SPACE DEBRIS SYMPOSIUM (A6)
Measurements (1)

Author: Dr. Mark Mulrooney
National Aeronautics and Space Administration (NASA), United States, mark.mulrooney-1@nasa.gov

Dr. Paul Hickson
University of British Columbia, Canada, hickson@physics.ubc.ca
Mr. Eugene Stansbery
National Aeronautics and Space Administration (NASA), United States, Eugene.g.stansbery@nasa.gov

ORBITAL DEBRIS DETECTION AND TRACKING STRATEGIES FOR THE NASA/AFRL METER CLASS AUTONOMOUS TELESCOPE (MCAT)

Abstract

MCAT (Meter-Class Autonomous Telescope) is a 1.3m f/4 Ritchey-Chrétien on a double horseshoe equatorial mount that will be deployed in early 2011 to the western pacific island of Legan in the Kwajalein Atoll to perform orbital debris observations. MCAT will be capable of tracking earth orbital objects at all inclinations and at altitudes from 200 km to geosynchronous. MCAT's primary objective is the detection of new orbital debris in both low-inclination low-earth orbits (LEO) and at geosynchronous earth orbit (GEO). MCAT was thus designed with a fast focal ratio and a large unvignetted image circle able to accommodate a detector sized to yield a large field of view. The selected primary detector is a close-cycle cooled 4Kx4K 15um pixel CCD camera that yields a 0.9 degree diagonal field. For orbital debris detection in widely spaced angular rate regimes, the camera must offer low read-noise performance over a wide range of framing rates. MCAT's 4-port camera operates from 100 kHz to 1.5 MHz per port at 2 e- and 10 e- read noise respectively. This enables low-noise multi-second exposures for GEO observations as well as rapid (several frames per second) exposures for LEO. GEO observations will be performed using a counter-sidereal time delay integration (TDI) technique which NASA has used successfully in the past. For MCAT the GEO survey, detection, and follow-up prediction algorithms will be automated. These algorithms will be detailed herein. For LEO observations two methods will be employed. The first, Orbit Survey Mode (OSM), will scan specific orbital inclination and altitude regimes, detect new orbital debris objects against trailed background stars, and adjust the telescope track to follow the detected object. The second, Stare and Chase Mode (SCM), will perform a stare, then detect and track objects that enter the field of view which satisfy specific rate and brightness criteria. As with GEO, the LEO operational modes will be fully automated and will be described herein. The automation of photometric and astrometric processing (thus streamlining data collection for environmental modeling) will also be discussed.