

of 12.5 mm. The surface wave is produced by the nature of piezoelectric material to contract or expand when subjected to an electric field.

Driving the IDT to generate wave at high amplitudes provides an actuation mechanism where the surface particles move elliptically, pulling powder particles on the surface toward the wave-source and pushing liquids in the opposite direction. This behavior allows the

innovation to separate large particles and fluids that are mixed. Fluids are removed at speed (7.5 to 15 cm/s), enabling this innovation of acting as a bladeless wiper for raindrops. For the windshield design, the electrodes could be made transparent so that they do not disturb the driver or pilot.

Multiple IDTs can be synchronized to transport water or powder over larger distances. To demonstrate the

transporting action, a video camera was used to record the movement. The speed of particles was measured from the video images.

This work was done by Yoseph Bar-Cohen, Xiaoqi Bao, Stewart Sherrit, Mircea Badeescu, and Shyh-shiuh Lih of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-46252

Compact Autonomous Hemispheric Vision System

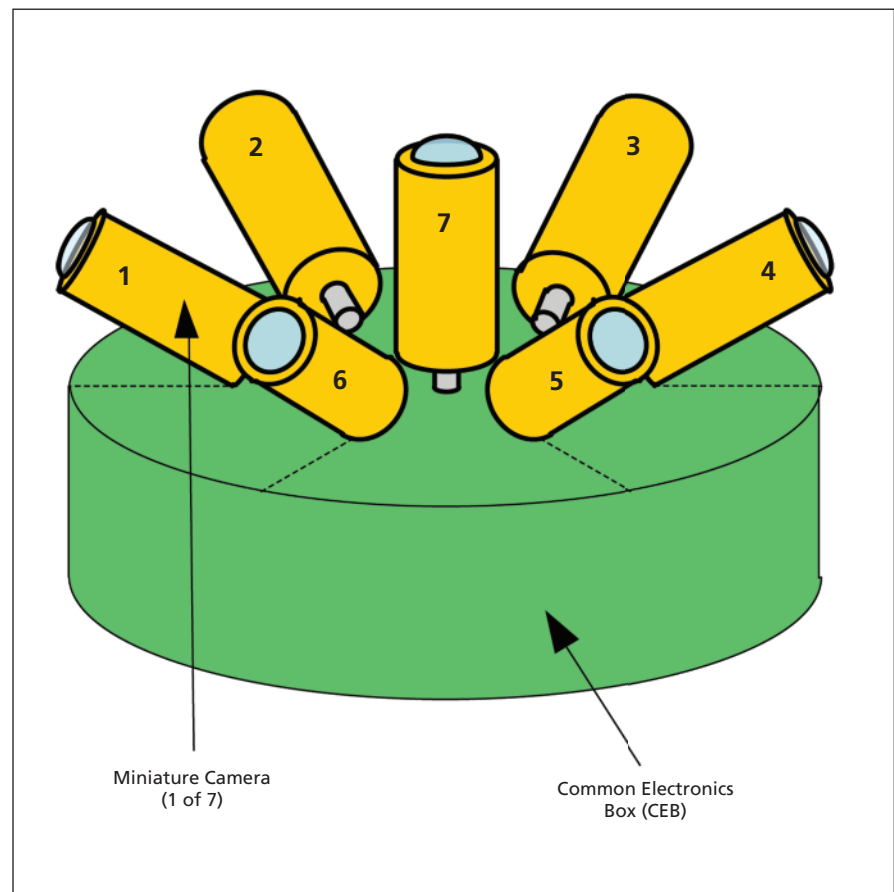
System has no moving parts and features expanded capabilities.

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Solar System Exploration camera implementations to date have involved either single cameras with wide field-of-view (FOV) and consequently coarser spatial resolution, cameras on a movable mast, or single cameras necessitating rotation of the host vehicle to afford visibility outside a relatively narrow FOV. These cameras require detailed commanding from the ground or separate onboard computers to operate properly, and are incapable of making decisions based on image content that control pointing and downlink strategy. For color, a filter wheel having selectable positions was often added, which added moving parts, size, mass, power, and reduced reliability.

A system was developed based on a general-purpose miniature visible-light camera using advanced CMOS (complementary metal oxide semiconductor) imager technology. The baseline camera has a 92° FOV and six cameras are arranged in an angled-up carousel fashion, with FOV overlaps such that the system has a 360° FOV (azimuth). A seventh camera, also with a FOV of 92°, is installed normal to the plane of the other 6 cameras giving the system a >90° FOV in elevation and completing the hemispheric vision system. A central unit houses the common electronics box (CEB) controlling the system (power conversion, data processing, memory, and control software).

Stereo is achieved by adding a second system on a baseline, and color is achieved by stacking two more systems (for a total of three, each system equipped with its own filter.) Two connectors on the bottom of the CEB provide a connection to a carrier (rover,



View of the Baseline 7-Camera Concept (360° horizontal FOV, >90° vertical FOV)

spacecraft, balloon, etc.) for telemetry, commands, and power. This system has no moving parts.

The system's onboard software (SW) supports autonomous operations such as pattern recognition and tracking. For example, when the system is commanded to detect and track an object of interest, the SW continuously reads

data from all the cameras until the object appears in one (or more) camera's FOV. The SW then reads these camera(s) and only returns to Earth the portion of the data that includes the object of interest.

Each camera weighs 50 g, measures 2 cm in diameter, 4 cm in length, and consumes less than 50 mW. The central elec-

tronics is a cylinder 14 cm in diameter and 4 cm thick. Variations with different and smaller form factors are possible.

By using the massively parallel architecture inherent to field-programmable gate arrays (FPGAs), per-imager processing may be performed concurrently by separate computational units within the FPGA. This architecture allows tracking

algorithms to scan the entire FOV for a set of features and then switch to a second operating mode that performs processing targeted to only the imagers capturing those features. This architecture would provide considerable bonus to science by improving the efficiency of long-range survey with no additional mass and very small power cost.

This work was done by Paula J. Pingree, Thomas J. Cunningham, Thomas A. Werne, Michael L. Eastwood, Marc J. Walch, and Robert L. Staehle of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-48172

A Distributive, Non-Destructive, Real-Time Approach to Snowpack Monitoring

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This invention is designed to ascertain the snow water equivalence (SWE) of snowpacks with better spatial and temporal resolutions than present techniques. The approach is ground-based, as opposed to some techniques that are air-based. In addition, the approach is compact, non-destructive, and can be communicated with remotely, and thus can be deployed in areas not possible with current methods.

Presently there are two principal ground-based techniques for obtaining SWE measurements. The first is manual snow core measurements of the snow-

pack. This approach is labor-intensive, destructive, and has poor temporal resolution. The second approach is to deploy a large (e.g., 3×3 m) snowpillow, which requires significant infrastructure, is potentially hazardous [uses a ≈200-gallon (≈760-L) antifreeze-filled bladder], and requires deployment in a large, flat area. High deployment costs necessitate few installations, thus yielding poor spatial resolution of data. Both approaches have limited usefulness in complex and/or avalanche-prone terrains. This approach is compact, non-destructive to the snowpack, provides high

temporal resolution data, and due to potential low cost, can be deployed with high spatial resolution.

The invention consists of three primary components: a robust wireless network and computing platform designed for harsh climates, new SWE sensing strategies, and algorithms for smart sampling, data logging, and SWE computation.

This work was done by Jeff Frolik and Christian Skalka of the University of Vermont for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16352-1