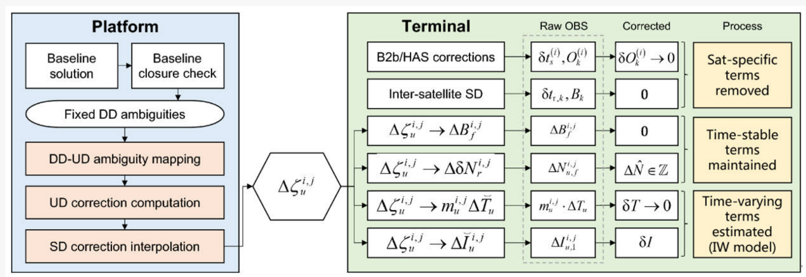
Hybrid positioning method keeps centimeter accuracy alive when correction signals drop



Overall framework of the proposed method

GA, UNITED STATES, September 11, 2026 /EINPresswire.com/ -- Positioning systems that guide autonomous vehicles, surveyors, and emergency responders face a critical vulnerability: when communication links fail, the precise corrections needed for centimeter-level accuracy disappear with them. Researchers have now developed a method that combines satellite-broadcast corrections with ground-based network data to keep positions accurate for over 20 minutes after ground corrections are interrupted—a breakthrough for remote areas, weak communication zones, and disaster response scenarios where reliability matters most.

Conventional Network Real-Time Kinematic (NRTK) positioning achieves centimeter accuracy by broadcasting corrections from reference station networks, but its effective service range is typically limited to about 100 kilometers. As baseline distances grow, atmospheric errors and orbit uncertainties increasingly degrade performance. Precise Point Positioning (PPP) works globally but can take ten minutes or more to converge to usable accuracy. Both approaches also rely heavily on continuous communication links—a serious limitation in remote regions, during natural disasters, or in any scenario where data transmission is unreliable. Due to these challenges, there is a clear need for a positioning framework that maintains high accuracy under long-baseline and asynchronous-correction conditions.

In a study published (DOI: 10.1186/s43020-026-00214-y) in Satellite Navigation on September 1, 2026, researchers from Southeast University demonstrate a new integration of Undifferenced Network RTK (URTK) with satellite-based correction services from China's BeiDou-3 PPP-B2b and Europe's Galileo High Accuracy Service (HAS). The team shows that this hybrid approach delivers centimeter-level positioning across 300-kilometer baselines and maintains fixed ambiguity solutions for over 20 minutes after ground-based correction delivery is intentionally interrupted.

The core innovation lies in how the system handles error sources across both space and time. On the platform side, the researchers extended the traditional three-station correction model to a multi-station formulation, using more reference stations to better model atmospheric delays. They applied B2b/HAS satellite-broadcast orbit and clock corrections to remove satellite-related errors, then mapped fixed double-difference ambiguities to undifferenced integers to generate comprehensive corrections that include fractional-cycle biases, atmospheric terms, and integer ambiguities. On the user terminal side, an ionospheric weighted model adapts to correction age—as corrections get older, the model's variance increases, allowing it to separate interpolated ionospheric residuals from age-induced drift. This helps preserve ambiguity-fixing capability for an extended period even when real-time ground-based correction updates stop arriving. In tests using a 300-kilometer network in western China with five reference stations, the method achieved horizontal and vertical accuracies of 1.30 cm and 5.67 cm for in-network users. For an out-of-network station 123 km beyond the nearest baseline, results were 1.014 cm horizontally and 5.997 cm vertically. When corrections were simulated as interrupted, the system maintained fixed ambiguity solutions for 1464 seconds in one test period and 1041 seconds in another, whereas the broadcast-ephemeris solution lost ambiguity fixing after only a few minutes and eventually degraded to decimeter-level accuracy.

The proposed framework combines the temporal stability of satellite-broadcast precise corrections with an age-dependent ionospheric weighting strategy, allowing the terminal to maintain stable positioning during temporary interruptions of ground-based corrections.

The implications extend across multiple high-stakes applications. Autonomous vehicles operating in remote or mountainous areas—where cellular coverage is spotty—could maintain lane-level positioning even when correction signals drop. Emergency responders entering disaster zones with damaged communication infrastructure would not lose precision at the moment they need it most. Precision agriculture, marine navigation, and infrastructure monitoring in regions with sparse reference station coverage all stand to benefit from a positioning system that does not demand continuous connectivity. The work also demonstrates that combining satellite-based augmentation services with ground-based network corrections can effectively extend the service range of high-precision GNSS beyond the traditional 100-kilometer limitation of conventional NRTK, potentially reducing the density of reference stations required for reliable regional coverage.

References
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