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PRECISION APROACH SYSTEM BASED ON GLOBAL NAVIGATION SATELLITE SYSTEM

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***Abstract**: This paper will present an intelligent system for high precision approach. The current core satellite constellation is unable to provide accuracy and integrity to achieve precision approach. This system uses the concept of differential corrections to augment satellites signal in order to meet these requirements.*

***Keywords**: navigation, satellite, augmentation, approach, GLS*

1. INTRODUCTION

Unfortunately, typical, ground-based navigation aids failed to keep up with the global navigation requirements and modern aircraft. The old method of navigation through the use of a sextant and dead reckoning is just not adequate for modern day systems. The development, initially by the United States, of a global system providing positioning and timing services allowed the introduction of an alternative to those conventional navigation and approach aids with the possibility of using new concepts in air navigation capable of satisfying the new needs of the aeronautical community.

The International Civil Aviation Organization (ICAO) had actively promoted the use of Global Navigation Satellite System (GNSS). A wide area of applications have already demonstrated the enormous benefits to be gain from onboard Global Positionong System (GPS) receivers, including safety enhancements. In air operations, GPS accuracy streamlines enroute and terminal navigation, thereby reducing flight times and ultimately fuel consumption. Since it is a three-dimensional system, descent, approach, and landing operations can be monitored more closely.

Today, GPS is used on land, sea, and in the sky to provide life saving information to navigation systems around the earth.

2. GROUND-BASED AUGMENTATION SYSTEM

For precision approach, standard GPS information alone does not offer the required quality level. The Ground-Based Augmentation System (GBAS) is a system that provides enhanced GPS positioning to aircraft with the accuracy, integrity, continuity and availability that precision approaches demand.

The GBAS principle relies on differential corrections of the GPS signal. A ground station is fitted with a number of GPS receivers. Given the pin pointed position of the receivers, errors in the received signal can be measured and corrections calculated. Together with final approach information this corrections are transmitted to the aircraft via Very High Frequency Data Broadcast (VDB). The aircraft benefits from accurate lateral and vertical positioning enabling procedure approach and landing operations.

GBAS works based on three segments: satellites constellation, ground station and aircraft receiver, as shown in Figure 1.

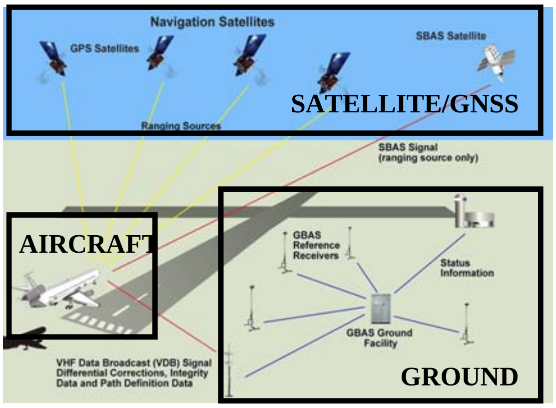

Figure 1 – GBAS architecture

• **Satellite subsystem:**
  – provides satellite status, position and timing signal;
  – has sufficient number of satellites to determine user position.

• **Ground subsystem provides:**
  – pseudorange corrections for each satellite in view;
  – integrity of aircraft subsystems (protects against satellite signal errors, ground subsystem errors and anomalous ionospheric errors);
  – approach paths (Final Approach Segment – FAS – for all runway ends);
  – local tropospheric parameters, necessary to adjustment;
  – predicted availability for precision approaches and estimates aircraft protection levels against alert limits.

• **Aircraft Subsystem:**
  – applies broadcast pseudorange corrections (PRC's);
  – computes position using corrected PRC's only;
  – computes deviations from broadcast approach path;
  – determines if GBAS Landing System (GLS) approach is safe;
  – follows desired approach path to decision height – continue with GLS approach or execute missed approach.

3. GBAS BENEFITS

Why is GBAS such a good system? It allows to fly very accurately approaches to airfields or towards runways, but with a ground installation which is more simpler, more cheaper and more flexible than the Instrumental Landing System (ILS).

One GBAS station can support multiple runway ends and reduce the total number of systems at an airport. With one ground station on an airfield you can feed all the runways and fly GLS approaches to all those fields with just one station which is located inside the airfield. A GBAS is sited to minimize critical areas which place fewer restrictions on aircraft movement during ground taxi and air operations. ILS requires one frequency per system and GBAS requires one VHF assignment for up to 48 individual approach procedures. This reduces the Very High Frequency (VHF) requirements and simplifies airport infrastructure. Also, GBAS requires less frequent flight inspections compared to those required of ILS systems.

From a pilot's point of view, GBAS has been architected to work identically to ILS (figure 2). The only difference is the nomenclature the pilot sees on the display and, instead of tuning into a frequency, they now tune a channel to select a specific procedure. From a flying perspective, it is identical to ILS, which simplifies training. No specific simulator training or checking is required as pilots.

Figure 2 – GLS and ILS flight display

"You fly the same, you have the same signals you have the same information instead of reading ILS here you read GLS here, instead having here a frequency you read what we call a channel, but for the rest, is exactly the same thing. You fly exactly the same way".[8]

3. CONCLUSIONS

The future of GNSS appears to be virtually unlimited. The aviation industry is developing the GBAS, a new positioning and landing system that integrates satellite and ground-based navigation information.

In conclusion, potential benefits of the GLS include significantly improved takeoff and landing capability at airports worldwide at reduced cost, instrument approach service at additional airports and runways, and eventual replacement of the ILS.

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