SOFIA

Safe Automatic Flight Back and Landing of Aircraft

Overall Presentation

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SOFIA Overall Data

**Budget:** 4,997,984 €  
**Duration:** 36 months  
**Start date:** 1st September, 2006  
**Web Site:** www.sofia.isdefe.es

SOFIA Consortium:

- Isdefe
- DFS Deutsche Flugsicherung
- GALILEO AVIONICA
- Thales Avionics
- AleniaSIA
- Rheinmetall Defence Electronics
- Diamond Aircraft
- IL
- Skysoft
Enabling the automatic return to ground of an airplane in the event of onboard hostile actions
Background

- SOFIA is a response to the challenge of developing concepts and techniques enabling the safe and automatic return to ground of an airplane in the event of hostile actions.

- SOFIA is proposed as a continuation of a part of the SAFEE project. SAFEE focused in the development and validation of a concept that detects and evaluates on-board threats using the Threats Assessment and Management System (TARMS) and enables the Emergency Avoidance System (EAS) to autonomously flight the aircraft to a secure point. SOFIA develops the system (FRF) that, from that secure point, takes control of the airplane and safely returns it to ground.

- Both projects are mainly related to the Research Domain 3.d “aircraft security” of the FP6-2005-AERO-1, Research Area 3 “Improving safety and security”.
SOFIA Scope

1. **EAS IDLE**
   - **FRF IDLE**

2. Threat
   - **EAS ARMED**
   - **FRF IDLE**

3. Pilot out-of-the-loop
   - **EAS AVOIDANCE**
   - **FRF IDLE**

4. **EAS ACTIVE**
   - **FRF IDLE**

5. **EAS ARMED**
   - **FRF ARMED**

6. **EAS ARMED**
   - **FRF ACTIVE**
SOFIA Core: the FRF (1/2)

The Flight Reconfiguration Function (FRF) is SOFIA’s core:
- Disables the control and command of the airplane from the cockpit
- Takes the control of the airplane under on-board security emergencies
- Manages to safely return the airplane to ground
SOFIA Core: the FRF (2/2)

It means to *create* and *execute* without any control from ground, a new flight plan towards a secure airport and landing the airplane at it.

- The **flight plan** can be *created*:
  1. Integrally by the **FRF** system
  2. By an **Authority on Ground** and negotiated with the FRF system
  3. In a **military airplane** and transmitted to the aircraft

- The **execution** of the new flight plan is **autonomously** performed by FRF
SOFIA Solutions

Three different solutions for the FRF are considered:

- **Solution 1: Flight Planning without negotiation:** FLPN is generated by the FRF system.

- **Solution 2: Flight Planning with negotiation:** FLPN is generated on ground and up-linked to the airplane. FRF system checks its feasibility.

- **Solution 3: Military A/C Relay:** FLPN is transmitted from a military aircraft.
Trajectory Generation by FRF

The Trajectory is generated by FRF considering:
- Destination airport according to the threat
- Jeppessen data
- Weather, terrain, obstacles, restricted areas and PSA (Prohibited for Security Areas)
- Fuel
- Aircraft performances

FRF enables Trajectory updates due to:
- ATC messages (e.g. change in destination airfield)
- Weather
- Traffic
- Obstacles, PSA
FRF Functions

Decision Centre Function (DCF)
- Manages FRF capabilities and controls events

Health Monitoring System Interface (HMS)
- Monitors for external systems failures critical to FRF

Route Planning and Static Flight Monitoring (RPL)
- Generates a suitable flight path to a secure airfield

Guidance Management and Leg Management (GLM)
- Performs flight guidance

Route Re-planning (RRP)
- Performs re-routing due to a conflict

Dynamic Flight Monitoring (DFM)
- Monitors aircraft performances and resolves conflicts

External Communication (COM)
- Processes the information to be exchanged with the GSDS

Display Management (DSM)
- Manages displays when FRF is active
SOFIA Safety Assessment

Safety assessment made at three levels
- Aircraft level (following ARP 4761)
- FRF level (following ARP 4761)
- ATM level (following EUROCONTROL SAM)

For every level, safety assessment is composed of:
- FHA
- PSSA

Safety Validation on:
- Flight simulators
- Real flights
- ATCO participation in trials
Validation Resources

FRF Version 1

IoA Aircraft

FRF Version 2

DAI Aircraft

GAL ATENA DFS ATC

DFS ATC

THA Airlab

Flight Trials

Ground Simulations

Preliminary Validation (Implementation)

Final Validation
IoA Validation Resources

- Aircraft: I-23 Manager

- Permissions from EASA and Polish Aviation Office to fly with FRF have been obtained
Integration at IoA Aircraft

- HW integrated in the I-23:
  - FRF/AP Computer
  - Actuators with the steering cords
  - CAN Bus connecting
  - AP Panel and separated supplying system with safety switches and fuses
DAI Validation Resources

- Flight Simulator: Testbed DA42 SIM
- Aircraft: DA42 Twin-Star
Integration at DAI Aircraft

Garmin G1000

A/C DATA

3. DAI

A/C GUIDANCE

CDI

1. RDE

FRF (FMS)

2. RDE

COMM

FLIGHT PLAN

Autopilot

Bendix King KAP 140
THAK YOU VERY MUCH FOR YOUR ATTENTION

ANY QUESTION, PLEASE?