DEMonstration of LiDar based Clear Air Turbulence detection

Funding: European (7th RTD Framework Programme)
Duration: Apr 2009 - Mar 2014
Status: Complete with results
Total project cost: €5,602,111
EU contribution: €3,811,000

Call for proposal: FP7-AAT-2008-RTD-1
CORDIS RCN : 92589

Background & policy context:
Atmospheric turbulence encounters are the leading cause of injuries to passengers and crews in non-fatal airline accidents. A whole class of turbulence, representing 40% of turbulence accidents, and designated as Clear Air Turbulence (CAT), cannot be detected by any existing airborne equipment, including state-of-the-art weather radar. This explains that the number of turbulence accidents has been growing by a factor of 5 since 1980, 3 times faster than the increase of the air traffic. Operational concepts for the protection against turbulence hazard, based on a UV LiDAR, are:
- short-range measurement of air speed ahead of the aircraft and action on the flight controls;
- medium-range detection of turbulence, and securing of passengers by seat belts fasten.

Objectives:
The short-range concept has been validated in the frame of the FP5 AWIATOR project. The objective of DELICAT is to validate the concept of LiDAR based medium range turbulence detection, allowing efficient protection of the passengers and crew by actions such as seat belts fasten. The validation will be based on the comparison of the information on a turbulent atmospheric area, provided on one side by the remote LiDAR sensor and on the other side by the aircraft sensors (acceleration, air speed, temperature).

Methodology:
The validation of medium range turbulence detection is based on the comparison of the information on a turbulent atmospheric area, provided on one side by the remote UV LiDAR and on the other side by the aircraft sensors (acceleration, air speed, temperature). This validation includes the following steps:
- a UV LiDAR mock up is designed and manufactured, tested in laboratory on the ground, and then installed onboard a research aircraft, which is intended to fly in turbulent and non-turbulent conditions;
- during the flight tests, the atmosphere is analysed by the UV LiDAR and also by the aircraft onboard sensors;
- the data obtained from the LiDAR and from the aircraft sensors are compared off line once the aircraft on the ground. The correspondence between LiDAR backscattered energy fluctuations and turbulence experienced by the aircraft, for a given atmospheric area, is assessed and evaluated.

The consortium assembled for the DELICAT project includes all the expertise necessary to reach the objective (project management, LiDAR design and manufacturing, Clear Air Turbulence forecasting, on board sensors, flight tests, data processing), and will take advantage of previous projects such as AWIATOR and FLYSAFE. The project resources are adequately balanced between the different activities and are globally adapted to the project objectives and innovation content. DELICAT takes advantage of existing hardware (laser sub assemblies, test aircraft fairing) to achieve the goal at lower possible cost.

The DELICAT project will directly contribute to the objectives of the AAT.2008.3.3.2 topic, by validating
an advanced technology for aircraft protection against Clear Air Turbulence hazards. This will increase both customer satisfaction and aviation safety. Based on traffic and accidents statistics, it can be estimated that such a UV LIDAR turbulence protection equipment would have avoided 8 to 10 turbulence accidents in 2005 and will reduce by 15 to 20, or 40%, the number of turbulence accidents per year, once developed.

**Parent Programmes:**

**FP7-TRANSPORT - Transport (Including Aeronautics) - Horizontal activities for implementation of the transport programme (TPT)**

**Institute type:** Public institution  
**Institute name:** The European Commission  
**Funding type:** Public (EU)

**Lead Organisation:**

<table>
<thead>
<tr>
<th>Thales Avs France Sas</th>
</tr>
</thead>
</table>
| **Address:** 75-77 Avenue Marcel Dassault  
33700 Merignac  
France |
| **EU Contribution:** €707,045 |

**Partner Organisations:**

<table>
<thead>
<tr>
<th>Uniwersytet Warszawski</th>
</tr>
</thead>
</table>
| **Address:** KRAKOWSKIE PRZEDMIESCIE 26/28  
00 927 WARSZAWA  
Poland |
| **Organisation Website:** http://www.uw.edu.pl |
| **EU Contribution:** €113,986 |

