Optical Studies of Space Debris at GEO - Survey and Follow-up with Two Telescopes

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For 14 nights in March 2007, we used two telescopes at the Cerro Tololo Inter-American Observatory (CTIO) in Chile to study the nature of space debris at Geosynchronous Earth Orbit (GEO).

In this project one telescope was dedicated to survey operations, while a second telescope was used for follow-up observations for orbits and colors. The goal was to obtain orbital and photometric information on every faint object found with the survey telescope. Thus we concentrate on objects fainter than R = 15th magnitude.

MODEST (Michigan Orbital DEbris Survey Telescope, the University of Michigan's 0.6/0.9-m Schmidt telescope at CTIO) was used in survey mode every night to scan a strip of sky 1.3-deg wide in declination by over 100 degrees long in hour angle. Five second exposures were obtained every 37.9 seconds, reaching a limiting R magnitude of 18.0 for a S/N of 10. With a field-of-view (fov) of 1.3-degrees, an average of 8 detections are made of individual objects at GEO during a 5.2 minute timespan.

A real-time processing pipeline detects objects and provides positions and magnitudes to the CTIO 0.9-m equipped with CCD imager with a fov of 0.22 degrees. Predictions of future rates and positions for the first recovery observation with the 0.9-m were made by fitting an assumed circular orbit (ACO) to the observed MODEST positions.

The recovery rate with the 0.9-m of objects found by MODEST was over 90%. The average time between the last detection on MODEST and acquisition on the 0.9-m was 17 minutes. The quickest hand-over was 4 minutes.

The 0.9-m was used to determine:
1. full 6 parameter orbits (including eccentricity). An initial orbit was determined based on observations during one night, and then refined with observations on subsequent nights. One challenge of studying these

objects with periods close to 23h56m is that frequent observations are required to refine and update the orbit so the object can be recovered later.

2. magnitudes and colors in the standard astronomical BVRI system.

Sequences of 10 observations in each filter were obtained to measure brightness variations.

In this paper we will summarize the results obtained and outline future work.