Safe Automatic Flight Back and Landing of Aircraft

**Funding:** European (6th RTD Framework Programme)

**Duration:** Sep 2006 - Dec 2009

**Status:** Complete with results

**Total project cost:** €4,997,985

**EU contribution:** €2,589,623

**Call for proposal:** FP6-2005-AERO-1

**CORDIS RCN:** 81479

**Background & policy context:**

The solution proposed in the EC FP6 project SAFEE (Security of Aircraft in the Future European Environment) and developed by SOFIA, the Flight Reconfiguration Function (FRF), is a technological response from the industry to the social demand of increasing the security of air transport after the September 11th terrorist attacks. It is also a technological development to cope with the aims of the 'Ultra Secure Air Transport System' concept developed by ACARE in its Second Strategic Research Agenda.

**Objectives:**

As a continuation of the SAFEE works on FRF, SOFIA:

- designed architectures for integrating the FRF system into several typologies of avionics for civil transport aircraft;
- developed one of these architectures; validate the FRF concept and the means to integrate it in the current ATM;
- assessed the safety of FRF at aircraft and operational (ATC) levels.

**Methodology:**

FRF will take the control of the aircraft and will manage to safely return it to ground upon a security emergency (e.g. hijacking), disabling the control and command of the aircraft from the cockpit. It will also execute a new flight plan towards a secure airport and land the aircraft there. The flight plan can be generated from the ground or in a military airplane and transmitted to the aircraft, or created autonomously in its own FRF system.

The execution of the new flight plan is autonomously performed by FRF without any control from ground. Additionally, SOFIA will investigate the integration of such solutions into different airspace environments: current ATM, ASAS/ADS-B, airspace with/without radar coverage, 4D trajectory negotiation, etc.

SOFIA will validate FRF by using a platform composed of an ATC facility and a flight cabin simulator (an upgrade of the one used in SAFEE SP3) linked, and by performing flight trials with real aircraft. The SOFIA consortium was a well-balanced and skilled set of nine organisations from seven countries across Europe and includes SMEs.

**Parent Programmes:**

FP6-AEROSPACE - Aeronautics and Space - Priority Thematic Area 4 (PTA4)

**Institute type:** Public institution

**Institute name:** European Commission

**Funding type:** Public (EU)
### Lead Organisation:

**Isdefe, Ingenieria De Sistemas Para La Defensa De España, S.a.**

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**EU Contribution:** €0

### Partner Organisations:

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**Skysoft Portugal - Software E Tecnologias De Informação, S.a.**

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**Thales**
Key Results:

Through its research SOFIA has reached the following main conclusions:

1. SOFIA has defined different procedures for managing aircraft in security emergency being controlled by the Flight Reconfiguration Function (FRF).
2. Safety and operability of these procedures were validated and approved by ATCOs.
3. SOFIA started the assessment of regulatory and certification frameworks for such security systems not only by the research itself but also through discussions with ICAO, EASA, EUROCONTROL, SESAR and several National CAAs.
4. A ground authority and/or system (like a Ground Security Decision System) is needed at European level to:
   - Take legal responsibility of decisions;
   - Generate and track the flight plan for the FRF aircraft;
   - Coordinate with national authorities, ANSP and airports;
5. SOFIA moves aviation security a step forward.
6. SOFIA opens the door towards the exploration of new application areas for a Flight Reconfiguration Function functionality in fields like:
   - Safety
   - Small general aviation aircraft
Highly automated systems
- UAS
- Single crew operations

7. SOFIA validated FRF functions are now available for aircraft operations in the future SESAR environment specially for 4D trajectory management and trajectory generation.

Technical Implications

The FRF system is proposed as a countermeasure to terrorist, hostile actions that aim to use the aircraft as a means to affect assets on ground. This can be implemented in different ways: crashing the aircraft, using it to propagate biological or chemical agents, or to multiply the effects of the explosion of a mass destruction weapon on-board the aircraft. As a response to this challenge, the SOFIA project developed the FRF system that enables the safe, automatic and autonomous return to ground of an airplane in the event of hostile actions. To carry out this action, the FRF disables the control and command of the aircraft from the cockpit, creates and executes a new flight plan towards a secure airport and lands the aircraft at it. Regarding the generation of the flight plan to be executed by the FRF, several options are considered in the SOFIA project:

- The flight plan can be generated on ground (ATC), or
- in a military airplane and transmitted to the aircraft, or
- created autonomously at the own FRF system.

Additionally, the SOFIA project investigated the integration of such a solution into different airspace environments: current ATM, ASAS/ADS-B, automation of ground functions, airspace with/without radar coverage, CDM, 4D trajectory negotiation. Finally, the SOFIA project also analysed the impact of the regulatory and certification frameworks into the FRF system and vice-versa, first, to constrain the FRF design to such frameworks and second, to propose new procedures and standards to facilitate the technological development.

Readiness

The FRF system developed in the SOFIA project proposes a solution to one of the biggest challenges of the future aviation: to make the aircraft more secure by themselves. But it also introduces some interesting questions that will have to be solved before these systems start to operate, in order to guarantee the security introduced by them. Additional to the technological development, SOFIA considers that it is needed to promote further research in:

1. Integration of the FRF with ACAS to enable the automatic response from FRF to ACAS alerts. Creation and execution of diversion trajectories or simply the execution of the trajectories proposed by the ACAS and ulterior resume of the previous flight plan.
2. Collaborative negotiation of the FRF trajectory with other aircraft, in collaboration with the ground ATC. The integration of FRF with the ADS-B is therefore needed. This would enable a higher integration of the FRF aircraft into the future airspace as defined by SESAR.
3. Integration of the FRF with advance surveillance systems, like those being proposed by the FLYSAFE and ALICIA projects.
4. Explore the application of FRF into other scenarios like safety ones, crew reduction, UAS, very small and personal aviation.
5. Need of a ground authority and system (GSDS) at European level to:
   - Take legal responsibility of decisions (flight plan, destination airport...);
   - Generate and track the flight plan for the FRF aircraft;
   - Coordinate with national authorities, ANSP and airports.
6. Testing of the software during flights test is very demanding and expensive. It is recommended to test the SW in ground simulators and tools well in advance.

Documents:
- Final Activity Report (Final report)

STRIA Roadmaps: Vehicle design and manufacturing, Network and traffic management systems
Transport mode: Air transport
Transport sectors: Passenger transport, Freight transport
Transport policies: Safety/Security
Geo-spatial type: Network corridors