

sample frequency in excess of the symbol rate.

Sample-clock phase-control feedback has direct applications in optical and radio frequency communication systems

for satellite and deep space applications, as well as other applications in high-precision timing.

This work was done by Kevin J. Quirk, Jonathan W. Gin, Danh H. Nguyen, and

Huy Nguyen of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-47663

360° Camera Head for Unmanned Sea Surface Vehicles

NASA's Jet Propulsion Laboratory, Pasadena, California

Autonomous navigation and control for unmanned sea surface vehicles requires a visual sensing system to provide a 360° view from the vehicle deck for situational awareness. Successful operation required a sensing system mechanically packaged to withstand weather, sea spray, and an environment of continual motion and mechanical shock. A low-cost, easily manufacturable, watertight, and mechanically robust sensing system was developed for autonomous navigation and intelligent control.

The 360° camera head consists of a set of six color cameras arranged in a circular pattern such that their overlapping fields of view give a full 360° view of the immediate surroundings. The cameras are enclosed in a watertight container along with support electronics and a power distribution system. Each camera views the world through a

watertight porthole. To prevent overheating or condensation in extreme weather conditions, the watertight container is also equipped with an electrical cooling unit and a pair of internal fans for circulation.

Most JPL systems use cameras that are pointed at targets either through actuation or motion of the host vehicle. The 360° six-camera layout allows full situational awareness in all directions with no actuation required. Also novel is the watertight design, which encases all six cameras in a cylinder with six symmetrically placed windows. Each window employs a porthole-style design, in which the circular glass pane is sealed against an O-ring to prevent leaking. All cylinder access panels are similarly sealed with O-rings, and the electrical cooling unit, which sits half inside and half outside

the camera head, is sealed with closed cell silicone foam.

This design proves the utility of 360° visual sensing to enhance situational awareness for Naval Unmanned Sea Surface Forces. The concept could be applied to future space missions to increase visual situational awareness without increasing actuation requirements.

This work was done by Julie A. Townsend, Eric A. Kulczycki, Reginald G. Willson, Terrance L. Huntsberger, Michael S. Garrett, Ashitey Trebi-Ollennu, and Charles F. Bergh of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov.

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, NASA Management Office-JPL. Refer to NPO-47717.

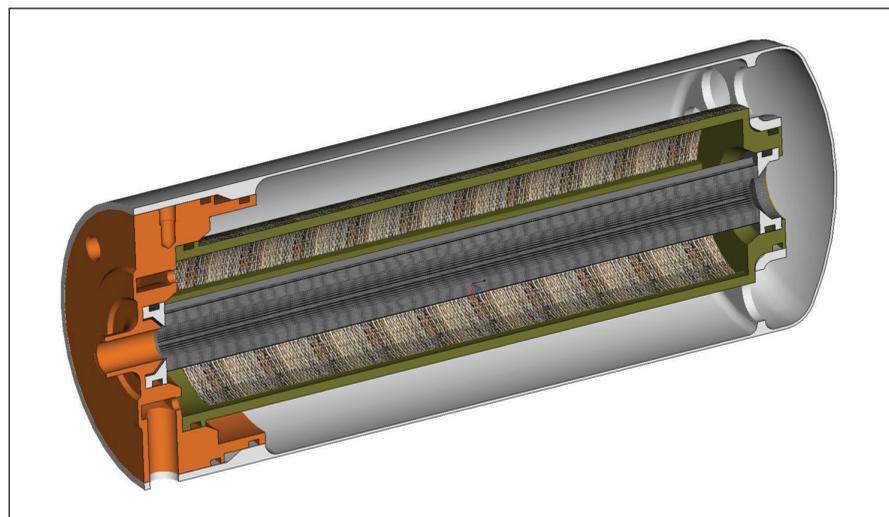
Microgravity Passive Phase Separator

There are no moving parts and there are no failure modes that involve fluid loss.

Lyndon B. Johnson Space Center, Houston, Texas

A new invention disclosure discusses a structure and process for separating gas from liquids in microgravity. The Microgravity Passive Phase Separator consists of two concentric, pleated, woven stainless-steel screens (25- μm nominal pore) with an axial inlet, and an annular outlet between both screens (see figure). Water enters at one end of the center screen at high velocity, eventually passing through the inner screen and out through the annular exit. As gas is introduced into the flow stream, the drag force exerted on the bubble pushes it downstream until flow stagnation or until it reaches an equilibrium point between the surface tension holding bubble to the screen and the drag force.

Gas bubbles of a given size will form a "front" that is moved further down the



Microgravity Passive Phase Separator

length of the inner screen with increasing velocity. As more bubbles are added, the front location will remain fixed, but additional bubbles will move to the end of the unit, eventually coming to rest in the large cavity between the unit housing and the outer screen (storage area). Owing to the small size of the pores and the hydrophilic nature of the screen material, gas does not pass through the screen and is retained within the unit for emptying during ground processing. If debris is picked up on the screen, the area closest to the inlet will become clogged, so high-velocity flow will persist farther down the length of the center screen, pushing the bubble front further from the inlet of the inner screen. It is desired to keep the velocity

high enough so that, for any bubble size, an area of clean screen exists between the bubbles and the debris.

The primary benefits of this innovation are the lack of any need for additional power, strip gas, or location for venting the separated gas. As the unit contains no membrane, the transport fluid will not be lost due to evaporation in the process of gas separation. Separation is performed with relatively low pressure drop based on the large surface area of the separating screen. Additionally, there are no moving parts, and there are no failure modes that involve fluid loss. A patent application has been filed.

This work was done by Matthew Paragano, William Indoe, and Jeffrey Darmetko of

Hamilton Sundstrand for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809.

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act {42 U.S.C. 2457(f)} to Hamilton Sundstrand. Inquiries concerning licenses for its commercial development should be addressed to:

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Refer to MSC-25058-1, volume and number of this NASA Tech Briefs issue, and the page number.