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AGENDA ITEM 4: AIR NAVIGATION

**NAVIGATIONAL AIDS CHECK USING DRONES
IN THE REPUBLIC OF KOREA**

Presented by the Republic of Korea

INFORMATION PAPER

SUMMARY

This report describes the drone system for check of Navigational Aids in the Republic of Korea. It is a case study developed and applied to Practical field.

NAVIGATIONAL AIDS CHECK USING DRONES IN THE REPUBLIC OF KOREA

1. INTRODUCTION

1.1 Navigational Aids are important facilities essential for the safe operation of aircraft from take-off to landing. The check of Navigational Aids includes regular ground check by maintenance personnel and government flight inspections conducted every 90 to 240 days depending on the stability of the each facilities.

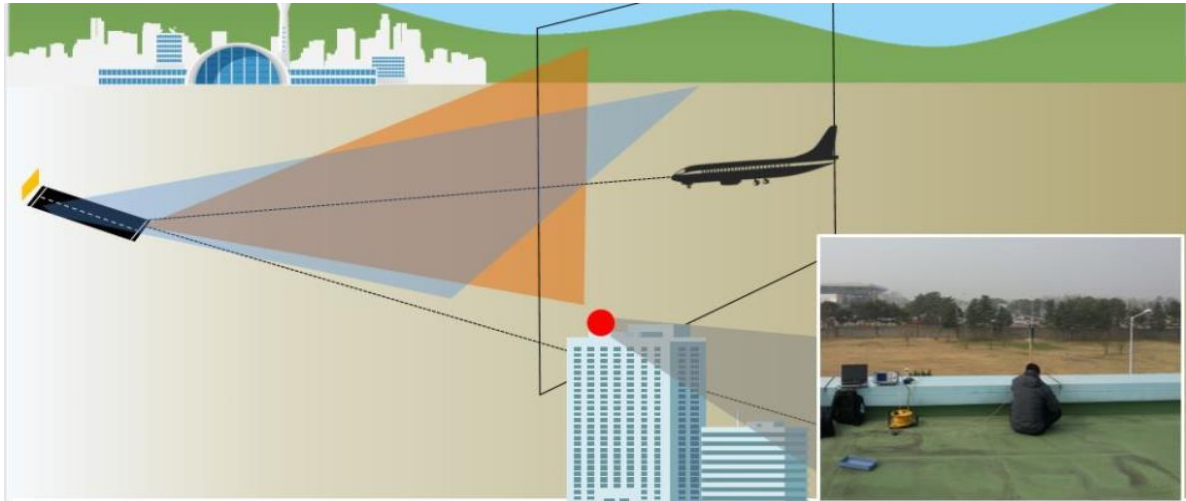


Figure 1. Limitations of Ground check of Navigational Aids

1.2 The method of check navigational Aids on the ground has a limitation in not being able to check air signals. The best way to check the aerial signal from the ground is the way to use an antenna mast or check the signal on the roof of a nearby building or at the top of a mountain. Such checks cannot measure the radio signal of the aircraft approach route and cannot check the entire range of the radio signal service provided by the navigational Aids.

2. Development of Drone System for Check of Navigational Aids

2.1 In order to overcome the limitations of ground check, Korea Airports Corporation started developing a Ultra-light and compact receiver for check of Navigational Aids by using drone from 2016, and produced prototypes and conducted field tests at airports in 2017. In 2018, we succeeded in developing a drone system for check of navigational Aids.



Figure 2. Drone system configuration diagram for navigational Aids check and software for analysis

2.2 The Korea Airports Corporation’s drone system(DIVA, Drone ILS/VOR Analyzer) for check of Navigational Aids can precisely check in real time the aerial radio signals of Navigational Aids, such as ILS, VOR, TACAN, and DME, with a flight of about 20 minutes through a pre-designated drone flight route. Additionally, PAPI and ALS check methods are currently under development.

