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AS19 Interferometry in Space (Michael Shao)

ABSTRACT TITLE: Interferometer Real Time Control Development for SIM

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Oral Presentation

Dr. Charles Bell received his BSME from Lafayette College and MS, PhD from MIT, ME System Dynamics and Control. Since joining JPL in 1981 Dr. Bell has worked on guidance and control system development for a number of spacecraft and instrument flight projects including Galileo, Earth Observing System, Magellan, Airborne Surveillance Sensor Evaluation Testbed, Cassini, and Space Interferometry Mission. Prior to joining Space Interferometer Mission as Interferometry Real Time Control Project Element Manager in 1997, he led the design, implementation, test, and delivery of the Cassini Mission Attitude and Articulation Control Subsystem as Technical Manager from 1986 to 1997. Dr. Bell is currently Flight System Deputy Manager on SIM.

ABSTRACT:

Real Time Control (RTC) for the Space Interferometry Mission will build on the real time core interferometer control technology under development at JPL since the mid 1990s, with heritage from the ground based MKII and Palomar Testbed Interferometer projects developed in the late 80's and 90's. The core software and electronics technology for SIM interferometer real time control is successfully operating on several SIM technology demonstration testbeds, including the Real-time Interferometer Control System Testbed, System Testbed-3, and the Microarcsecond Metrology testbed.

This paper provides an overview of the architecture, design, integration, and test of the SIM flight interferometer real time control to meet challenging flight system requirements for the high processor throughput, low-latency interconnect, and precise synchronization to support microarcsecond-level astrometric measurements for greater than five years at 1 AU in Earth-trailing orbit. The electronics and software architecture of the interferometer real time control core and its adaptation to a flight design concept are described. Control loops for pointing and pathlength control within each of four flight interferometers and for coordination of control and data across interferometers are illustrated. The nature of on-board data processing to fit average downlink rates while retaining post-processed astrometric measurement precision and accuracy is also addressed.

Interferometer flight software will be developed using a software simulation environment incorporating models of the metrology and starlight sensors and actuators to close the real time control loops. RTC flight software and instrument flight electronics will in turn be integrated utilizing the same simulation architecture for metrology and starlight component models to close real time control loops and verify RTC functionality and performance prior to delivery to flight interferometer system integration at Lockheed Martin's Sunnyvale facility. A description is provided of the test environment architecture supporting the RTC path to flight.

KEY WORDS: Interferometer, real-time control, low-latency, interconnect, instrument flight software