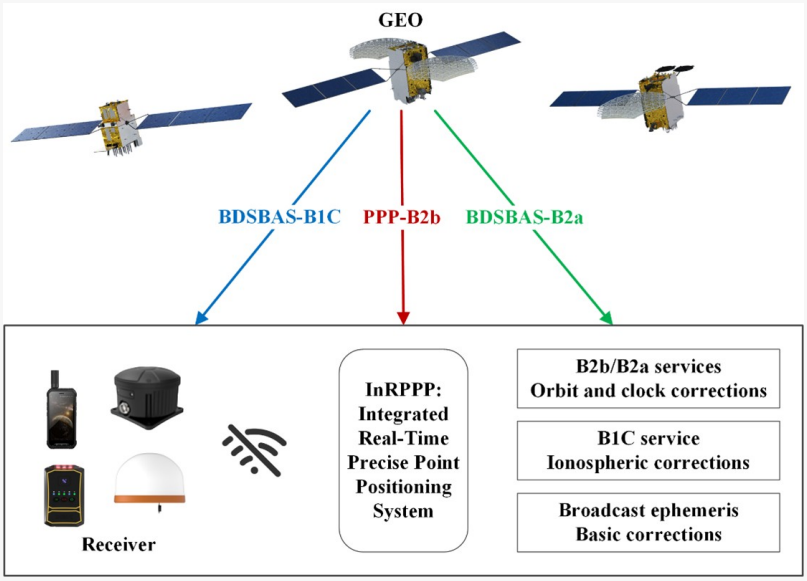
Unlocking superior accuracy in satellite positioning with advanced BDS services

GA, UNITED STATES, July 23, 2025 /EINPresswire.com/ -- The development of an Integrated Real-Time Precise Point Positioning (InRPPP) system leveraging BeiDou Navigation Satellite System (BDS) B2b, B2a, and B1C services has significantly enhanced satellite-based positioning accuracy. By resiliently utilizing these augmentation messages, the InRPPP system corrects satellite orbit and clock errors and mitigates ionospheric delays, outperforming traditional methods. Experimental results from both static and kinematic conditions demonstrate superior performance, showing improved positioning accuracy, faster convergence times, and greater stability in challenging environments. This breakthrough offers potential for applications in real-time navigation, precision positioning, and disaster monitoring, with a broader impact on industries requiring reliable and continuous positioning data.



Schematic diagram of the InRPPP system.

Satellite-based navigation systems, like the Real-Time Precise Point Positioning (RTPPP), are crucial for many industries that require accurate location data. However, these systems face limitations in areas with weak Internet connectivity or signal interference. BeiDou's satellite augmentation services, namely B2b, B2a, and B1C, have emerged as a promising solution. Yet, integrating these services into one cohesive system for optimal performance remained unexplored. This study pioneers the Integrated InRPPP system, which integrates all three services including correcting satellite clock, orbit errors, and ionospheric delays, unlocking new levels of positioning accuracy. The results from this research address critical limitations in current satellite-based positioning technology, setting the stage for real-world applications in complex environments.

In a 2025 Satellite Navigation publication, researchers from the State Key Laboratory of Geo-Information Engineering and Key Laboratory of Surveying and Mapping Science and Geospatial

Information Technology of MNR, State Key Laboratory of Spatial Datum, and Hohai University introduced the InRPPP system, a new approach that leverages the B2b, B2a, and B1C services of the BDS. By combining these services, the InRPPP system corrects satellite orbit and clock errors while mitigating ionospheric delays. With enhanced accuracy, stability, and faster convergence times, this system has the potential to transform satellite-based positioning, offering more reliable and continuous service in real-time applications, especially in environments where traditional positioning systems struggle to perform.

The InRPPP system brings a new level of precision to satellite navigation by combining the best of BeiDou's B2b, B2a, and B1C services. Through this integration, the system corrects satellite orbit and clock errors with B2b and B2a services, while B1C handles ionospheric delays. This resilient approach allows the system to deliver superior performance, even in high-occlusion or remote environments. The static experiments showed the InRPPP system surpasses other methods, with a 59.6% improvement in positioning accuracy and a 65.9% reduction in convergence time compared to using B2b, B2a, or B1C individually. In dynamic conditions, the system demonstrated enhanced stability and reduced signal interruptions, achieving up to a 34.3% improvement in accuracy. The integration of these services increases the number of visible satellites, enhancing the Position Dilution of Precision (PDOP) values and ensuring better satellite geometry. This integrated approach not only improves accuracy but also ensures continuous, reliable solutions, making it a game-changer for fields like geodesy, navigation, and disaster monitoring.

Zhetao Zhang, the lead researcher behind the InRPPP system, remarked, "The ability to integrate multiple BeiDou augmentation services into a single real-time positioning system represents a major breakthrough. By leveraging B2b, B2a, and B1C, our system offers a more reliable and accurate solution than anything available today. In both static and kinematic tests, the InRPPP system has outperformed traditional positioning methods, demonstrating its robustness and resilience in environments where signal conditions are far from ideal. This system is already applied in real applications and has potential to reshape industries reliant on satellite navigation and positioning."

The implications of the InRPPP system are vast, with applications spanning multiple sectors that depend on high-precision satellite navigation. From autonomous vehicles and precision agriculture to disaster management and geospatial services, the enhanced accuracy and stability offered by InRPPP can support real-time decision-making in critical environments. This system also promises to improve the resilience of navigation systems in regions with poor satellite visibility or signal interference. As technology advances, the InRPPP system could pave the way for even more robust solutions, advancing global sustainability goals and improving disaster response capabilities by offering uninterrupted, reliable positioning data.

References

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