Flight Validation and Flight Inspection of IFR Helicopter Procedures

Information and Fact Sheet
A New Approach for Flight Validation and Flight Inspection

The Challenge
The lack of a smooth process for introducing IFR helicopter procedures hampers helicopter operations in many countries. While in special cases helicopters may use available IFR procedures designed for fixed wing aircraft (such as ILS), dedicated IFR procedures are clearly needed for operations such as EMS, government, oil rig supply and other special mission users. Liability issues inherent to procedure design and publication, as well as high regulator (CAA) involvement, make IFR procedure publication a complex and often costly process. The same applies for the assessment of navigation performance and other safety-critical aspects such as database integrity, communication coverage and GPS performance during commissioning Flight Inspection and Flight Validation, which are prerequisites for publication of any IFR procedure according to ICAO requirements. This has been recognized at the European level, and implementation programs such as GSA EGNOS and SESAR PROuD have been established to accelerate the introduction of LPV procedures, including those for helicopters, within Europe.

The Project
Since the end of 2014, Switzerland has begun introducing a “low flight network” (LFN) in mountainous terrain using Point-in-Space (PinS) procedures and approaches to hospitals for a country-wide, all-weather, Helicopter Emergency Medical Service (HEMS). RNP 0.3 (Required Navigation Performance) and PinS procedures are typically Localizer/Vertical Performance (LPV), equivalent to APV/SPBAS (Approach Procedures with Vertical guidance /Space Based Augmentation). The first RNP-AR procedures are planned to be introduced in the 2016/2017 time frame. A co-operation between the Swiss Air-Rescue Operator, Rega and FCS Flight Calibration Services GmbH resulted in a project to specially equip an AgustaWestland AW109SP helicopter with an Automatic Flight Inspection System, the AD-AFIS-220H, which was completed and certified in late 2014. A second AW109SP will be equipped as a backup aircraft and deliver improved operational flexibility in 2016. Additional project stakeholders are the Swiss Air Navigation Institute (ANI), skyguide, the Swiss Air Force (SAF), and the Swiss Federal Office of Civil Aviation (FOCA).

The Platform
The AgustaWestland AW109SP Da Vinci helicopter used for Flight Validation has the following specifications:

Helicopter data
- MTOW 7,000 lbs
- Max. speed: 168kts; max. range 932 km (503NM)
- Retractable landing gear
- IFR equipped, dual instrumentation including dual primary GNSS receivers and dual Genesys Aerosystems IDU-450 EFIS/FMS
- RNP 0.3 performance, approach angle up to 9°
- Quick Access Recorder with full ARINC 429 / RS-232 FMS data interface

Flight inspection system (FIS) interfaces:
- Separate VHF/UHF antenna interface
- Separate L1/L2 GPS antenna
- Quick locking stretcher base for Flight Inspection System installation
- 800 W available power

Certification
- Certified by Rega’s engineering department under EASA authorisation.
Flight Inspection System – the “HeliFIS”

With the focus of Flight Inspection being on GNSS and SBAS performance, interference detection and communication coverage assessment with low measurement uncertainty, a certified high end Flight Inspection System complying with both international and national standards is required. The HeliFIS provides essential features such as a highly accurate positioning system, corrections for antenna data and lever arms, and compensation for cable losses. It was decided to use the Aerodata AD-AFIS-220 Flight Inspection System, as installed in FCS’s King Air 350 Flight Inspection aircraft, in a special configuration for helicopter operations. The system records all necessary flight parameters including attitude, position and acceleration at 10Hz and achieves a position accuracy of better than 0.2m, with angular uncertainties better than 0.1°, using a differential GPS, INU-supported hybrid truth system which is fully independent from primary avionics. The use of existing software reduces both the certification and training effort. A major challenge was to design a rack certified for both extremely high ‘g’ loads while using a quick-locking mechanical interface with the helicopter’s stretcher base unit for quick installation and removal to revert to the EMS role.

Flight Validation and Flight Inspection Process

The process, from initial procedure planning to final Flight Validation and Inspection requires highly effective project management. In addition to Jeppesen coding the new procedures into the pre-production ARINC NAV database and Genesys Aerosystems supplying the binary FMS database, the process involves ANI procedure designers, GNSS and communication coverage simulation experts, Rega’s Flight Validation pilots and the FCS Flight Inspection team. Following confirmation that the PinS and LPV procedures provide satisfactory and safe performance, and Flight Validation and Inspection reports are issued, the final formality is publication of the procedure in the national AIP.

Future Applications

The HeliFIS equipped AW109SP lends itself to a wide range of additional applications such as Flight Inspection of Precision Approach Path Indicators (PAPI), Helicopter Visual Segment Approach Lighting Systems (HALS) and Precision Approach RADAR (PAR) installations with high approach angles such as those found in mountainous terrain. Even the certification of flight guidance systems is within the scope of applications due to the extremely precise and independent position reference system. A further application is the coverage evaluation of a VHF emergency radio communications network operated by Rega and covering the whole of Switzerland.

The combined experience of FCS Flight Inspection and Rega’s HEMS operation define a new standard for Flight Inspection and Flight Validation of helicopter IFR procedures.
Technical Data AD-AFIS-220H Helicopter Flight Inspection System

**General**
- Data acquisition rate: 10Hz for all parameters
- Online evaluation (standard); optional post flight evaluation
- ASCII data available for all phases of flight.

**Positioning Reference (Truth System)**
INS with carrier phase DGPS

- **Parameter** | **Measurement Uncertainty (2 sigma)** | **Parameter** | **Measurement Uncertainty (2 sigma)**
- Latitude | < ±0.2m three-dimensional | Pitch angle | 0.1°
- Longitude | | Roll angle | 0.1°
- Altitude | | True heading | 0.4°

Note: Measurement uncertainty INS with Wide-Area DGPS (Omnistar VBS); normally used for en-route inspections is less than ±2.4m horizontal.

**FIS FMS**
The HeliFIS is equipped with an internal, RF-leg capable FMS for error calculation against the reference flight path.

**Communications**

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<thead>
<tr>
<th>VHF/UHF Parameters</th>
<th>Measurement Uncertainty</th>
<th>Remarks</th>
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<tr>
<td>Power density / field strength</td>
<td>±3dB</td>
<td>VHF and UHF COM bands</td>
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<tr>
<td>Audio</td>
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<td>Demodulation and recording</td>
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**GNSS / SBAS**
The HeliFIS is equipped with a GNSS/SBAS engineering receiver and a TSO approved aircraft GNSS/SBAS receiver. Error calculations are available for all positions.

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<tr>
<th>Parameter</th>
<th>Remark</th>
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<tbody>
<tr>
<td>Position</td>
<td>Lat, Lon, Alt</td>
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<td>Protection level</td>
<td>Horizontal and vertical</td>
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<tr>
<td>FOM</td>
<td>Horizontal and vertical</td>
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<td>No. of visible / tracked Sats</td>
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<td>Sat elevation and azimuth</td>
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<td>Sat PRN and CNR</td>
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<td>Sensor operational mode</td>
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<td>DOP</td>
<td>H, V, P, G</td>
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<td>MT event</td>
<td>For 2 SBAS SVs</td>
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<td>RAIM faults</td>
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<td>SBAS horizontal error</td>
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<td>SBAS vertical error</td>
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A joint venture of DFS, skyguide and Austro Control