

Lars Kletten
Marketing Executive
Normarc Flight Inspection Systems
P.O.Box 156 Manglerud
N-0612 OSLO
NORWAY



USING HIGHLY ACCURATE DGPS - RTK REFERENCE FOR FLIGHT INSPECTION OF ILS CATEGORY III

ABSTRACT

Normarc Flight Inspection Systems utilizes high precision RTK-receivers in its Flight Inspection Systems to provide the customers with an accurate position reference highly suitable for inspection of up to and including ILS Category III facilities. During the last decade, with higher precision reference systems readily available, there has been a generation change in the flight inspection industry with regards to this.

This change for higher accuracy reference systems has also brought with it the need for better understanding of the DGPS-RTK position reference system. Parameters that were insignificant with less accurate positioning systems, may now be contributing significantly to the overall error-budget.

Ground Facility Survey

The exact coordinate location of the Ground Facility to be inspected is one of the key parameters in flight inspection. It does not help to know the position of the aircraft down to a few centimeters accuracy, if the ground facility location is only known within a few meters. Remember; no chain is stronger than the weakest link.

The importance of this issue is often overlooked, as the error induced may seem small compared to less accurate positioning systems. However, it becomes crucial with the high accuracy of modern reference systems.

Graphs will be presented to show the influence that coordinate errors in the ground facility position will have on the total error budget.

Timing Considerations

The Flight Inspection Aircraft is basically comparing two signals: the radio signal from the ground facility, and the position reference from the Positioning Reference System. Based on the comparison of these two signals, the error of the ground facility is calculated. It is important to make sure that the comparison between the matching data set was made. In other words, timing or time stamping of these two signals is very important.

The radio signal from the ground facility is passed from the receiving antenna through the airborne receiver, then through interfacing hardware and into the computer system. This signal chain introduces a delay in the signal, i.e. the signal has a certain age when it reaches the computer system.

Likewise, the position reference obtained from the RTK-receiver will pass through a similar chain before it reaches the computer system. It is important that the two signals are corrected for any time-differences before they are compared.

Graphs will be presented showing the influence of this on the total error budget, and what areas to pay special attention to regarding this problem.

Dynamics of Reference System vs. Navaid Signals

Another effect of the accurate GPS-based position reference systems of today, is the increased dynamics.

The ground facility signal is passed through a navaid receiver in the aircraft. This receiver works like a low pass filter on the incoming signal. This means that if the aircraft experiences a sudden drop, due to for example turbulence, the signal from the receiver needs some time before it settles at the new value.

The signal from the RTK-based position reference, on the other hand, will follow the exact dynamics of the aircraft. This may lead to the reference position curve having a more high frequency nature than the navaid signal. This high frequency will also be visible on the compared value between the two signals.

It is important to understand that this “noise”, is caused by the fact that the reference system has better dynamics than the navaid receivers.

Graphs will be shown showing this nature of the signals.

Aircraft Antenna Displacement and Attitude Information

The position of the navaid-antennas and the GPS-antennas on the aircraft may often be several meters apart when fixed on the aircraft. The position measured by the navaid-receiver is based on the location of the navaid-antenna, while the reference position from the RTK-receiver is based on the position of the GPS-antenna.

Imagine the following scenario;

An aircraft is inbound on the centerline of the localizer. The pilot is experiencing strong crosswind and is compensating by putting the aircraft into a crab. Now, if the GPS antenna on the aircraft, which is the known reference position of the aircraft in space, is not in the exact same position as the NAV antenna, the perpendicular distances from the localizer centerline will not be the same and the signal compare calculations will be incorrect.

It is therefore necessary to compensate for the offset between the two antennas, and often it is handled in the system Software. To perform the compensation, the exact location of the antennas must be known.

In addition to knowing the antenna location, it is necessary to know the attitude of the aircraft to perform the offset compensations.

With this antenna position compensation and knowledge about the aircrafts attitude at any given time by interfacing to the aircraft gyros we can obtain correct compare calculations.

Based on the exact positions of the antennas, it may suffice with accurate heading-information to perform the offset calculations on small and sometimes on medium size aircrafts. However, the best

accuracy is obtained by having all three attitude parameters available to the computer system.

The accuracy of the attitude system itself is another parameter that must be taken into account. If the heading is significantly wrong, it will lead to errors in the offset calculations, and thus to errors in the final result.

Conclusion

The appearance of more accurate position reference systems have led to previously less significant parameters becoming very important. It is crucial to understand this new situation when dealing with modern flight inspection systems with high demands of accuracy.

Once these parameters are understood and included properly into the flight inspection system, the system will be able to obtain an overall accuracy more than capable of performing flight inspection of Cat III facilities.