

## Unsupervised Learning-based Satellite Selection Algorithm for GPS-NavIC multi-constellation receivers



**Dr. Sanat K Biswas**  
Assistant Professor  
IIIT- Delhi

**Abstract:** The lower bound of the GDOP is an important parameter to benchmark satellite selection algorithms. Existing GDOP lower bound formulations do not consider the satellite azimuth and elevation angle constraints with respect to the user for Geostationary Earth Orbit (GEO) and Inclined Geosynchronous Orbit (IGSO) based regional navigation constellations. A GDOP lower bound formulation considering the azimuth and elevation angle constraints is formulated for GEO and IGSO based navigation constellations. Using numerical simulation, it is demonstrated that the GDOP lower bound for using the Navigation using Indian Constellation (NavIC) is significantly higher than the Global Positioning System (GPS), whereas the existing GDOP lower bound formulation provides comparable GDOP lower bound for the GPS and NavIC. It also indicates that one or more navigation constellations should be used with the NavIC to achieve better position accuracy. In this context, an Unsupervised Learning-based Satellite Selection (ULiSeS) algorithm is also proposed, and the effectiveness of the algorithm is demonstrated through numerical simulation for the GPS and the NavIC constellations. A meta-cognitive component is also introduced to enable the ULiSeS algorithm to decide when to learn and when to use the available model. The ULiSeS algorithm selects a better set of satellites than the Quasi-optimal selection algorithm and requires 89.12% less processing time than the fast satellite selection algorithm.

**Bio:** Sanat K. Biswas is an Assistant Professor with IIIT Delhi. His research interests are space vehicle navigation, GNSS applications, nonlinear estimation, and Space Situational Awareness. He received the B.E. degree from Jadavpur University in 2010, the M.Tech. degree in Aerospace Engineering from IIT Bombay in 2012, and the Ph.D. degree in computationally Efficient Unscented Kalman filters for space vehicle navigation from the University of New South Wales (UNSW), Sydney, in 2017.

At IIIT Delhi he is leading research groups involved in developing algorithms for Space Situational Awareness, NavIC reflectometry receiver for remote sensing applications and Precise Point Positioning (PPP) of Low Earth Orbit Satellites. Dr. Biswas serves in the technical committee on Space Communications and Navigation (SCAN), and the technical committee on Space Traffic Management (STM) of the International Astronautical Federation. He was the recipient of the 2014 Emerging Space Leaders Grant from the International Astronautical Federation, 2019 Early Career Research Award from the Department of Science and Technology, India and Young Scientist Award 2020 and 2021, from the International Union of Radio Science (URSI).

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