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LADAR TRANSMITTING AND RECEIVING SYSTEM

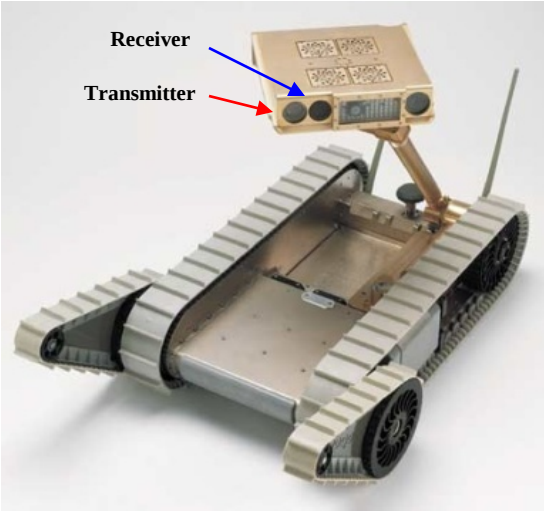
Introduction

This invention presents a major advance in the development of a compact, low-cost and low-power laser radar (LADAR) imager for small unmanned (robotic) ground vehicles.

Researchers at the Sensors and Electron Devices Directorate of the U.S. Army Research Laboratory (ARL), Adelphi, Maryland, designed, built and successfully tested a new LADAR-based sensor system for creating three-dimensional maps of ground-level surroundings to enable independent navigation and obstacle avoidance. The ARL invention is already providing substantial image improvement over other commercially available LADAR systems in engineering tests. Moreover, it is a relatively simple, versatile design that could greatly expand the spectrum of autonomous robot applications.

Concept

In recent years, the market has been searching for better short-range LADAR imagers for small unmanned ground vehicles to enhance capabilities such as navigation, obstacle/collision avoidance, and target detection and identification. To date, commercial LADARs have been flawed by issues such as low pixelization, insufficient range or range resolution, imaging artifacts, no daylight operation, bulky size, high power consumption and high cost.



ARL LADAR–based system mounted on iRobot Explorer PackBot (Image source: ARL)

In response, ARL researchers developed a robust and simple receiver that solves these outstanding problems. It is based on commercial-off-the-shelf (COTS) technology, but produces excellent performance: a large image size of 256 x 128 pixels with a 6-Hz frame rate; a 60° x 30° field of regard; a 20-meter range; eye-safe operation; and a 40-centimeter range resolution (with provisions for super-resolution when needed). ARL integrated its system on an *iRobot PackBot* (shown in the image above) and has generated a series of test results with the transceiver installed in the arm-mounted sensor head. All other electronics including the data acquisition, signal processing, power distribution and ancillary subsystems are also built and operating. ARL continues to refine the LADAR system by developing different software-driven applications.

Invention Overview

- *Innovative, low-cost LADAR receiver design*
- *Receiver components do not require special equipment or fabrication techniques*
- *Enables development of robots to perform a variety of tasks from routine to risky: package delivery, janitorial services, lawn maintenance, area patrol and surveillance/explosives disposal*
- *TRL 5 – Fully functioning engineering prototype on robotic platform; test data available*
- *Patent application filed*

Doing Business with ARL

- *ARL is a leader in partnering with domestic firms*
- *Successfully developed and implemented innovative tools to ease the technology transfer process*
- *Tools include Patent License Agreements (PLAs), Cooperative Research and Development Agreements (CRADAs), Test Services Agreement (TSA) and others*
- *Visit www.arl.army.mil for more information*

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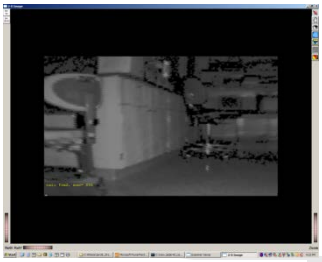
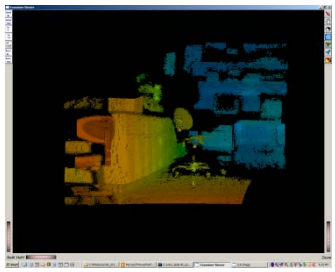
Features/Capabilities/Intellectual Property

The ARL LADAR receiver is based on two novel features. The first is the use of a tapered fiber bundle to increase the light capture area, or the optical gain, of the receiver while permitting 60° field of view. A classical lens approach cannot yield any optical gain in this case. ARL's method increases optical gain by as much as tenfold, thus reducing laser power from difficult to practical levels. The other ARL receiver innovation is the use of large-area detectors to increase the receiver capture area and further improve the signal-to-noise ratio. Large-area detectors have high capacitance, which can sharply limit bandwidth if the photocurrent is fed directly into a 50-ohm microwave amplifier. Fortunately, ARL has overcome this obstacle by devising a feedback circuit that maintains high bandwidth while reducing amplifier instability.

Scene Photo
(Images source: ARL)



Grey Scale LADAR Image



False Color LADAR Image

Potential Markets/Applications

There are many potential commercial uses for ground robots employing this low-cost, inexpensive and low-power LADAR receiver/transmitter invention. From simple tasks (e.g., delivering packages, picking-up trash, sweeping floors, etc.) in both indoor and outdoor environments to law enforcement and first responder duties (e.g., disarming explosives, collecting samples of suspicious materials, etc.). Other potential applications/industries might include:

Manufacturing:	Robotic safety/control
Scene archiving:	Forensic, archeological, etc.
Media/Cinema:	Capture range/depth data for emerging 3-D movie and TV markets

Key Advantages & Benefits

- *Low cost*
- *Compact size and highly configurable*
- *Uses COTS components*
- *Receiver requires no precision alignment*
- *Provides clear, more highly pixilated images at greater distances than like LADAR systems (Up to 20 meters vs. 2.6 meters)*
- *Inventor team available to work with commercialization partner*

Contact Information

This technology was developed by ARL. It is now available for licensing and CRADA opportunities.

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