Day 2 (Wednesday, 26 October) 9:30 - 11:00, Hall C

Technical Session 3 Global Navigation Satellite Systems

T3-1-A

Identification and Operational Impact Analysis of GNSS RFI Based on Flight Crew Reports and ADS-B Data

Patric Fol, Michael Felux (Zurich University of Applied Sciences)

Today, satellite navigation is the primary means of navigation in civil aviation. Global Navigation Satellite Systems offer global coverage, high accuracy, and reliable position information. They are not only used for en-route navigation but there are also approach procedures based on satellite navigation and safety systems like the Terrain Avoidance and Warning System, that depend on its reliable data. However, Global Navigation Satellite Systems also have their weaknesses; as the signals from space are very weak, they can easily be disturbed. In recent years, reports about so-called radio frequency interference strongly increased which poses a problem for civil aviation. Airlines have identified the risks associated with radio frequency interference but data on such events is scarce. This paper analyzes Automatic Dependent Surveillance-Broadcast data of flights where cockpit crews reported issues that are in line with the expected effects of radio frequency interference. The analysis showed that the effects of radio frequency interference are clearly visible in the Automatic Dependent Surveillance-Broadcast messages, which therefore can serve as a useful source of information to get a holistic picture about the extent of radio frequency interference. Together with flight crew reports describing the effects in the cockpit for different aircraft types, the operational impact of such jamming events can then be assessed.

T3-2-A

Impact of GNSS Outage on Mid-Air Collision Risk

Benoit Figuet, Manuel Waltert, Raphael Monstein, Felux Michael (Zurich University of Applied Sciences)

Automatic dependent surveillance broadcast technology is transforming aviation by providing air traffic controllers with fast and accurate surveillance capabilities which rely on aircraft broadcasting their position obtained typically through the global navigation satellite system. While satellite navigation enables accurate positioning, it remains vulnerable to external disturbances, which can be triggered by multiple causes, such as intentional jamming or ionospheric events. In such cases, navigation systems revert to less accurate navigation techniques, such as inertial sensors or ground-based radio navigation aids. This study comes with two main objectives: (i) to study the impact of an outage of satellite navigation systems on mid-air collision risk due to navigation performance degradation, and (ii) to translate collision probabilities due to navigation error into minimum spacing requirements. In this context, this study simulates navigation errors of real world trajectories by using a probabilistic radio navigation error model. Results show that the risk of mid-air collisions is increased in case of a degradation of the navigation performance. However, it stays well below the target level of safety when ground-based navigation aids are used instead of satellite navigation.

T3-3-A

Preliminary Evaluations of User Positioning Errors in DFMC SBAS Demo at Thailand Location

Somkit Sophan, Lin M. M. Myint, Pornchai Supnithi (King Mongkut's Institute of Technology Ladkrabang)

Satellite-based augmentation system (SBAS) is an integral part of modern-day aeronautical navigation. Recently, the dual-frequency multi-constellation (DFMC) SBAS based on the L1 and L5 frequencies (1575.42 MHz and 1176.45 MHz) have received a wide attention. However, the ionosphere-free combination (IF) technique used in DFMC SBAS brings about relatively higher noise levels compared with the L1 frequency-only approach. Importantly, the suitable radius (distance) between the user and reference receivers needs to be investigated for the preliminary SBAS corrections and performances. Therefore, in this work, we investigate the long-term correction (LTC) parameters generated from three reference stations in Thailand. The positioning performances of DFMC SBAS demo (GPS and Galileo satellites) are investigated. The positioning results are calculated based on the single point positioning (SPP) algorithm. Using the estimated LTC parameter (radius of ~587 km) on quiet days, the positioning errors in horizontal and vertical directions are 1.38 and 2.59 m, respectively. In addition, on disturbed days, the horizontal and vertical errors are 1.50 and 2.93 m, respectively. From the study, the reference stations in the radius of ~600 km can be considered a suitable range for the DFMC SBAS demo at Thailand location.