
Phase Sensor for Aligning a Segmented Telescope Mirror

Alignment can be maintained even in the presence of atmospheric turbulence.

Marshall Space Flight Center, Alabama

A phase sensor has been developed for use in aligning a segmented telescope mirror to within a fraction of a wavelength in piston. (As used here, "piston" signifies displacement of a mirror segment along the optical axis of the telescope.) Such precise alignment is necessary in order to realize the full benefit of the large aperture achievable through segmentation.

This phase sensor is achromatic. It is based on two-wavelength shearing interferometry, and can be modified to utilize an extended or broad-band (e.g., white) light source. The sensor optics include a ruled diffraction grating and an imaging lens.

The sensor can measure the piston shift between segments as well as aberrations of the segments. It can measure

the surface error of an individual segment, making it possible to compensate for the error with optimal amount(s) of piston and/or tilt. The precise capture range of the sensor depends partly on the telescope design; the largest relative piston shifts measurable by use of this sensor are of the order of 100 μm . The accuracy of the sensor also depends partly on the telescope design; in general, the accuracy is sufficient to enable alignment to within approximately half a wavelength. The interferometric image is digitized and processed by a simple algorithm in real time, and the output of the algorithm can be used to maintain alignment in real time, even in the presence of atmospheric turbulence.

The sensor is robust. Through calibration, it can be made insensitive to (and, hence, tolerant of) misalignments and aberrations of its own optics, most aberrations of the telescope as a whole (in contradistinction to aberrations of individual segments), and most aberrations introduced by atmospheric turbulence.

This work was done by H. Philip Stahl of Marshall Space Flight Center and Chanda Bartlett Walker of Pace & Waite, Inc. Further information is contained in a TSP (see page 1).

This invention is owned by NASA, and a patent application has been filed. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-31852-1.

Control Software for Advanced Video Guidance Sensor

Marshall Space Flight Center, Alabama

Embedded software has been developed specifically for controlling an Advanced Video Guidance Sensor (AVGS). [As described in several previous *NASA Tech Briefs* articles, a Video Guidance Sensor is an optoelectronic system that provides guidance for automated docking of two vehicles (spacecraft in the original intended application). Such a system includes pulsed laser diodes and a video camera, the output of which is digitized. From the positions of digitized target images and known geometric relationships, the relative position and orientation of the vehicles are computed.] The present software consists of two sub-

programs running in two processors that are parts of the AVGS. The subprogram in the first processor receives commands from an external source, checks the commands for correctness, performs commanded non-image-data-processing control functions, and sends image-data-processing parts of commands to the second processor. The subprogram in the second processor processes image data as commanded. Upon power-up, the software performs basic tests of functionality, then effects a transition to a standby mode. When a command is received, the software goes into one of several operational modes (e.g. acquisition

or tracking). The software then returns, to the external source, the data appropriate to the command.

This program was written by Richard T. Howard, Michael L. Book, and Thomas C. Bryan of Marshall Space Flight Center. Further information is contained in a TSP (see page 1).

This invention has been patented by NASA (U.S. Patent No. 6,888,476). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-31865-1.

Generating Control Commands From Gestures Sensed by EMG

Electrical signals from muscles involved in gestures are recognized.

Ames Research Center, Moffett Field, California

An effort is under way to develop noninvasive neuro-electric interfaces through which human operators could control systems as diverse as simple mechanical devices, computers, aircraft, and even space-

craft. The basic idea is to use electrodes on the surface of the skin to acquire electromyographic (EMG) signals associated with gestures, digitize and process the EMG signals to recognize the gestures,

and generate digital commands to perform the actions signified by the gestures.

In an experimental prototype of such an interface, the EMG signals associated with hand gestures are acquired by use