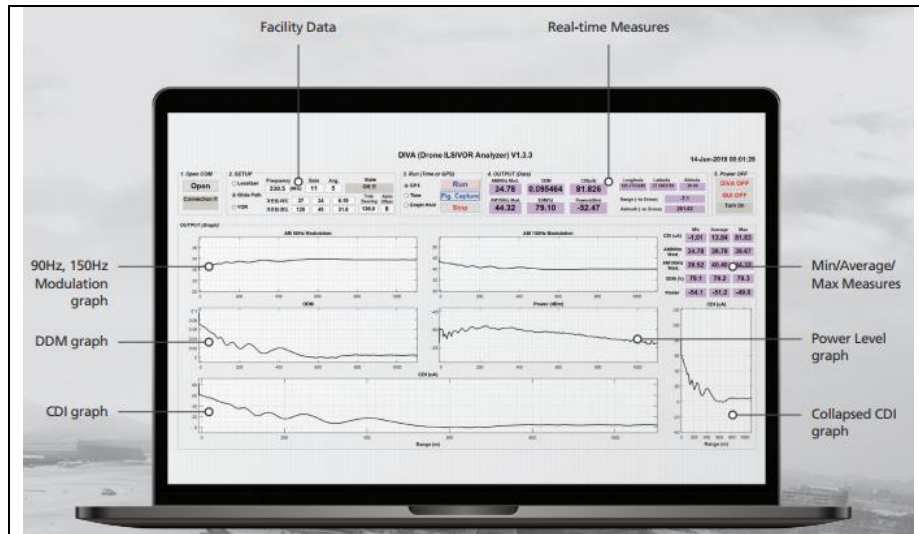


Figure 3. Software for analyzing aerial signal of Navigational Aids

2.3 Check of Navigational Aids using a drone system has the advantage of being able to closely check aerial radio signals from the point of view of the user (aircraft). Compared to aircraft, drones have a free flight path and easier control of flight speed, so the user can check the section where the distortion of the aerial radio signal is suspected at the route and speed desired by the user. In addition, since it is possible to stop flying (hovering) in the air, it is possible to continuously check the change in radio signals at a specific point in real time.



Figure 4. Drone automatic flight path for ILS and VOR check

3. Drone check of Navigational Aids nationwide

3.1 Korea Airports Corporation is taking the lead in checking Navigational Aids using drones at airports and En-route beacon stations across the country. A drone system has been established for each of the six regions across the country, and technical personnel for each region provide technical support for the check of navigational safety facilities at nearby airports.

3.2 Navigational Aids maintenance personnel acquire the national drone pilot qualification, directly control the drone, and analyze the Navigational Aids signal in real time. Korea Airports Corporation's drone system has high reliability compared to flight inspection using aircraft, and maintenance personnel can check whether there is an abnormality in the air Navigational Aids signal from time to time. In addition, ‘Guidelines for operation procedures and safety management of

unmanned aerial vehicles in the airports’ and ‘Standard work procedures for drone system operation’ have been prepared to prevent accidents that may occur at airports due to drone flight.

LOCALIZER			
FLIGHT CHECK CATEGORIES (Normal)	FLIGHT INSPECTION (20.01.30)	DRONE#6 (20.04.10)	PRECISION
Modulation	39.5	39.8	99%
Width	3.46	3.44	99%
Alignment	0.6R	0.2L	-
Symmetry	51.5	50.9	98%

Figure 5. Comparison of flight inspection results and drone-based aerial check results

3.3 Recently, with the acceleration of development around airports, artificial structures such as new apartments, iron towers, and wind turbines are increasing. These structures can cause distortion of radio signals of Navigational Aids as radio wave obstacles. When a Navigational Aids failure occurs due to the distortion of the radio wave signal of the Navigational Aids, the origin of the radio wave obstacle can be identified by checking the aerial radio environment using a drone. In this way, for the stable operation of Navigational Aids, Korea Airports Corporation is using drones.



Figure 6. Example of radio wave environment survey using drones

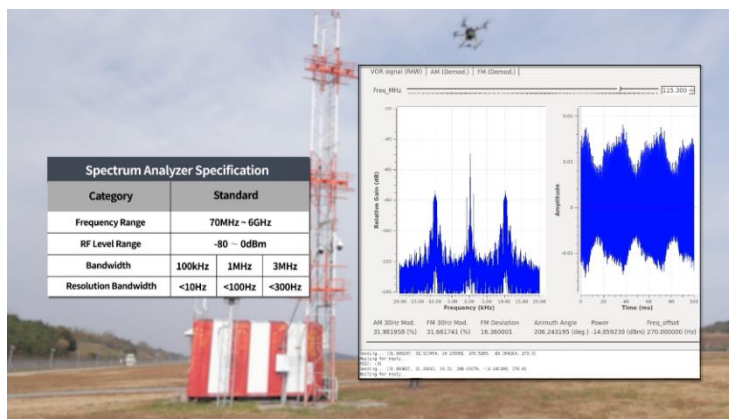


Figure 7. Aerial radio spectrum analysis using drones

3.4 In 2019, Korea Airports Corporation completed commercialization, such as obtaining European CE certification for a drone-mounted signal receiver for Navigational Aids, and sold 5 sets of drone systems to the Korean Air Force. The Republic of Korea Air Force uses drones at airfields across the country to inspect Navigational Aids.

3.5 In addition, under a contract with the Inter-American Development Bank (IDB), technical consulting for Navigational Aids drone check was performed in Colombia. Check and precise analysis of radio signals were conducted using drones for Navigational Aids (ILS, VOR, DME) at Pereira International Airport in Colombia, and consulting was conducted on regulations for safe use of drones at airports in Colombia.



Figure 8. Colombia Pereira International Airport check Consulting

4. Conclusion

4.1 Korea Airports Corporation introduced a paradigm innovation in Navigational Aids management by developing a drone check method that can be checked from an aircraft point of view that can overcome the limitations of ground check. In addition, a drone system has been established nationwide so that Navigational Aids can be checked with drones.

4.2 Korea Airports Corporation plans to expand its business in the future, starting with the sales business of the Korean Air Force and the technical consulting business in Latin America. Korea Airports Corporation plans to release a new version of a drone-equipped Navigational Aids signal analyzer in 2022, and is working to contribute to a safer global aviation industry by spreading Navigational Aids check technology using drones.

5. ACTION BY THE CONFERENCE

5.1 The Conference is invited to note the information contained in this Paper.