

ABSTRACT TITLE: METROLOGY FOR SPATIAL INTERFEROMETRY 111

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ABSTRACT:

Very high resolution spatial interferometry requires picometer level one-dimensional metrology, three-dimensional metrology and surface metrology. The absolute distance measurements have to be performed only 10<sup>-11</sup> part in a million level due to the careful design of the instrument.

We have developed an absolute metrology system with an accuracy of 1.25 microns rms over a distance of 1 meter in air. This system uses a stabilized (1 part in 10 to the tenth) 1.3 micron, solid-state infrared laser locked to a ULE cavity. The length of the cavity is controlled by a thermal vacuum oven. We achieved 1 milli-degree Centigrade rms stability with the oven in air for time scales of days. The absolute distance measurement is accomplished by sweeping the laser frequency between several modes of the cavity. The length of the cavity as well as the distance monitored are measured simultaneously.

The absolute calibration of our surface metrology gauge down to one thousandth of the wavelength of light is continuing. We have developed algorithms to cancel the figure of the reference mirror from the interferometer output. These algorithms require different sets of data with one of the mirrors in different positions. We are in the process of analyzing actual interferometer data using these algorithms.

A 3 dimensional gauge which will monitor the position of the corner of a corner cube down to 10 picometer rms accuracy in vacuum is being assembled. Early results from this demonstration will be presented.

The research described is performed at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

BRIEF BIOGRAPHY:

The author is a member of the technical staff in the Spatial Interferometry group of the Microwave, Lidar and Interferometer Technology section at JPL. After getting his Ph.D. from Caltech, he has worked in the Gravitational Physics Group at Caltech, in the Artificial Intelligence Laboratory at MIT and in the JIGGO Project at Caltech as a Staff Scientist.