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PROPOSAL NUMBER	A062-215-1693
TITLE	Real-time Radar Perception For UGV Navigation
PROJECT MANAGER	Mark Ollis (724) 934-8965 mollis@appliedperception.com
COMPANY	Applied Perception, Inc. 220 Executive Drive, Suite 400 Cranberry Township PA 16066 Minority Owned: No Veteran Owned: No Number of Employees: 13
KEYWORDS	UGV navigation, radar processing, sensor fusion, autonomous perception, terrain classification
ABSTRACT	Though ladar and stereo have received far more attention for UGV navigation use, radar offers some unique benefits. Many radar systems have the ability to partially penetrate thin vegetation, fog, smoke, and other obscurants while detecting hidden solid obstacles. Also, some systems provide useful information in addition to range; for example, Doppler radars measure target relative velocities as well. Weaknesses of radar-based sensing systems (such as limited angular resolution and erratic readings due to specular reflections) are generally quite different than those of stereo or ladar, so that radar data can be particularly useful when fused with another sensing modality. Further, a number of inexpensive radar units are currently commercially available, marketed primarily as automotive driver warning systems. This proposal describes an effort to combine some of the unique advantages of radar with more widely-used ranging devices for UGV applications. Phase I work aims to design and partially implement a UGV perception system, using a COTS radar unit, to merge radar sensor data with ladar in real time to generate useful terrain characterizations for autonomous navigation. Also included is a Phase I option for modifying this design to support stereo data.
BENEFITS	The primary anticipated benefit from this work is an improvement in the state-of-the art in autonomous vehicle perception, particularly in bad weather and/or terrain containing dense vegetation. To date, intelligent autonomous and semi-autonomous navigation in outdoor, off-road terrain remains an open challenge, and past attempts to engineer perception systems that can discern passable terrain from obstacles have largely concentrated on stereo vision and ladar. Though these efforts have had some success, it is becoming apparent that no single sensor modality is optimal for all possible situations. Combining radar

	with other sensing technologies should result in an improved perception capability across a wider variety of environments. Demand for a technically successful radar fusion system (one which was able to demonstrate measurably improved perception for UGV use) would be quite strong in both the military and civilian sectors. The limitations of current ladar- and stereo- based autonomous vehicle perception are widely recognized, as is evidenced by the extensive ongoing UGV research efforts in this area in both military and corporate laboratories. A successful system could be useful in a wide range of applications which require outdoor vehicle work, including military missions, agriculture, construction, mining, and general transportation.