**ILDAS**

**In-flight Lightning Strike Damage Assessment System**

**Funding:** European (6th RTD Framework Programme)
**Duration:** Oct 2006 - Jul 2009
**Status:** Complete with results
**Total project cost:** €4,256,922
**EU contribution:** €2,331,792

**Call for proposal:** FP6-2005-AERO-1
**CORDIS RCN:** 81465

**Background & policy context:**

Commercial passenger aircraft are on average struck by lightning once a year. The effects of lightning on aircraft and helicopters are minimal for low-amplitude strikes, but higher-amplitude strikes may result in expensive delays and important repair and maintenance.

The present certification threat level is derived from cloud-to-ground lightning strike data measured on instrumented towers. While historically this threat definition has served the purpose of lightning protection adequately on metallic airframes, modern aircraft incorporate an increasing amount of composite materials that make them more susceptible to damage. Moreover, aircraft now employ more high-authority electronic control systems that are susceptible to upset and damage. As a result of the introduction of extra protection measures the advantages of modern materials could be cancelled by the addition of weight and higher cost.

To be able to design appropriate lightning protection, fixed-wing aircraft and helicopter manufacturers have a strong need for a good definition of the threat that lightning poses to aircraft.

**Objectives:**

The first objective of the ILDAS research project was to develop and validate a concept prototype of an ILDAS, capable of in-flight measurement of the parameters of lightning strikes. Such a system would, in due course, provide better knowledge of these parameters that could be used to improve aircraft lightning protection. Based on the reconstructed attachment points and amplitudes of the in-flight lightning strike in real time, the second objective was to enable the development of tailored and efficient maintenance inspection procedures that must be applied after a recorded strike.

**Methodology:**

In order to achieve these objectives, it was necessary to develop a measurement system concept prototype. ILDAS uses advanced sensor techniques that enables characterization of lightning strike parameters from the measured electric fields on, and the current flowing in the aircraft skin. For the purpose of measured data interpretation, the development and implementation of an innovative Inverse Method, based on a numerical simulation of the lightning current propagation, was performed. Finally a database concept was realised, enabling subsequent exploitation.

The validation of the various types of sensors and the entire ILDAS Concept Prototype system has been done. The validation comprised simulated lightning tests on a bespoke rig fitted with the system in the UK and its installation and ground testing on an Airbus A320 in France. Characterisation of current flow patterns from simulated strikes to a helicopter has been done in Germany.

**Parent Programmes:**

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

**Institute type:** Public institution
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**Key Results:**

A number of sensors have been developed for ILDAS by the Technical University of Eindhoven and by ONERA, in order to evaluate possible sensor configurations capable of correctly measuring the lightning current. A specific H-field sensor has been developed capable of measuring both the high-frequency (HF) lightning strike signals as well as the associated low-frequency (LF) signals that characterise continuing current. Another specific sensor is a window sensor, which can possibly replace externally mounted fuselage sensors. Furthermore, a method for measuring the E-field behind a window has been evaluated in order to verify if it can replace an external fuselage E-field sensor. Several methods for determination of the continuing current were developed and evaluated.

In the framework of the ILDAS project, numerical methods have been proposed both for recovering the localisation of initial lightning attachment points (lightning scenario) and for the reconstruction of the return stroke current waveform, starting from the magnetic field components measured with different sensors on the structure.

Measurement aspects of the components have been considered during the ILDAS concept development and the performance has been verified during laboratory tests and tests on a test rig at the Cobham Lightning Laboratory in the United Kingdom. A further set of tests to an A320 aircraft at the Airbus site in Toulouse was made with an ILDAS sensor set and DADS system installed to study an actual
installation of the system. While the main sensor set was designed around a largely aluminium alloy transport aircraft, there is interest in composites and rotor craft too so the current density characteristics arising from strikes to a composite helicopter were measured during some tests at Eurocopter in Donauwoerth.

A verification of the system was performed to confirm the system's measurement and data handling performance and to provide initial calibration values for the measurement chain. For each sensor, the effective area was determined, for each integrator the time constant was measured. For the electronics unit the band pass frequency of both the LF and HF channels was verified to be 160 mHz to 10 MHz, while the amplitude dynamic range was determined to be 96 dB when using the twin HF measurement channels. Download of 192 MiB of data from a single sensor assembly to the DADS took about twenty seconds. Tests were conducted for the case of an A320 plane and an EC135 type helicopter.

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**Technical Implications**

While the concept prototype was successfully demonstrated during the A320 ground test campaign, there is still some work required in order to make the ILDAS system able to measure real lightning strikes in flight condition.

A number of adaptations and improvements will have to be done. Environmental qualification of the device and its elements will be necessary to make sure that shocks, vibrations, acceleration, humidity, temperature and pressure variations will not impair the good behaviour of the system. Some of the subsystems will probably have to go through a redesign phase, for instance to reduce their dimensions so that they can fit most appropriately at the selected locations, in particular below the flap track fairings.

The interfacing with a number of aircraft systems will also have to be implemented and verified. It is not expected that the installation of fiber optics and power supply cables will be a problem given the fact that the current target for ILDAS first flight is a test aircraft (such as the A320 MSN1) where existing paths can be re-used.

A preliminary economical viability study showed that the payback period for an ILDAS system used on airliners would be at least 15 years. This is too long compared to the 1 to 3 year period that is considered acceptable by airlines and MROs (Maintenance, Repair and Overhaul). Therefore at this stage, it is foreseen that ILDAS will continue to be developed primarily as a flight test equipment. Its possible commercial adaptation – and associated industrialisation - will be re-evaluated once a final prototype is ready, which could be as soon as 2011 or 2012.

Indeed, it is the intent of Airbus to try and use the ILDAS system for the flight test campaign of the all-composite A350 XWB. The icing campaign in particular would be a very good occasion to measure a significant number of lightning strikes, which would greatly contribute to the constitution of the lightning strike database.

Documents:
- Results of the Concept Prototype tests - ICOLSE 2009 Conference (Project presentation)
- STRIA Roadmaps: Vehicle design and manufacturing, Infrastructure
- Transport mode: Air transport
- Transport sectors: Passenger transport, Freight transport
- Transport policies: Safety/Security
- Geo-spatial type: Network corridors