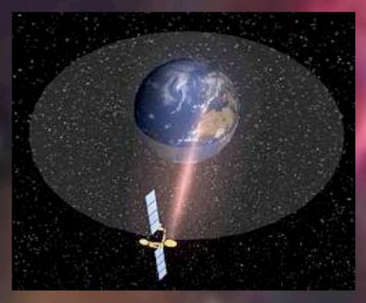
THE PASAGE PROJECT
ASTROMETRIC POSITIONING OF GEOSTATIONARY SATELLITES

T. López Moratalla, C. Abad, F. Belizón, J.C. Coma, F.J. Montojo,
J.L. Muiños, J. Palacio and M. Vallejo

The problem

- Geostationary satellites have assigned nominal locations at the equator (Hispasat satellites at 30ª W) and a window of operation centered at nominal location (dimensions of Hispasat window are 0.1º in latitude and 0.14ª in longitude).
- Maneuvers are necessary for satellites station keeping inside window (Hispasat is maneuvered every 2 weeks) ought to different perturbations (Earth gravity field, luny-solar attraction, solar radiation pressure and eclipses, etc.)
- To get, available at any time, precise geosynchronous satellites ephemerides of is of great importance for satellite's station keeping routines.
- Several positioning methods are actually implemented by satellites agencies. Hispasat uses radio-goniometric measures with angular accuracy of 18 arc seconds (about 3 km) and 10 meters of error in distance.



Our goal

- The major goal of this project is to use earth-based astrometric observations both for obtaining precise ephemeris of geosynchronous satellites, and for orbit determination of these satellites. We expect errors of 0.1 arc seconds in angular measures.
- This use will be a new and important application of earth-based astrometry, and will require the development of the necessary techniques and algorithms for processing the observations.
- Topocentric equatorial coordinates of the satellite can be obtained with one single telescope, and a sufficient number of observations can be used for orbit determination purposes.
- A better ephemeris determination can be achieved by means of astrometric observations taken from several telescopes.

Instrumental basis

The geographic positions of San Fernando, in Spain, and Mérida, in Venezuela, are ideal ones for performing astrometric observations of many different geosynchronous satellites, among which we can find the Hispasat satellites.

Gautier Astrograph Telescope of the Real Instituto y Observatorio de la Armada (ROA), provided with an appropriate CCD camera, will be an excellent device for doing the task. The improvement of the telescope's performances by using CCD techniques will suppose the recovery of this instrument, obsolete at present.

Observations with the Schmidt camera of Centro de Investigación de Astronomía (CIDA) in Mérida (Venezuela) will be available from the beginning of the project.

Baker-Nunn camera

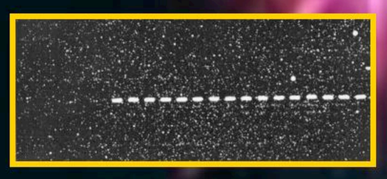
In the middle of the project, ROA's Baker-Nunn camera will also be available at Observatory Fabra II in the Catalan Pirinee. Processing astrometric observations from the three telescopes will provide high accurate satellite positions.

Complementary technique

A redundant check on the ephemeris precision can be supported by using "two way" synchronizing techniques. Pseudo-range measures can be obtained with this procedure. Astrometric and "Two Way" techniques could be mutually validated.

Preliminary observations

Observation of INTELSAT 706 from CIDA Schmidt Camera on August 2003



- Right picture is a composition of an image captured by CIDA Schimdt camera. Satellites appear as continuous track.
- Observation was carry out in drift-scan mode.
- Discontinuities are intentionally performed every minute of time by changing instrument declination in order to get a dated point of measure of satellite position with respect to background stars.
- The way to get dated positions with Gautier telescope will be quite different, also in drift scan mode. Images will appear like left picture.

14th International Laser Ranging Workshop. San Fernando, Cadiz, Spain. 7-11 June 2004