Proc. of the IWAC2022
pp. 234, Oct. 2022

Paper ID : T13-2-I

DFMC GBAS testbed at Ishigaki, Japan

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This paper introduces the dual-frequency and multi-frequency (DFMC) ground-based augmentation system (GBAS) testbed developed by the Electronic Navigation Research Institute and installed at the New Ishigaki Airport. The testbed can receive most of the signals of all the major GNSS constellations. It can generate two kinds of GBAS messages corresponding to the two architectures proposed. The first data collection campaign was conducted from 8 to 10 March 2022. More flight campaigns are planned in October 2022 and March 2023.

Key Words: DFMC GBAS, low latitude ionosphere, GBAS flight trials

1. Introduction

Technical requirements for the ground-based augmentation system (GBAS) to support Category II/III approach and landing which is called GBAS approach service type D (GAST D) have been standardized by the International Civil Aviation Organization (ICAO) and are effective since November 2018.

To mitigate ionospheric threats, radio frequency interference (RFI) and constellation failure, technical specifications of the next generation GBAS based on the dual-frequency and multi-constellation (DFMC) GNSS are being discussed in the international GBAS community.

Currently, there are two major proposals, "GAST F" proposed by the Single European Sky ATM Research (SESAR)[1)] and MT23 for "GAST X" proposed by Tim Murphy et al.[2)].

2. DFMC GBAS testbed

The Electronic Navigation Research Institute (ENRI) has developed a GAST D experimental prototype was developed and installed at the New Ishigaki Airport (24.4ºN, 124.2ºE, 19.6º magnetic latitude) in 2014. It was restructured to be a DFMC GBAS testbed in 2020. Figure 1 shows the layout of the equipment consisting the testbed.

There are five GNSS stations in the airport field. Received signals are transferred via optical fibers to the receivers located in a room in the airport building. The receivers can track most of the signals of all the major GNSS constellations. The GBAS data processor in the room generates GBAS messages. The GBAS messages are transmitted via VHF data broadcast (VDB).

The GBAS data processor can generate standard GBAS messages for GAST D (message type (MT) 1, 2, 3, 4, and 11) and messages for DFMC GBAS including MT-42 and 50 for GAST F and MT-23 for GAST X.

Because ionosphere-free smoothing of pseudoranges are used only when the ionospheric anomaly is detected in both the cases, data and information on the ionospheric conditions are important even for DFMC GBAS. The testbed is supported by various instruments for observations of the ionosphere located nearby.

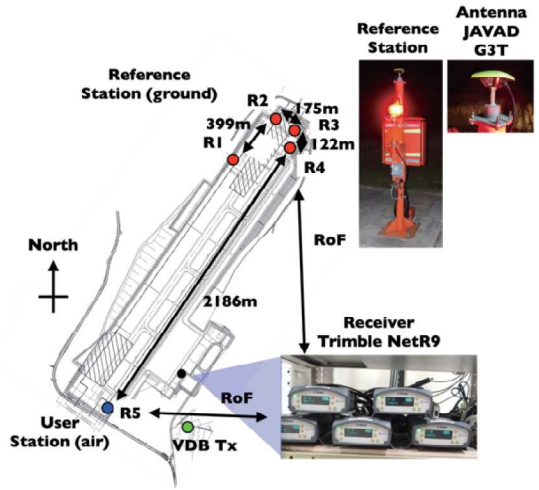

Figure 1. The layout of equipment of the DFMC GBAS testbed at the New Ishigaki Airport.

3. Flight trial

A first DFMC GBAS flight data collection campaign was conducted from 8 to 10 March 2022. In total, 27 approaches were made. Although the ionosphere was very quiet, the obtained DFMC ground and airborne data are useful for technical validation of the proposed DFMC GBAS architecture.

More flight campaigns are planned in October 2022 and March 2023 in the seasons when ionospheric disturbances are known to occur frequently.

4. Summary

The testbed will contribute to the definition of the definition of the DFMC GBAS architecture and validation of it under the low magnetic latitude ionosphere.

References

1) ICAO Working Paper, NSP4 WP41, DFMC GBAS Conceptual Framework – SESAR Joint Undertaking.
2) Murphy, T. et al., Alternative Architecture for Dual Frequency Multi-Constellation GBAS, Proc. ION GNSS+ 2021, September 2021, pp. 1334-1374.