International Conference
State and Development Prospects of Integrated Modular Avionics

New functionality of avionics in the implementation of prospective ATC system and its validation of the hardware-in-the-loop simulation method

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Tasks and Functions for Avionic in Advanced ATM

New ATM system requirements
- Involve flight crew to CDM - Collaborative Decision Making
- Delegate authority and responsibility to flight crew (forward to FF)

Old/New Out-Window Conditions

Traffic
- High density
- Air Space Restrictions
- Airport Capacity Restrictions

Weather
- Local unpredictable weather restrictions on the route (the storm centers, strong cumulonimbus clouds, turbulence)
- Wind shear during takeoff and landing restrictions

Ground (approach, surface (RW, TW))
- Natural and artificial obstacles in the flight altitude
- Heavy traffic at the airfield aircraft an vehicle
- The increasing complexity of airport infrastructure (increasing quantity of runways, taxiways, gates, etc.)

New tasks and applications
- To provide the seamless intercommunication inside SWIM (ATM)
- To provide the digital data links functions in broadcasting and point-to-point modes (ADS-B, CPDLC, AOS)
- To provide the advanced HMI (CDTI)
- To enhance Airborne Traffic Situational Awareness for the flight crew on the ground and in the air (ATSA - …)
- Conflict prediction on the ground and in the air
- Intellectual support the flight crew for conflict prevention and conflict resolution procedures (ACM)

New introduced technology
- In the communication area - ATN - Aeronautical Telecommunications Network, digital data links
- In the navigation area - PBN - Performance Based Navigation, GNSS +
- In the surveillance area - the integration of ADS-B/TCAS/WXR/TAWS proceeding functions as a partitions in IMA structure

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Onboard Functional Software for Aircraft Safety Flights

SoW

Standards and Rules

Functions

Verification

Simulating

Analysis of International programs

Algorithms

Software prototype

Verification

Prototyping

Load module
Prospective On-board Surveillance Applications

- Enhanced Visual Acquisition (EVAcq)
- Conflict Detection (CD)
- Airborne Conflict Management (ACM)
- Rerouting

- Enhanced Visual Approach (EVApp)
- Airport Surface Situational Awareness (ASSA) & Final Approach and Runway Occupancy Awareness (FAROA)
- In-Trail Procedure (ITP)

- Approach Spacing for Instrument Approaches (ASIA)
- Independent Closely Spaced Parallel Approaches (ICSPA)
Conflict Detection, Prevention and Resolution

**Conflict detection:**
- With Surrounding Aircrafts
- With Restricted Airspace Areas (RAA)

**Resolution making:**
- Non-recommended Flight Sectors
- Recommendations for taking care of Surrounding Aircrafts
- Recommendations for taking care of RAA
Rerouting Procedure

- Dynamic surveillance of restriction movement and recommendations for avoidance
- Tracking changes in the flight plan for the prevention of dangerous approaches
In-Trail Procedure

Developed ITP algorithm is responsible for computing the flight deck information needed by the crew to determine whether the criteria required for an ITP procedure is met or not.
Standards for Implementation of Onboard Surveillance Software

- **DO-289** Minimum Aviation System Performance Standards for Aircraft Surveillance Applications (ASA)

- **DO-317A** Minimum Operational Performance Standards (MOPS) for Aircraft Surveillance Applications (ASA) System
Research stand with hardware-in-the-loop and human-in-the-loop for ground and on-board ATM components simulation
Functional Scheme of the Stand
«KIS UVD» Stand
«KIS UVD» Stand
Research Stand for Aerodrome Functioning Simulation
Functional Scheme of the Aerodrome Stand

Aerodrome Control Simulator

Tower Simulator

External air situation

Avionics cockpit simulation system

AC and GV Synthetic State vectors

IMA Crates

Model of cockpit

AC and GV Synthetic State vectors

Traffic controller

Traffic controller

Hardware and Software Scheme of the Aerodrome Stand

- Aircraft full model
  - In-Flight aircrafts simulator
  - Ground aircrafts simulator
  - Aerodrome ground vehicles simulator
  - Ground surveillance simulator

- Taxi Controller Workstation

- AMDB
  - Data complexing

- The view from the Tower
- The view from the N sensors (TV / IR)

- Processing algorithms

- "KIS UVD"

- Synthetic view
Aerodrome Stand
Aerodrome Stand
Results

I. New algorithms, procedures and software layouts development for ground and on-board components

• avionics software for advanced aircrafts
  intellectual support of decision making for aircraft (ASAS, situation Awareness, rerouting, arrival, departure, surface movement, etc.)

and

• ATC (AMAN, DMAN, SMAN, rerouting, etc.) and airspace use planning systems upgrade on different levels (ATM Main Center, aggregative area control centers, airports)

II. Further improvement of interaction between controllers and pilots with new procedures being implemented

✓ Research and validation of new procedures, schemes and technologies application
  • digital communication
  • ADS-B
  • queues management within airports and hubs
  • new interoperability between controllers and pilots
  • SWIM elements (for example, centralized providing actual flight plan data)
  • CDM (air traffic flow management)

✓ Research for collaboration support and coordinated performance of air traffic stakeholders: ATM Main Center and area control centers, FIRs and airports, airlines and ATM centers