Project Overview
Helicopter-Recording-Random-Flights (HRRF)

A project in the frame of the Swiss-wide implementation programme of satellite-based navigation

Marc Troller
Skyguide, Swiss Air Navigation Services
Assembly Resolution 1998

A32-19: Charter on the Rights and Obligations of States Relating to GNSS Services

Whereas Article 44 of the Convention on International Civil Aviation, signed on 7 December 1944 (the “Chicago Convention”), mandates the International Civil Aviation Organization (ICAO) to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport:

Whereas the concept of the ICAO communications, navigation and surveillance/air traffic management (CNS/ATM) systems utilizing satellite-based technology was endorsed by States and international organizations at the ICAO Forty-Ninth Air Navigation Conference and was approved by the 20th Session of the
Satellite-Based Navigation vs. Conventional Navigation

› Guidance Systems
› Only for aviation
› Operated by ANSP
› Controlled by ANSP
› Strong signals

› Positioning Systems
› Multi-domain applications
› Partially operated by (foreign) non-aviation agencies
› Week signals
Signal Quality of Satellite-Based Navigation

- Skyguide is operating a GNSS monitoring
  - ABAS/RAIM
  - SBAS
  - GBAS
- Limited to few locations (ZRH, GVA)
- Limited possibilities concerning
  - signal shading assessments due to terrain
  - RFI jamming situations
- Flights close to terrain are potentially those who are affected most by terrain and RFI
Idea Helicopter Recording Random Flights (HRRF)

› Recording of data in the whole Swiss airspace on lower flight levels close to terrain
› Refrain from dedicated flights due to costs
› Use of helicopters operating in the Swiss airspace

› Swiss Air Force (SAF)
  • 18 Helicopters Eurocopter type EC635

› Swiss Air-Ambulance Service (Rega)
  • 6 Helicopters Eurocopter EC145
  • 11 Agusta Westland AW109SP (DaVinci)
Objectives Helicopter Recording Random Flights

› Performance Analysis (accuracy, protection levels)

› Carrier-to-Noise analysis (interference)

› Flight technical error determination (difference navigation track – desired track) if procedures are used

› Total system error determination for specific cases (use of additional geodetic GNSS receiver)

› Specific analyses…
Project Equipment

› Installation of miniQAR access recorder
› Recording of
  • GPS/SBAS
    position, altitude, time, protection level
    where available: used satellites, satellite data,
    range information, carrier-to-noise
  • FMS
    position, altitude, time, speed
    if available: flight plan information
  • AHRS
    pitch, roll, heading
› Upgrade of GPS/RAIM to GPS/SBAS receivers on EC145 helicopters
Project Equipment (cont.)

› Temporary installation of geodetic GPS/GLONASS receiver
› Mounting of GNSS antenna with vacuum cap to the window
› Collection of independent raw GPS/GLONASS data
› Determination of Actual Flight Path and Derivation of Total System Error (TSE)

› Implementation of dedicated routings (Waldshut and Thunersee)
Project Design Considerations

› Target area:
  • entire Swiss territory (40'000 km²)
  • from ground to 5'500 m
› Voxel (3D) of 1 km x 1 km x 1 km = 200'000 voxels
› GPS receiver position output rate: 1 second
› In the mean: 0.7 positions per voxel per day
› Reality: No homogeneous statistical distribution
› But: Our main interests are where helicopters are flying
› 3 years of data recordings: ~700 records per voxel
› Project goal: 40'000 flight hours to have a statistical relevance