gling an output pin creating a square wave signal. If the system hangs completely prior to reporting its health status, the square wave is no longer generated. This absence of the square wave, whether intentional or because the Health Manager is hung, indicates bad health, analogous to a deadman switch. This is done by creating a Health Manager Reporting Task, which loops and pends on a semaphore. A timer Interrupt Service Routine gives the semaphore that allows the Health Manager to run. When the Health Manager Reporting Task receives the semaphore, it reads the system health status. If the status is good, an output pin is toggled. If the status is bad health, it latches the system's bad health variable so it can never switch back to good health and stops the square wave.

This work was done by Roger Zoerner of Kennedy Space Center. Further information is contained in a TSP (see page 1). KSC-12809

Stereo Imaging Miniature Endoscope

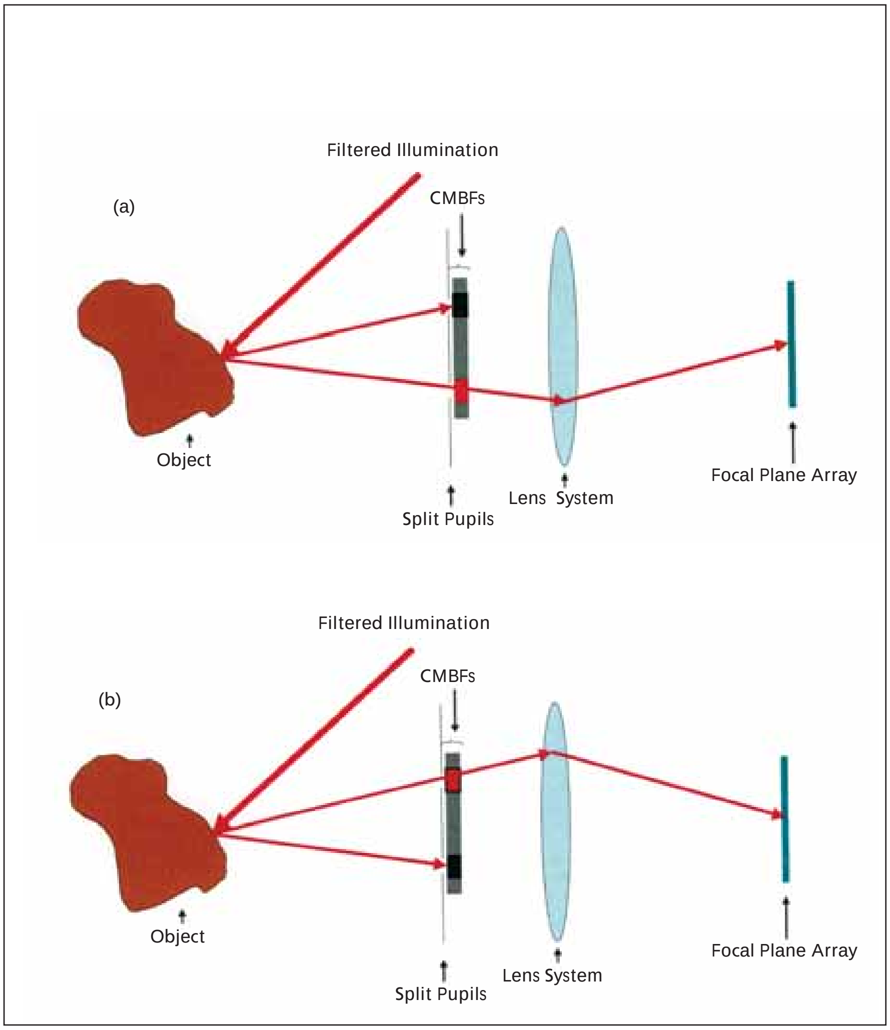
This endoscope can be used in minimally invasive surgery, in geological resource exploration, and in miniature analytical tools.

NASA's Jet Propulsion Laboratory, Pasadena, California

Stereo imaging requires two different perspectives of the same object and, traditionally, a pair of side-by-side cameras would be used but are not feasible for something as tiny as a less than 4-mm-diameter endoscope that could be used for minimally invasive surgeries or geoexploration through tiny fissures or bores. The proposed solution here is to employ a single lens, and a pair of conjugated, multiple-bandpass filters (CMBFs) to separate stereo images. When a CMBF is placed in front of each of the stereo channels, only one wavelength of the visible spectrum that falls within the passbands of the CMBF is transmitted through at a time when illuminated. Because the passbands are conjugated, only one of the two channels will see a particular wavelength. These time-multiplexed images are then mixed and reconstructed to display as stereo images.

The basic principle of stereo imaging involves an object that is illuminated at specific wavelengths, and a range of illumination wavelengths is time multiplexed. The light reflected from the object selectively passes through one of the two CMBFs integrated with two pupils separated by a baseline distance, and is focused onto the imaging plane through an objective lens. The passband range of CMBFs and the illumination wavelengths are synchronized such that each of the CMBFs allows transmission of only the alternate illumination wavelength bands. And the transmission bandwidths of CMBFs are complementary to each other, so that when one transmits, the other one blocks.

