



GPS Precise Point Position Technique's Usability for Improving Geodesy Applications

Somnath Mahato¹ · Aravindh Subramanian Subramanian² · Debipriya Dutta³

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Abstract This paper investigates the single-point positioning capability of 18 International GNSS Service (IGS) stations globally, utilizing data from the NASA Crustal Dynamics Data Information System for the first 145 days of 2022. Employing the open source software for post-processing, the study assesses critical parameters at 4 h intervals, producing 3D graphs for visualizing dynamic positioning solutions. Benchmarking against Precise Point Positioning data from the Canadian Geodetic Survey allows a comparative analysis, revealing strengths and weaknesses in the single-point positioning method for each station. The findings offer targeted insights into the global distribution of precise positioning capabilities among IGS stations, aiding in station selection for geodetic research and GNSS applications worldwide. This research enhances the understanding of individual station performance, empowering informed decision-making for improved accuracy and reliability in GNSS positioning systems and contributing to the advancement of geodetic research.

Keywords IGS station · GPS · Accuracy · Standard deviation · SPP

GNSS constellations like GPS, GLONASS, Galileo, and BeiDou, along with regional systems like QZSS, IRNSS/

NavIC, and SBAS, enable precise global positioning and navigation across various applications, showcasing a significant achievement in satellite-based technology [1, 2]. GNSS offers global coverage, high accuracy, and adaptability, utilizing satellite constellations for precise positioning worldwide. Supported by the International GNSS Service (IGS) network, it aids in monitoring Earth's crustal movements, studying tectonic plates, and enhancing overall positioning precision [2, 3]. IGS data is publicly accessible, supporting earthquake monitoring, climate research, and navigation improvements. It aids in evaluating IRNSS and assessing SPP and RTK positioning [4, 5]. RTKLIB is an open-source software for high-precision RTK positioning, supporting GPS, GLONASS, Galileo, and more, ideal for surveying, agriculture, and scientific applications [6, 7]. Parajuli et al. [8] and SS Adavi et al. [9] analyzed RTKLIB's positioning modes using data from a single IGS station. They assessed accuracy using metrics like 2DRMS, CEP for 2D positions, and SEP, MRSE for 3D positions [10, 11].

This study stands out by evaluating single-point positioning across eighteen IGS stations worldwide using RTKLIB software. Utilizing open-source IGS station data ensures accessibility and transparency, fostering global scientific collaboration. RTKLIB's endorsement by the International GNSS Service (IGS) underscores its reliability for high-precision GNSS data processing. The research will gather data from these stations over two months to compare single-point positioning accuracy internally and against precise point positioning data. Single-point positioning is vital in GPS, enabling receivers to determine their location using satellite signals alone, crucial for navigation, surveying, and mapping applications without additional infrastructure [12, 13].

This study comprehensively analyzes 18 strategically placed IGS stations worldwide, highlighting their crucial role in precise geodetic measurements across scientific

✉ Somnath Mahato
somnathmahato1@gmail.com

¹ Meteorological Training Institute, India Meteorological Department, Pune, Maharashtra 41008, India

² College of Engineering Guindy, Anna University, Chennai, Tamil Nadu 600025, India

³ Department of ECE, Dr. B. C. Roy Engineering College, Fuljhore, Durgapur 713206, India