Biography

Anurag Raghuvanshi is a PhD candidate in the School of Electrical Engineering and Computer Science at Ohio University. He received his M.S.E.E Degree from Ohio University and B.S.E.E from Sikkim Manipal Institute of Technology, India. He is an ION member and his research interest is focused on aircraft precision approach using the Ground Based Augmentation System (GBAS) with interest in antenna induced group delays. He received an ION best graduate student award in April 2016 for his contribution in the field of Antenna Group Delay.

Abstract

Most of the commercial aircrafts use a ARINC 743A certified L1 only airborne antenna for landing aircraft using the Ground Based Augmentation System(GBAS). Until 2006, the airborne antenna group delay variations(GDV) for these antennas were not considered a major error source in GBAS for precision approach operations. In the earlier development of the standards for GBAS it was thought to be incorporated in the airborne multipath and noise standard deviation . Unfortunately, the flight experiments used to model the airborne multipath and noise used a dual frequency antenna and there can be a significant difference in the GDV between a dual frequency and a single frequency antenna.

In 2006, Radio Technical Commission for Aeronautics (RTCA) Special Committee 159 Working Group 7 updated the L1-only airborne antenna Minimum Operation Performance Specification (MOPS). The updated MOPS [1] included the results of testing of ARINC 743A certified antenna [2]. The WG7 presented results of the GDV as a function of arrival angles and large variations of several feet was seen. Unfortunately, the results couldn't be verified by similar experiments conducted by a different research group [3]. The results from both the groups showed that a major source might not have been included in the previous developments on the standards of GBAS. The dissimilarity of results however needed a thorough analysis and characterization of the error source.

In my presentation, I will explain the basics of Global Positioning System(GPS) and the Local Area Augmentation System (LAAS). I will introduce various error sources affecting the system accuracy. The airborne antenna group delay is one of the major error sources with multipath being the other. It is difficult to separate multipath and antenna group delay in flight. In my presentation, I will explain methodology used to separate the antenna group delay and multipath on the ground. Next, a flight test experiment results will ascertain the characterization of the statistics of the multipath error and to determine if the ground and airborne measurements agree. The flight test experiment uses level turns with a 5-nmi radius to measure group delay variation as a function of azimuth angle for each of the tracked satellites at specific elevation angles. The results of this characterization could be used to revisit the error allocations in [1] and the Local Area Augmentation System (LAAS) MOPS [4].

References

[1] RTCA, Inc., "Minimum Operational Performance Standards for Global Navigation Satellite System (GNSS) Airborne Active Antenna Equipment for the L1 Frequency Band," DO-301, 2006.

[2] Van Dierendonck, A. J., Erlandson, R. J., "RTCA Airborne GPS Antenna Testing and Analysis for a New Antenna Minimum Operational Performance Standards (MOPS)," Proceedings of the ION NTM, January 2007.

[3] Murphy, T., Geren, P., Pankaskie, T., "GPS Antenna Group Delay Variation Induced Errors in a GNSS Based Precision Approach and Landing Systems," ION GNSS 2007, 25-28. September 2007, Fort Worth, Texas.

[4] RTCA, Inc., "Minimum Operational Performance Standards for GPS Local Area Augmentation System Airborne Equipment, DO-253C, 2008.