<table>
<thead>
<tr>
<th>Stichting Centrum Voor De Ontwikkeling Van Transport En Logistiek In Europa</th>
</tr>
</thead>
</table>
| **Address:** Van Nelleweg 1  
3044 BC Rotterdam  
Netherlands |
| **Organisation Website:** http://www.cetle.org |
| **EU Contribution:** €722,500 |

<table>
<thead>
<tr>
<th>National Institute Of Research And Development For Optoelectronics</th>
</tr>
</thead>
</table>
| **Address:** Atomistilor Street 409  
RO77125 Magurele  
Romania |
| **EU Contribution:** €55,206 |

<table>
<thead>
<tr>
<th>Hovemere Ltd</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Address:</strong></td>
</tr>
<tr>
<td>Organisation Name</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Tannery Road Unit 14/15 Tannery Road Unit 14/15 Tonbridge TN9 1RF United Kingdom</td>
</tr>
<tr>
<td>Airbus Defence And Space GmbH</td>
</tr>
<tr>
<td>Organization Of The Russian Academy of Sciences A.M. Obukhov Institute Of Atmospheric Physics Ras</td>
</tr>
<tr>
<td>Deutsches Zentrum Fr Luft Und Raumfahrt E.V</td>
</tr>
<tr>
<td>Laser Diagnostic Instruments As</td>
</tr>
</tbody>
</table>
**Meteo-France**

**Address:**
Avenue De Paris 73  
94165 Saint Mande Cedex  
France  

**EU Contribution:** €167,860

---

**Thales**

**Address:**
45 rue de Villiers  
92200 NEUILLY-SUR-SEINE  
France  

**Organisation Website:**  
http://www.thalesgroup.com  

**EU Contribution:** €92,955

---

**Centre National De La Recherche Scientifique**

**Address:**
3 rue Michel-Ange  
75794 PARIS  
France  

**Organisation Website:**  
http://www.cnrs.fr  

**EU Contribution:** €112,108

---

**Technologies:**

- Sensor technologies  
- Laser Optics

**Development phase:** Validation

---

**Key Results:**

**Towards better detection of turbulence**

A recent EU project has built and tested a device that can detect turbulence up to 30 km away from the aeroplane.

Turbulence is responsible for a large number of injuries to passengers on commercial aeroplanes. A remote sensing technology known as LIDAR (light detection and ranging) can identify turbulence at short ( 

A short-range detection method in this line has already been validated through EU-funded research, and the 'Demonstration of LIDAR based clear air turbulence detection' (http://www.delicat-fp7.org (DELICAT)) project carried this research forward.

Specifically, the DELICAT team aimed to produce and validate a short- and medium-distance turbulence detection device. As noted, the device is based on LIDAR — a technology that uses light reflection on particles to calculate distance.

Researchers designed the LIDAR device and built a pilot-scale unit. DELICAT designed and tested components such as the transmitter, beam steering system and receiver modules to prepare the device for in-flight testing.

For this to take place, researchers developed a test strategy, prepared the aeroplane for integration of the device, and installed the prototype.
The device was tested in flight and detected some light turbulence in specific conditions. No heavy turbulence was encountered during testing, so the DELICAT device has yet to be tested in those conditions.

If future tests prove successful, the DELICAT device could become a key component of all commercial aircraft in the future. Its incorporation into aircraft is expected to contribute to a reduction in passenger injuries by avoiding or countering Clear Air Turbulences in time.

Documents:
- Final Report Summary - DELICAT (DEmonstration of LIdar based Clear Air Turbulence detection)

**STRIA Roadmaps:** Vehicle design and manufacturing

**Transport mode:** Air transport

**Transport sectors:** Passenger transport

**Transport policies:** Safety/Security

**Geo-spatial type:** Other