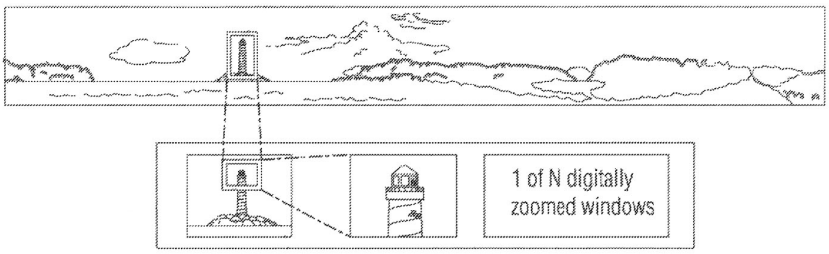
National Aeronautics and
Space Administration



TECHNOLOGY SOLUTION

Optics

High-Resolution, Continuous Field-of-View, Nonrotating Imaging System

A high-resolution imaging system that yields a continuous 360-degree field of view without mechanical rotation

NASA's Jet Propulsion Laboratory has developed a novel imaging system especially suitable for use in a periscope head that yields a nonrotating 360-degree view of the surrounding environment. With conventional periscopes, the instantaneous field of view (FOV) is limited by the entrance aperture, so the user sees an apparent tunnel. Wide-angle coverage has been attempted using multiple imagers, but state-of-the-art systems cannot simultaneously provide narrow- and wide-FOV scene visualization. JPL's imaging system improves upon these systems by using multiple camera arrays, each of which encloses a combination of wide-FOV imagers and narrow-FOV imagers. Because this imaging system displays a full 360-degree seamless FOV and allows the user to select regions for higher resolution inspection, it can simultaneously carry out a number of diverse visual tasks, including surveillance, vision-based navigation, automatic target recognition, and tracking.

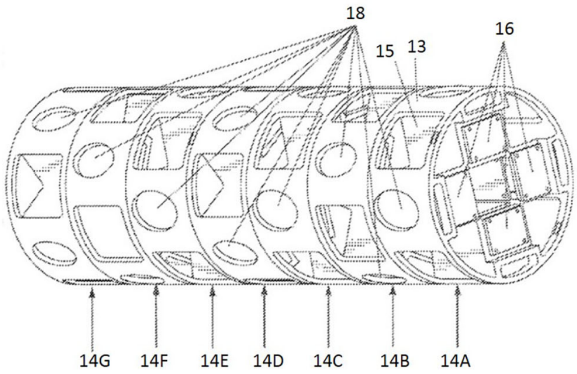
BENEFITS

- Combination of wide- and narrow-FOV imagers allows for simultaneous narrow- and wide-FOV scene visualization
- Interactive graphical user interface displays a full 360-degree FOV and allows the user to select regions for higher resolution inspection
- Imaging system can concurrently perform a number of diverse visual tasks, including surveillance, vision-based navigation, automatic target recognition, and tracking

THE TECHNOLOGY

JPL's high-resolution complementary metal-oxide semiconductor (CMOS) imaging system comprises two major elements: a sensor head for scene acquisition and a control apparatus with distributed processors and software for device control, data handling, and display. The sensor head is configured as a cylinder suitable for use on the existing mast of conventional periscopes and has seven decks. Each deck encloses a combination of wide-FOV CMOS imagers (i.e., full-field imagers [FFIs]) and narrow-FOV CMOS imagers (i.e., tracking zoom imagers [TZIs]). The control apparatus includes four TZI processors, one FFI processor, one host processor, and an optional automatic target recognition (ATR) processor for high-speed, high-precision target detection, identification, and tracking.

A high-resolution, continuous FOV, nonrotating imaging system has been demonstrated using readily available CMOS imagers. The image processing and system-level control electronics are instantiated in six conventional PC104 stacks (one for each processor) and contained in a 10x50x20-cm housing, which has a footprint approximately the size of a standard laptop computer. The display system is computer workstation hosting an interactive graphical user interface that allows the user to exercise all of the operational states of the system (e.g., search, tracking, display, high-resolution windowing, etc.).



The sensor head includes an imaging array with seven cylindrical decks (14A through 14G) stacked end-to-end. Each deck includes an outer wall (13) and closed internal partitions (15) forming a honeycomb of compartments for the imagers. Deck 14A encloses four wide FOV imagers and each of the remaining decks (14B through 14G) encloses four narrow FOV imagers.

APPLICATIONS

The technology has several potential applications:

- Aerospace - planetary exploration
- Imaging systems - surveillance, navigation, target recognition

PUBLICATIONS

Patent No: 7,773,121

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NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

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