SMARTnet: First Experience of Setting Up a Telescope System to Survey the Geostationary Ring

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Abstract:
Space debris in geostationary orbits may be detected with optical telescopes when the objects are illuminated by the Sun. The advantage compared to Radar can be found in the illumination: radar illuminates the objects and thus the detection sensitivity depletes proportional to the fourth power of the distance. As the sky background is quite dark, illumination from the Sun suffices for most of the objects. By utilizing natural illumination one-way range has to be considered and the detection sensitivity decreases proportional to the second power of the distance. The detection size of an object depends on the aperture of the telescope, sky background and exposure time. As a typical example, a 2s exposure time and a sky background being 17-18mag bright is assumed. Simulations show that for a telescope with an aperture of 50 cm, objects of approximately 50cm and less can be detected.

In close collaboration with AIUB, GSOC is building a telescope system to demonstrate the capability of performing geostationary surveillance. A telescope system will consist of two telescopes on one mount: a smaller telescope with an aperture of 20cm will serve for fast survey while the larger one, a telescope with an aperture of 50cm, will be used for follow-up observations. The telescopes will be operated by GSOC remotely from Oberpfaffenhofen. The observation plan will be generated seven days in advance by applying an optimized planning scheduler, taking into account fault time like cloudy nights, priority of objects etc. From each picture taken, stars will be identified and everything not being a star is treated as a possible object. To confirm detection, multiple images are taken and a short series of angular measurements is extracted, that is called a tracklet. These tracklets will be correlated to identify individual objects, ephemeris data for these objects is generated and cataloguized. This will allow for services like collision avoidance to ensure safe operations for GSOC's satellites. The complete data processing chain is handled by the Backbone CAtalogue of Relational Debris Information (BACARDI) and is suggested for an extra presentation.

Such a telescope system will be located at the Sutherland Observatory, South Africa, covering the two COMSATBw-satellites at longitudes 13.2° E and 63° E. Together with the ZimSMART telescope located at the Zimmerwald Observatory, Switzerland, a first small network is achieved. Several test campaigns performed in Switzerland have shown very good results: from recored tracklets, the calculated orbit accuracy for GPS satellites is better than 250m in all three dimensions, and the limiting magnitude is larger than expected. Also observation correlation for clusters like ASTRA has been successfully performed.

With setting up the first two telescopes in Sutherland, South Africa, almost 1/3 of the geostationary regime will be observed together with the ZimSMART telescope located in Zimmerwald, Switzerland. In South Africa, the smaller telescope with an aperture of 20cm will serve for fast survey while the larger one, a 50cm aperture telescope, will be used for follow-up observations. It is shown how geostationary objects are monitored by a first version of a small network consisting of two locations. Furthermore, first experiences of handling a telerobotic telescope are presented.