advanced research and development for proximity sensing in two areas: (1) Computational vision, and (2) Sensor Design. We are also researching embedded systems design where computer and software architecture optimization are key issues. TAMU's computational vision research is addressing real-time sensor fusion to produce high definition geometry of space objects, with simultaneous high precision relative pose navigation. This work supports 6-DOF proximity navigation by providing millimeter and milliradian precision, thereby enabling high fidelity object recognition, situational awareness, and high precision control. TAMU's sensor development efforts are focused on building, with its industrial partner SPEC, HD6D: a revolutionary 4th generation LADAR with the Phoenix-relevant SWAP characteristics: FOV 30°, range measurement at 12M/sec, range to target errors 3mm (0-300m), and .5m at 25 km, mass < 3 kg, power < 30 W.