

Ginan Supporting Future LEO-PNT

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Ginan, the open-source GNSS (Global Navigation Satellite System) processing software developed by Geoscience Australia and its research partners, has been upgraded to enable LEO (Low Earth Orbit) satellite POD (Precise Orbit Determination). The Ginan LEO POD capability includes a comprehensive set of dynamic orbit models that considers both the gravitational and non-gravitational forces acting on LEO satellites and takes into account the physical specifications of LEO satellites and information from the LEO satellite's attitude and orbit control system (ADCS). The POD processing capability supports fully dynamic, reduced-dynamic, or kinematic processing modes to satisfy the requirements of various applications. The flexible filtering approach implemented in Ginan makes it also suitable for applications where LEO's precise orbits are required in (near) real-time, including forthcoming LEO-PNT (Positioning, Navigation, and Timing) systems. This study investigates the initial capabilities of Ginan for future LEO-PNT systems. It starts with evaluating the LEO POD, including analyses of the errors affecting the satellites' orbits, residuals of GNSS observations collected onboard LEO satellites, and internal and external validations of the POD. The accuracy of the estimated orbits for twin satellites from the GRACE-FO mission, used as an example in this study, is found to be at the cm level, which is suitable for many positioning applications. Next, the LEO precise orbits and its ADCS outputs are used to simulate the observations from a small LEO-PNT constellation of GRACE-like satellites to a ground user. This positioning scenario is then processed using Ginan, highlighting its capabilities for PNT (Positioning, Navigation and Timing).