Coherent Laser Vision System (CLVS)

Developer: Coleman Research Corporation
Contract Number: DE-AR21-94MC31190
Crosscutting Area: Robotics

Deactivation & Decommissioning FOCUS AREA

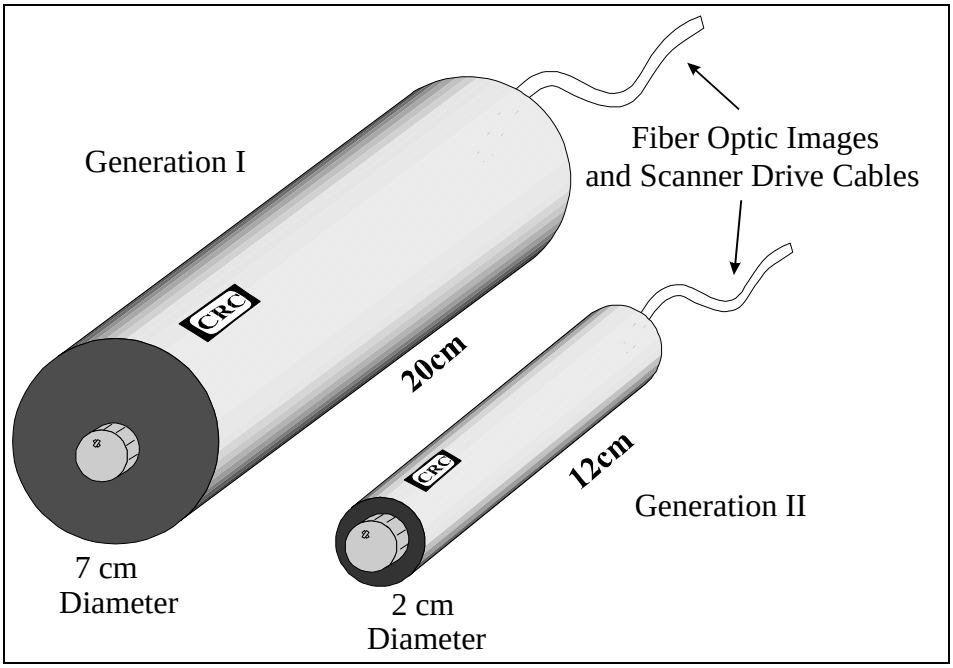
Problem:

Robotic systems require detailed position and orientation data throughout the volume in which they operate. Systems that can provide accurate and reliable data do not exist. As a result, the full capability of robotic operations has been severely hampered. Existing three-dimensional vision technology lacks resolution and is sensitive to ambient lighting conditions and surface shading.

Without reliable, accurate, and timely position and orientation data, robotic operations face severe restrictions to avoid collisions and in conducting contact operations. Various techniques including world models and simulations exist to work around these difficulties, but the challenges become even more severe if the work area itself is dynamic, i.e., other objects are moving or the scene is changing.

Solution:

A sensor that can provide timely, accurate, and reliable three-dimensional position and orientation data in a dynamic environment. The Coherent Laser Vision System (CLVS) is a lightweight, compact, robust sensor that provides raster scanned images of 256 x 256 pixels at a rate of one frame per second. The data provided is true three-dimensional data of each pixel. The CLVS performs equally well in any ambient lighting conditions and is not degraded by surface shading or the texture of the surface. With this capability, autonomous robotic operations will be significantly enhanced. The precise three-dimensional data can be integrated directly with the robotic device, enabling it to calculate its relative position within the overall scene and to other objects in the scene.



Benefits:

- Simulations or remote operation by humans will not be necessary
- Robots will be able to function in dynamic environments
- Able to detect low-contrast features and those of minor surface distortions
- True robotic operations functioning on a real-time basis

Technology:

The CLVS is a fiber optic coupled FMCW coherent laser radar. The

radar uses the relatively large tuning range of injector laser diodes to achieve greater precision than available with other techniques. An eye-safe laser source is used. An acousto-optic scanner with no moving parts is used to steer the laser beam and enable random addressability of all pixels. A smart digital receiver that retains knowledge of which pixels have recently changed permits an efficient processing scheme by avoiding broad range searches and concentrating the effort on the dynamic portions of the scene. The fiber optic architecture of the system offers an extremely robust, compact design.

The scanner will be an extremely small device. The transmitter, receiver, processor, power supply, etc. will be packaged in a standard-size portable half-rack that can also serve as a shipping container. For specific applications, the overall system size can be reduced. The scanner can be located separately from the rest of the system since it is connected to the receiver/transmitter by a fiber optic cable.

The Phase I proof-of-concept instrument has been built and demonstrated. Its 128 X 128 frame size and 1.5 m range will be expanded to 256 X 256 and greater than 5 m in Phase II.

Contacts:

Coleman has been successful in the development and prototyping of robotic, sensor and signal processing hardware/software for geophysical modeling. This technology is now being applied to the Department of Energy's (DOE's) environmental restoration programs. For information on this project, the contractor contact is:

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DOE's Federal Energy Technology Center supports the Environmental Management - Office of Science and Technology by contracting the research and development of new technologies for waste site characterization and cleanup. For information regarding this project, the DOE contact is:

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