International Civil Aviation Organization

Twenty Eighth Meeting of the Communications/ Navigation and Surveillance Sub-group (CNS SG/28) of APANPIRG

Bangkok, Thailand, 01-05 July 2024

Agenda Item 6: Navigation

6.4 Other navigation related matters

IMPROVEMENT OF NAVIGATIONAL AIDS CHECK BY USING DRONE IN REPUBLIC OF KOREA

(Presented by Republic of Korea/Korea Airports Corporation)

SUMMARY

This paper provides information about improvement of Navigational Aids check system by using Drone in Republic of Korea.

1. INTRODUCTION

1.1. In order to overcome the limitations of ground check, Korea Airports Corporation started developing an ultra-light and compact receiver for check of Navigational Aids by using drone from 2016, We developed a VOR inspection algorithm in 2017, ILS in 2018, TACAN in 2019, and a DME inspection algorithm from 2020 to 2022, as well as a function to simultaneously inspect two types of facilities (Such as LOC/GP, VOR/DME, VOR/TACAN). Currently, we are using a drone system to inspect NAVAIDs at airports across the country.

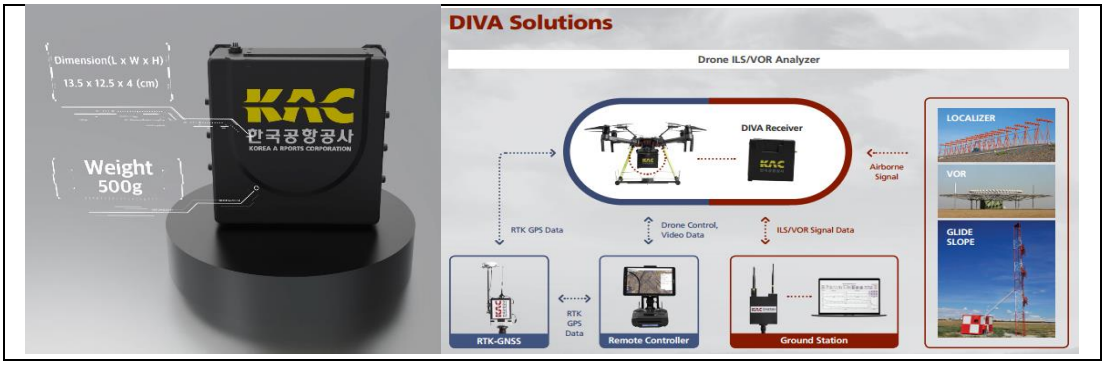

Figure 1. Drone system configuration diagram for navigational Aids check and software for analysis

2. DISCUSSION

Improvements of Inspection System using drones

2.1 Korea Airports Corporation had several meetings with flight inspectors to enhance the accuracy of the Drone ILS/VOR/TACAN/DME Analyzer (DIVA) system and to derive results similar to flight inspection. Based on the advices from flight inspectors, improvements were made to the LOC's CLR inspection routes, result graphs format, and other related aspects. The DIVA system automatically generates inspection report including data and graphs for key items of Approach and Level run (Modulation, Width, Symmetry, Structure Below Path, Path Structure Zone-3, Frequency, Power, etc.). The report is designed similarly to the flight inspection aircraft report to facilitate comparison. For future expansion, the results up to Point A (4NM) are also included.

2.2 Also with repeated measurements, we have successfully determined the optimal GP aiming point and level run altitude by setting them to achieve results similar to the certified flight inspection graph at Gimpo Airport. For the Gimpo Airport approach inspection, it was found that adding 0.5m(1.64ft) to the GP altitude is the optimal setting, while flying at an altitude of 45m during the level run inspection resulted in obtaining results matching the flight inspection graph. The optimal settings may vary depending on the characteristics of each airport, and it is important to align the flight inspection results through multiple flights.

Measurements of radio frequency interference and 3D check of Navigational Aids

2.3 With the recent appearance of various electronic and communication devices, airports are increasingly concerned about the potential operational damage due to electromagnetic interference. While the Central Radio Management Service manages radio interference in Republic of Korea, it's challenging to control radio interference in the airspace where aircraft operate, rather than on the ground. To address this issue, Korea Airports Corporation has proposed a solution using drones for measuring the radio frequency environment. And Korea Airports Corporation plans to collaborate with the Central Radio Management Service to establish an airborne radio interference inspection system around airports and respond this issue.

2.4 Furthermore, Korea Airports Corporation is testing three-dimensional inspection with DIVA. Drones can fly freely in all directions (forward, backward, left, right, up, and down), allowing for three-dimensional inspection of specific cross-sections within the service area of navigation aids. A vertical-grid flight enables the measurement of major characteristics of GP for ground facility operators, including modulation and coverage (±8°).

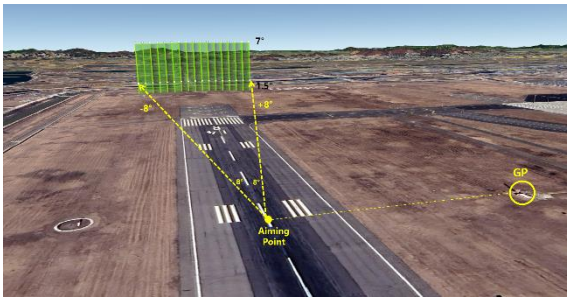

Figure 2. 3D Vertical-Grid Flight of Drone for GP Inspection

2.5 Figure 3 shows the measurement results of the Vertical-Grid flight of the GP at 14R runway of Gimpo Airport on March 29, 2024. It includes three-dimensional measurements of DDM (Difference in Depth of Modulation). DDM becomes '0 DDM' at an azimuth angle of 0° (runway center) and a vertical angle of 3°, changing from positive to negative on either side of the runway center. With continuous research, it is expected that GP performance changes can be accurately tracked with simple flights.

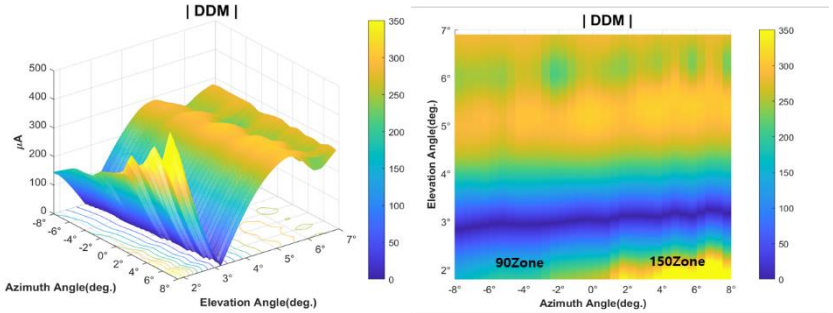

Figure 3. 3D DDM Characteristics of GP

Conclusion

2.6 Republic of Korea plans to prepare detailed regulations for Navigational Aids inspection technology using drones with concept of expanding ground check before flight inspections. If the regulations are established, it is expected that flight inspection period can be extended by regularly Navigational Aids inspection using drones. Republic of Korea have established and implemented a big plan to spread Navigational Aids inspection technology using drones around the world, and are working to make safer skies around the world.

3. ACTION BY THE MEETING

3.1 Aerial inspections using drones, which are being implemented in Republic of Korea, can more efficiently and effectively conduct ground inspections of Navigational Aids. Countries in the Asia-Pacific region also need to pay attention to inspections using drones for the efficiency of airport operation and the stable management of Navigational Aids

3.2 The meeting is invited to :

a) note the information contained in this paper, and

b) discuss any relevant matter as appropriate

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