and then communicates over a parallel communications interface with a microcontroller. The microcontroller analyzes the digital signal from the CPLD, and applies a non-linear correction obtained through extensive data analysis at the various relevant EVA operating pressures. The microcontroller then presents the quantitatively accurate carbon dioxide partial pressure regardless of optical density.

This technique could extend the linear dynamic range of typical absorption spectrometers, particularly those whose low end noise equivalent absorbance is below one-part-in-100,000. In the EVA application, it allows introduction of a path-length-enhancing architecture whose optical interference effects are well understood and quantified without sacrificing the dynamic range that allows quantitative detection at the higher carbon dioxide partial pressures. The digital components are compact and allow reasonably complete integration with separately developed analog control electronics without sacrificing size, mass, or power draw.

Dispersed Fringe Sensing Analysis — DFSA

NASA's Jet Propulsion Laboratory, Pasadena, California

Dispersed Fringe Sensing (DFS) is a technique for measuring and phasing segmented telescope mirrors using a dispersed broadband light image. DFS is capable of breaking the monochromatic light ambiguity, measuring absolute piston errors between segments of large segmented primary mirrors to tens of nanometers accuracy over a range of 100 micrometers or more.

The DFSA software tool analyzes DFS images to extract DFS encoded segment piston errors, which can be used to measure piston distances between primary mirror segments of ground and space telescopes. This information is necessary to control mirror segments to establish a smooth, continuous primary figure needed to achieve high optical quality.

The DFSA tool is versatile, allowing precise piston measurements from a variety of different optical configurations. DFSA technology may be used for measuring wavefront pistons from sub-apertures defined by adjacent segments (such as Keck Telescope), or from separated sub-apertures used for testing large optical systems (such as sub-aperture wavefront testing for large primary mirrors using auto-collimating flats). An experimental demonstration of the coarse-phasing technology with verification of DFSA was performed at the Keck Telescope.

DFSA includes image processing, wavelength and source spectral calibration, fringe extraction line determination, dispersed fringe analysis, and wavefront piston sign determination. The code is robust against internal optical system aberrations and against spectral variations of the source. In addition to the DFSA tool, the software package contains a simple but sophisticated MATLAB model to generate dispersed fringe images of optical system configurations in order to quickly estimate the coarse phasing performance given the optical and operational design requirements. Combining MATLAB (a high-level language and interactive environment developed by MathWorks), MACOS (JPL's software package for Modeling and Analysis for Controlled Optical Systems), and DFSA provides a unique optical development, modeling and analysis package to study current and future approaches to coarse phasing controlled segmented optical systems.

Indium Tin Oxide Resistor-Based Nitric Oxide Microsensors

Applications for these sensors include engine emission and environmental monitoring.

John H. Glenn Research Center, Cleveland, Ohio

A sensitive resistor-based NO microsensor, with a wide detection range and a low detection limit, has been developed. Semiconductor microfabrication techniques were used to create a sensor that has a simple, robust structure with a sensing area of 1.10×0.99 mm. A Pt interdigitated structure was used for the electrodes to maximize the sensor signal output. N-type semiconductor indium tin oxide (ITO) thin film was sputter-deposited as a sensing material on the electrode surface, and between the electrode fingers. Alumina substrate (250 µm in thickness) was sequentially used for sensor fabrication.

The resulting sensor was tested by applying a voltage across the two electrodes and measuring the resulting current. The sensor was tested at different concentrations of NO-containing gas at a range of temperatures. Preliminary results showed that the sensor had a relatively high sensitivity to NO at 450 °C and 1 V. NO concentrations from ppm to ppb ranges were detected with the low limit of near 159 ppb. Lower NO concentrations are being tested.

Two sensing mechanisms were involved in the NO gas detection at ppm level: adsorption and oxidation reactions, whereas at ppb level of NO, only one sensing mechanism of adsorption was involved.

The NO microsensor has the advantages of high sensitivity, small size, simple batch fabrication, high sensor yield, low cost, and low power consumption due to its microsize. The resistor-based