This can be clearly understood if the wavelength bands are divided broadly into red, green, and blue, then the illumination wavelengths contain two bands in red (R1, R2), two bands in green (G1, G2), and two bands in blue (B1, B2). Therefore, when the objective is illuminated by R1, the reflected light enters through only the left-CMBF as the R1 band corresponds to the transmission window of the left CMBF at the left pupil. This is blocked by the right CMBF. The transmitted band is focused on the focal plane array (FPA). Here, the FPA does not include color filter array (black and white); hence, the image sensors only measure light intensities. Similarly, when the object is illuminated by R2, it is



Schematic showing the principle of the **Stereo Imaging Endoscope** using CMBFs. (a) The first illumination band passes through the left CMBF to cast an image at the focal plane, but is blocked by the right CMBF. (b) The second illumination band passes through the right CMBF to cast an image at the focal plane, but is blocked by the left CMBF.

transmitted only through the right-CMBF and is blocked by the left-CMBF. This continues over other wavelength bands as well.

So, it can be seen that the image sensors at the focal plane are measuring light intensities of alternately transmitted light from the two CMBFs. At the end of one complete illumination cycle, six images will have been collected. Then the images from R1, G1, and B1 become the primary colors for the left side of the stereo image, and R2, G2, and B2 become that of the right side of the stereo image. Two stereo images have been time-multiplexed on the same imaging chip. This intensity data is stored as an array from which the 3D stereoscopic color image is constructed by applying processing and reconstruction algorithms.

This work was done by Youngsam Bae, Harish Manohara, Victor E. White, and Kirill V. Shcheglov of Caltech and Hrayr Shahinian of Skull Base Institute for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to NPO-47420, volume and number of this NASA Tech Briefs *issue, and the page number.*

Early Oscillation Detection Technique for Hybrid DC/DC Converters

Potential users include commercial and military power supply manufacturers, and high-reliability electronic product companies.

Goddard Space Flight Center, Greenbelt, Maryland

Oscillation or instability is a situation that must be avoided for reliable hybrid DC/DC converters. A real-time electronics measurement technique was developed to detect catastrophic oscillations at early stages for hybrid DC/DC converters. It is capable of identifying low-level oscillation and determining the degree of the oscillation at a unique frequency for every individual model of the converters without disturbing their normal operations. This technique is specially developed for space-used hybrid DC/DC converters, but it is also suitable for most of commercial and military switching-mode power supplies.

This is a weak-electronic-signal detection technique to detect hybrid DC/DC converter oscillation presented as a specific noise signal at power input pins. It is based on principles of feedback control loop oscillation and RF signal modulations, and is realized by using signal power spectral analysis. On the power spectrum, a channel power amplitude at characteristic frequency (CP_{cf}) and a channel power amplitude at switching frequency (CP_{sw}) are chosen as oscillation level indicators. If the converter is stable, the CP_{cf} is a very small pulse and the CP_{sw} is a larger, clear, single pulse. At early stage of oscillation, the CP_{cf} increases to a certain level and the CP_{sw} shows a small pair of sideband pulses around it. If the converter oscillates, the CP_{cf} reaches to a higher level and the CP_{sw} shows more high-level sideband pulses. A comprehensive stability index (CSI) is adopted as a quantitative measure to accurately assign a degree of stability to a specific DC/DC converter. The CSI is a ratio of normal and abnormal power spectral density, and can be calculated using specified and measured CP_{cf} and CP_{sw} data.

The novel and unique feature of this technique is the use of power channel amplitudes at characteristic frequency and switching frequency to evaluate stability and identify oscillations at an early stage without interfering with a DC/DC converter's normal operation. This technique eliminates the probing problem of a gain/phase margin method by connecting the power input to a spectral analyzer. Therefore, it is able to evaluate stability for all kinds of hybrid DC/DC converters with or without remote sense pins, and is suitable for real-time and in-circuit testing. This frequency-domain technique is more sensitive to detect oscillation at early stage than the time-domain method using an oscilloscope.

This work was done by Bright L. Wang of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15777-1

Parallel Wavefront Analysis for a 4D Interferometer

NASA's Jet Propulsion Laboratory, Pasadena, California

This software provides a programming interface for automating data collection with a PhaseCam interferometer from 4D Technology, and distributing the image-processing algorithm across a cluster of general-purpose computers.

Multiple instances of 4Sight (4D Technology's proprietary software) run on a networked cluster of computers. Each connects to a single server (the controller) and waits for instructions. The controller directs the interferometer to several images, then assigns each image to a different computer for processing. When the image processing is finished, the server directs one of the computers to collate and combine the processed images, saving the resulting measurement in a file on a disk.

The available software captures approximately 100 images and analyzes them immediately. This software separates the capture and analysis processes, so that analysis can be done