Overcoming Geometric Deficiencies in Pseudolite Navigation Systems

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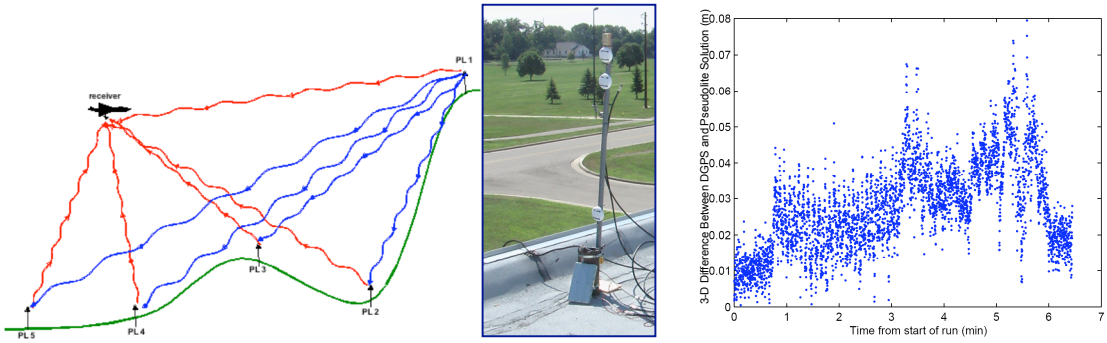

In order to test navigation systems in situations where GPS is not available, a highly accurate non-GPS-based test reference system is necessary. Beacon navigation is a viable candidate for such a reference system. Pseudo-satellites (Pseudolites) are ground-based beacons which transmit GPS-like ranging signals. The Air Force Institute of Technology (AFIT) is using a Locata pseudolite system which operates at a frequency other than the standard L1 and L2 GPS frequencies. This research is focused at overcoming the geometric deficiencies that occur when working with ground-based navigation beacons. When a test vehicle is in a situation (such as a landing aircraft) where it is nearly coplanar with the beacons, the vertical position becomes increasingly unobservable. Determining the optimal placement to mitigate the horizontal dilution of precision (HDOP) is not as demanding as finding ways to mitigate the effects of poor vertical DOP (VDOP). AFIT is attacking this problem from all angles. Research has focused on correctly characterizing the effects of geometry and finding ways to constrain the solution to predefined surfaces. Additionally the use of an orbiting pseudolite has been evaluated. Such a case would provide the needed geometry for estimating the vertical position component. This research also looks at how additional sensors, such as inertial navigation systems (INS) or ground distance sensors, can also be used to compliment the beacon navigation system, providing the vertical observability the pseudolite system lacks. By applying ground constraints and carrier-phase ambiguity resolution methodologies, we have demonstrated 10 cm or better accuracy in field tests of this system.

For more information, see Amt, J. and J. Raquet, "Positioning for Range-Based Land Navigation Systems Using Surface Topography," *Proceedings of ION GNSS-2006*, Fort Worth, TX, Sep 2006