3D Display Using Conjugated Multiband Bandpass Filters

NASA's Jet Propulsion Laboratory, Pasadena, California

Stereoscopic display techniques are based on the principle of displaying two views, with a slightly different perspective, in such a way that the left eye views only by the left eye, and the right eye views only by the right eye. However, one of the major challenges in optical devices is crosstalk between the two channels. Crosstalk is due to the optical devices not completely blocking the wrong-side image, so the left eye sees a little bit of the right image and the right eye sees a little bit of the left image. This results in eyestrain and headaches.

A pair of interference filters worn as an optical device can solve the problem. The device consists of a pair of multiband bandpass filters that are conjugated. The term "conjugated" describes the passband regions of one filter not overlapping with those of the other, but the regions are interdigitated. Along with the glasses, a 3D display produces colors composed of primary colors (basis for producing colors) having the spectral bands the same as the passbands of the filters. More specifically, the primary colors producing one viewpoint will be made up of the passbands of one filter, and those of the other viewpoint will be made up of the passbands of the conjugated filter. Thus, the primary colors of one filter would be seen by the eye that has the matching multiband filter. The inherent characteristic of the interference filter will allow little or no transmission of the wrong side of the stereoscopic images.

This work was done by Youngsam Bae and Victor E. White of Caltech, and Kirill Shcheglov of SBC Global for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-47578

Real-Time, Non-Intrusive Detection of Liquid Nitrogen in Liquid Oxygen at High Pressure and High Flow

Stennis Space Center, Mississippi

An integrated fiber-optic Raman sensor has been designed for real-time, non-intrusive detection of liquid nitrogen in liquid oxygen (LOX) at high pressures and high flow rates in order to monitor the quality of LOX used during rocket engine ground testing. The integrated sensor employs a high-power (3-W) Melles Griot diode-pumped, solid-state (DPSS), frequency-doubled Nd:YAG 532-nm laser; a modified Raman probe that has built-in Raman signal filter optics; two high-resolution spectrometers; and photomultiplier tubes (PMTs) with selected bandpass filters to collect both N_2 and O_2 Raman signals.

The PMT detection units are interfaced with National Instruments' LabVIEW for fast data acquisition. Studies of sensor performance with different detection systems (i.e., spectrometer and PMT) were carried out. The concentration ratio of N_2 and O_2 can be inferred by comparing the intensities of the N_2 and O_2 Raman signals. The final system was fabricated to measure N_2 and O_2 gas mixtures as well as mixtures of liquid N_2 and LOX.

This work was done by Jagdish P. Singh and Fang-Yu Yueh of Mississippi State University, and Rajamohan R.Kalluru and Louie Harrison of Mississippi Ethanol LLC for Stennis Space Center. For more information contact Jagdish Singh at (662) 325-7375. Refer to SSC-00322.

Method to Enhance the Operation of an Optical Inspection Instrument Using Spatial Light Modulators

The interferometer would accommodate a large variety of spherical and aspherical optical components.

Goddard Space Flight Center, Greenbelt, Maryland

For many aspheric and freeform optical components, existing interferometric solutions require a custom computer-generated hologram (CGH) to characterize the part. The overall objective of this research is to develop hardware and a procedure to produce a combined, dynamic, Hartmann/Digital Holographic interferometry inspection system for a wide range of advanced optical components, including aspheric and freeform optics. This new instrument would have greater versatility and dynamic range than currently available measurement systems.

The method uses a spatial light modulator to pre-condition wavefronts for imaging, interferometry, and data processing to improve the resolution and versatility of an optical inspection instrument. Existing interferometers and Hartmann inspection systems have either too small a dynamic range or insufficient resolution to characterize conveniently unusual optical surfaces like aspherical and freeform optics. For interferometers, a specially produced, computer-generated holographic optical element is needed to transform the wavefront to within the range of the interferometer.

A new hybrid wavefront sensor employs newly available spatial light modulators (SLMs) as programmable holographic optical elements (HOEs). The HOE is programmed to enable the same instrument to inspect an optical element in stages, first by a Hartmann measurement, which has a very large dynamic range but less resolution. The first measurement provides the information required to precondition a reference wave that avails the measurement process to the more precise phase shifting interferometry.

The SLM preconditions a wavefront before it is used to inspect an optical component. This adds important features to an optical inspection system, enabling not just wavefront conditioning for null testing and dynamic range extension, but also the creation of hybrid measurement procedures. This, for example, allows the combination of dynamic digital holography and Hartmann sensing procedures to cover a virtually unlimited dynamic range with high resolution. Digital holography technology brings all of the power and benefits of digital holographic interferometry to the requirement, while Hartmann-type wavefront sensors bring deflectometry technologies to the solution.

The SLM can be used to generate arbitrary wavefronts in one leg of the interferometer, thereby greatly simplifying its use and extending its range. The SLM can also be used to modify the system into a dynamic Shack-Hartmann system, which is useful for optical components with large amounts of slope. By integrating these capabilities into a single instrument, the system will have tremendous flexibility to measure a variety of optical shapes accurately.

This work was done by James Trolinger, Amit Lal, Joshua Jo, and Stephen Kupiec of MetroLaser, Inc. for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16056-1