Short Delay Time GPS Multipath Detection, Estimation, and Mitigation

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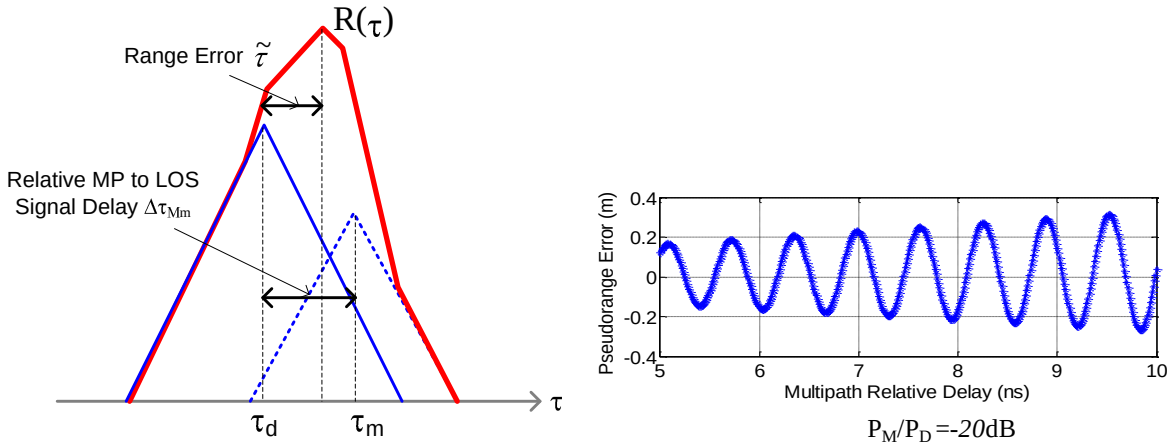

Fig. 1. Schematics of GPS multipath impact on range measurements and simulated pseudorange error for weak multipath with relatively short delay time.

Multipath is a major source of error in high precision Global Positioning Systems (GPS) measurements. Much effort has been made to devise techniques that mitigate the ranging errors induced by multipath. One particular difficult type of multipath is associated with the ones having short delay times. Existing multipath mitigation methods that make use of the differences in the time delays between the multipath and the direct line-of-sight (DLOS) GPS signal (i.e. temporal diversity) are not effective for this type of multipath. Methods that exploit the differences in the angles of arrival (AOA) between the multipath and the DLOS GPS signal (i.e. spatial diversity) are the natural approach in handling of the short delay time multipath. Previous methods, however, are based on the maximum likelihood estimation (MLE) technique to jointly estimate the direct and multipath signal parameters. Such approaches are inefficient for detecting and estimating the number of multipath sources. The proposed project aims to improve the efficiency and quality of multipath mitigation methods that use spatial diversity by separating the multipath detection, estimation, and mitigation into distinctive stages of operation.

For the first stage of our research, we have developed a robust and efficient short delay time multipath detection algorithm based on the one-way ANOVA (analysis of variance) technique. A thorough analysis on the performance of the method under various operating conditions is currently under way. Multipath estimation is also under investigation.

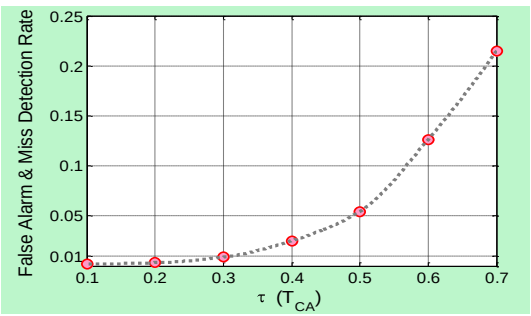

Fig. 2. False alarm rate and missed detection rate as a function of the multipath delay time. The multipath signal power is 10 dB below its direct signal power.

References:

[1] Brenneman, M. T., Y. T. Morton, Q. Zhou, "GPS Multipath Detection with ANOVA Using Multi-Channel Software Receivers," in press, *IEEE Trans. Aero. & Elec.*, 2009.

[2] Brenneman, M., Y. Morton, Q. Zhou, "Applying ANOVA test to GPS multipath detection using a multi-channel software receiver," *Proc. 2008 IEEE PLANs/ION*, Monterey, CA, May, 2008.

[3] Brenneman, M., Y. Morton, C. Yang, F. van Grass, "Mitigation of GPS multipath using polarization and spatial diversities," *Proc. 2007 ION Global Nav. Satellite Sys.*, p1221-1229, Fort Worth, TX, Sept. 2007.