

Title of the methodology:

Precise Orbit Determination of Geosynchronous Navigation Satellites using
Synchronous Elements and Ground Observations

Keywords:

geosynchronous orbits, ground-based observations; non-singular synchronous elements, Kalman filter; tracking measurements, geometry, and accuracy

Write-up: (Maximum 500 words)

India has a constellation of seven navigation satellites, called NavIC. Their orbits are determined using ground observations and then uplinked to the satellites using standard orbital elements, following Global Positioning System (GPS) practices of the US constellation. But the GPS constellation is at 20,000 km altitude and at orbit inclination angle of 55 degrees, whereas the Indian constellation is geosynchronous with its three satellites at nearly zero inclination and zero eccentricity. For this reason, the orbit dynamics model of the GPS is not suitable for the NavIC satellites. A more suitable model, particularly for the three geostationary satellites with nearly zero inclination and zero eccentricity would be based on synchronous orbital elements in terms of eccentricity vector and inclination vector [1].

The objective of this research is to develop algorithms to estimate the orbits of the seven NavIC satellites using synchronous elements, ground tracking measurements, and extended Kalman filter, as formulated in [1-2]. Accuracy of orbit propagation using synchronous elements will be assessed.

References:

[1] Soop, E.M., *Handbook of Geostationary Orbits*, Ch. 8 Orbit Determination, Kluwer Academic Publishers, 1994

[2] Montenbruck, O., and Gill, E., *Satellite Orbits: Models, Methods, and Applications*, Springer 2012