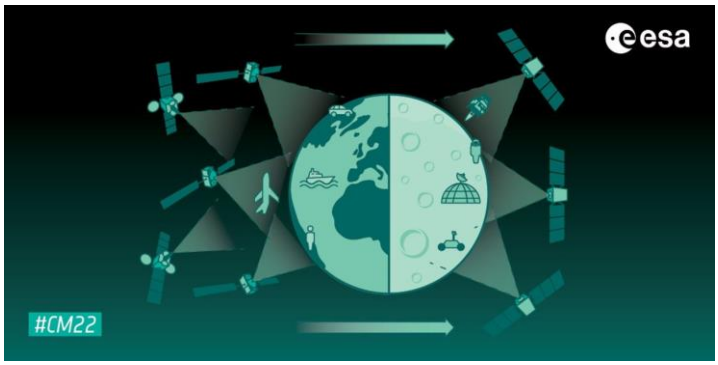
Theme: GNSS

On-board corrections' estimation for future LEO-PNT systems



Courtesy of ESA.

Background information

The future development of new Low Earth Orbit (LEO) satellite navigation systems is foreseen as one of the key innovations for Positioning-Navigation-Timing (PNT) applications. These LEO-PNT constellations will augment the current Global Navigation Satellite System (GNSS), and are expected to provide numerous benefits for real-time positioning. As part of a new "FutureNAV" programme, launched in 2022 by the Directorate of Navigation, a novel LEO-PNT satnav system is foreseen, with a first in-orbit demonstration expected in 2026. This novel system will leverage on-board GNSS capabilities for the real-time on-board estimation of orbit and clock products needed for precise point positioning (PPP), without requiring precise atomic clocks on board.

Main challenges

A LEO-PNT constellation could consist of hundreds of satellites with an orbital period of around 100 minutes. By estimating the corrections on board it is possible to avoid the need of a too large on-ground infrastructure. However, the accuracy of such satellite corrections is fundamental, especially when aiming at ambiguity-fixed solutions. Both estimation and prediction of PPP corrections on board are essential components for these novel systems, and they have not yet been addressed in a rigorous way. Without such precise corrections, LEO-PNT improvements will be limited.

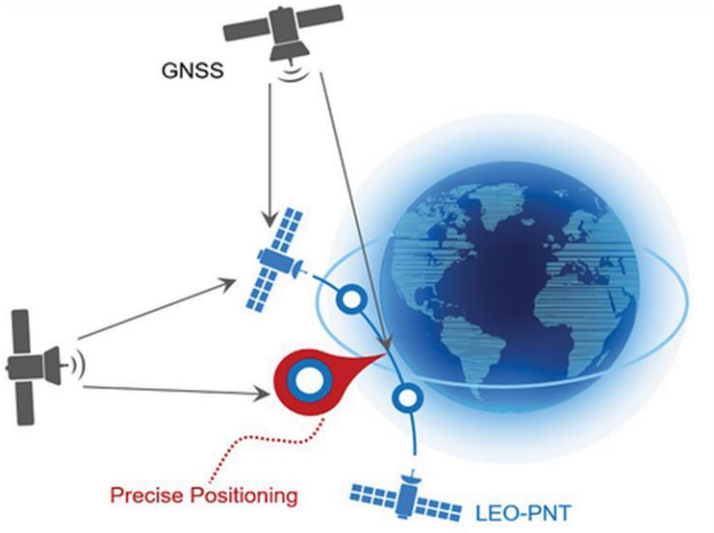
Description of tasks

The candidate will start with a literature review of the LEO-PNT concepts, along with the state of the art in the generation of satellite corrections for PPP Ambiguity Resolution (PPP-AR). A review of current positioning techniques and available streams of corrections shall also be performed in order to understand what performances are nowadays possible with standard GNSS. Experimentation with synthetic data will be carried out based on few ad-hoc algorithms developed for the on-board estimation of PPP corrections.

The main objective is to numerically evaluate what accuracy level could be achieved for these on-board corrections, and ultimately set some technical requirements on their quality for enhancing the on-ground performances on the LEO-PNT User Segment.

Requirements

The candidate shall have good programming skills (MATLAB or Python), and sufficient knowledge of GNSS data processing and user positioning algorithms. A good understanding of the satellites' orbital dynamics might be considered an asset.



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