

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 6 Aeronautical navigation : issues

TEST APPLICATION OF 3-DIMENSIONAL LANDING GUIDANCE SYSTEM FOR THE IMPLEMENTATION OF GNSS

(Presented by the Republic of Korea)

SUMMARY

This information presents the result of an experiment in which navigational information was provided by electronic maps and three-dimensional (3-D) flight screens on Cockpit Display to the pilot for landing and take off under GNSS.

1. INTRODUCTION

1.1 ICAO recommends GNSS to be used as landing guidance system, and it has been reviewed, updated and identified as a standard navigation system by worldwide research.

1.2 The Republic of Korea has developed and tested three-dimensional(3-D) visual equipment for GNSS, which would enable the pilots to obtain precise visualized navigation solution.

1.3 The 3-D visual map has been created with great resemblance to the actual features such as runways and contains an area beyond the starting point of Tunnel-In-The-Sky.

2. PREPARATION OF THE THREE-DIMENSIONAL MAP

2.1 The 3-D map was developed using survey maps. Based on the aerial photographs and drawing of Ulsan and Gimpo airports, detailed and realistic maps were created.

2.2 The maps show the runways and features of the ground in 3-D, and beyond the starting point of Tunnel-In-The-Sky from the airport to give more reality.

2.3 In addition, the software for 3-D is designed to visualize position information from the GPS with the greatest precision possible and to process data with real-time upgrade rate not exceeding 1Hz at maximum.

3. **DISPLAY FEATURES**

3.1 The 3-D display programs start from the point where aircraft with GNSS avionics obtain the initial navigation data. When the navigation solution and flight information are sent to a control tower, the screen will visualize the data processed in the receiver.

3.2 The cockpit system transmits to the display system data such as :

- GPS Week
- GPS time
- UTC time
- WGS84 latitude and longitude, altitude coordinate
- WGS84 ECEF coordinate
- Speed information (horizontal, vertical direction)
- Heading, Pitch, Roll
- The number of visible GPS satellites
- The DGPS from the FLAG value

3.3 Given a precise course of fields, a specific point on the course is fixed as the central point of Tunnel-In-The-Sky. A square-shaped tunnel is made when horizontal and vertical measurements of the path are input. A tunnel is created when the anchor line is drawn between the central point on the base and the surface and can be made into a 3-D tunnel when these steps are taken as necessary. The dimension of the tunnel is designed to meet the requirements for CAT I lateral and vertical direction approach set out by Document RTCA/DO-245.

4. **TEST SCREEN**

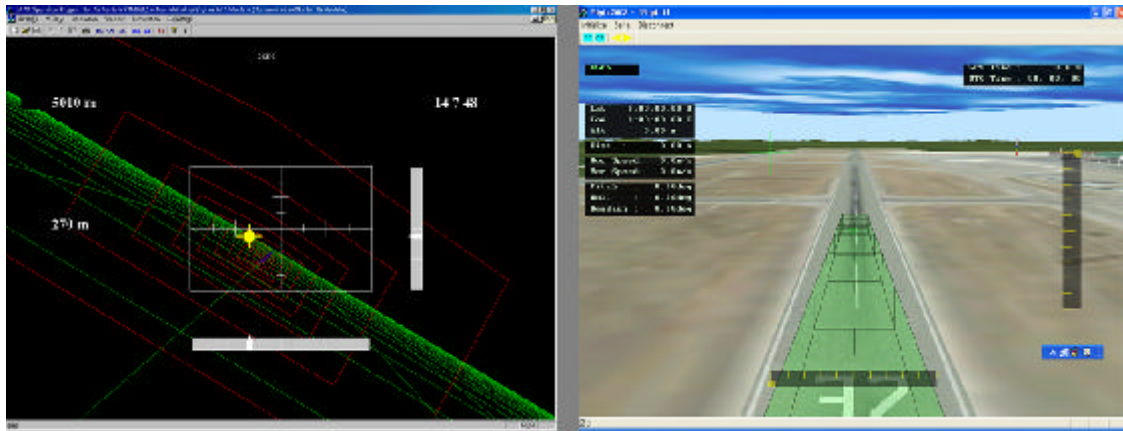


Figure 1. 2 dimension display system(left) and enhanced 3D display system(right)



Figure 2. Gimpo airport test scene



Figure 3. Gimpo airport screen(runway end)



Figure 4. Ulsan airport test scene

5. CONCLUSION

5.1 This experiment has shown that the system using the concept of "Tunnel-In-The-sky" enables a more precise navigation than is possible with the widely used ILS approach, even during poor weather condition by providing a 3-D view of the flight path.

6. **ACTION BY THE MEETING**

- 6.1 The meeting is invited to note the information contained in this paper.

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