PLASMAERO

Useful PLASMa for AEROdynamic control

**Funding:** European (7th RTD Framework Programme)

**Duration:** Oct 2009 - Dec 2012

**Status:** Complete with results

**Total project cost:** €4,988,029

**EU contribution:** €3,815,410

**Call for proposal:** FP7-AAT-2008-RTD-1

**CORDIS RCN:** 92892

**Background & policy context:**

The design of tomorrow’s aircraft will be dictated by the need to have more environmentally ‘green’ aircraft in line with the ACARE 2020 vision. This can be achieved in three ways: reduced structural weight, improved combustion, and optimised aerodynamic performance.

**Objectives:**

The PLASMAERO project sought to demonstrate how surface and spark discharge plasma actuators could be used to control aircraft aerodynamic flow. This was achieved through an enhanced understanding of their physical characteristics and an in-depth study on how they could be optimised to influence air flow properties. The project showed the advantages and notably the ease of implementation that these innovative devices have over other potential active actuators.

The project objectives were:

- To understand, model and classify, through experimental and numerical studies, the most relevant physical characteristics of surface and jet plasma actuators capable of influencing airflow;
- To perform comparative experimental tests and numerical studies of different actuator configurations and to select the most promising for further development;
- To demonstrate through wind tunnel experiments the ability of plasma devices to significantly influence the aerodynamics in terms of lift, lift/drag and high lift noise in representative aeronautical airflow conditions (take-off, cruise and landing);
- To demonstrate the easy-of-use and installation of these actuators in a reduced-size flight platform;
- To provide exhaustive recommendations on future work to be performed to achieve the implementation of this technology base on next generation aircraft programmes.

**Methodology:**

The project concentrated on the factors influencing lift, notably through the reduction of separation of tip vortex and through delayed transition for take-off and landing, and influencing lift/drag through controlling the shock/boundary layer interaction induced turbulent separation for cruise conditions. The results demonstrated the aircraft industry the advantages of this technology both in terms of ease of use and in terms of integration possibilities on the aircraft.

**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: 

**Office National D' Etudes Et De Recherches Aérospatiales**

**Address:**  
29, avenue de la Division Leclerc  
BP72 CHÂTILLON CEDEX  
France

**Organisation Website:**  

**EU Contribution:** €1,058,384

### Partner Organisations: 

**Safran Aircraft Engines**

**Address:**  
2 Bvd Du General Martial-Valin  
75724 Paris  
France

**Organisation Website:**  
[http://www.safran-aircraft-engines.com](http://www.safran-aircraft-engines.com)

**EU Contribution:** €20,875

**Stichting Centrum Voor De Ontwikkeling Van Transport En Logistiek In Europa**

**Address:**  
Van Nelleweg 1  
3044 BC Rotterdam  
Netherlands

**Organisation Website:**  
[http://www.cetle.org](http://www.cetle.org)

**EU Contribution:** €150,000

**Ecole Polytechnique Fédérale De Lausanne**

**Address:**  
Batiment Ce 3316 Station 1  
1015 LAUSANNE  
Switzerland

**Organisation Website:**  
[http://www.epfl.ch](http://www.epfl.ch)

**EU Contribution:** €384,177

**Instytut Maszyn Przepływowych Im Roberta Szewalskiego Polskiej Akademii Nauk - Imp Pan**

**Address:**  
Ul. Fiszera 14  
80N/A231 Gdansk  
Poland

**Organisation Website:**
<table>
<thead>
<tr>
<th>Organisation</th>
<th>EU Contribution</th>
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<tbody>
<tr>
<td>University Of Southampton</td>
<td>€139,999</td>
</tr>
<tr>
<td>Address: Highfield Southampton SO17 1BJ United Kingdom</td>
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<tr>
<td>Organisation Website: <a href="http://www.soton.ac.uk">http://www.soton.ac.uk</a></td>
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| Arttic | €165,140 |
| Address: 58A rue du Dessous des Berges 75013 PARIS France |
| Organisation Website: [http://www.arttic.com](http://www.arttic.com) |

| Centro Italiano Ricerche Aerospaziali Scpa | €299,840 |
| Address: Via Maiorise s/n 81043 CAPUA (CE) Italy |
| Organisation Website: [http://www.cira.it](http://www.cira.it) |

| The University Of Nottingham | €248,250 |
| Address: University Park Nottingham NG7 2RD United Kingdom |

| Technische Universitat Darmstadt | €253,500 |
| Address: KAROLINENPLATZ 5 64289 DARMSTADT Germany |
| Organisation Website: [http://www.tu-darmstadt.de](http://www.tu-darmstadt.de) |
Technologies:

- Aircraft propulsion
- Noise control using plasma actuators and simulation

**Development phase:** Research/Invention

**Key Results:**

The use of plasma devices was investigated, focusing on achieving advantages such as simple manufacture and construction, and the possibility of real-time control at high frequencies. Key identified results were the following:

- Experts from leading European research institutes and manufacturers cooperated to test how dielectric barrier discharge and spark discharge plasma actuators can control aircraft aerodynamic flows.
- Numerical and experimental studies helped the team to better understand how such devices influence air flow, and to identify the most promising configurations.
- Subsequent wind tunnel tests showed how plasma devices could significantly improve aerodynamics in terms of lift, lift/drag and high lift noise during take-off, cruise and landing.
- The investigations also focused on how to integrate the actuators on a flight platform in real-world atmospheric conditions.
- The project brought together expertise and identified the focus of future research efforts in this area.
- The next generation of aircraft needs to be significantly more efficient than the current state of the art; PLASMAERO technologies would help to bring in a new era of greener flying.

**Innovation aspects**

The primary innovative aspect of PLASMAERO was in fact the use of plasma technologies which had shown itself to be very promising from a performance point of view as well as in terms of diversity in potential applications such as external and internal flow control, combustion enhancement and noise attenuation.

Main advantages of plasma devices are their easy manufacturing, integration simplicity and ability for real-time control at high frequency. There are no moving parts, and only two thin electrical wires are connected to their electrical power.

**Technical Implications**

Main technical impact was a deeper understanding and improvement of systems using plasma technology and their effect on the principal flow configurations existing in aircraft. Project’s results can be incorporated into future studies of these systems and their implementation in new generations of transport aircraft.

PLASMAERO provided exhaustive recommendations on future work to achieve implementation of this technology, propositions that could be followed directly, or that could help the industry or scientific community to perform flow control using plasmas. PLASMAERO’s main recommendations were:

- Plasma actuator developments and understanding of the plasma / flow interaction physics.
- Improvement of simulation models.
• Broadening the scope of plasma technology applied to other types of flow control.
• PLASMAERO flow configurations assessment.

**Strategy targets**

Innovating for the future: Technology and behaviour.
Promoting more sustainable development.

Documents:

* [PLASMAERO: workshop](#)

**STRIA Roadmaps:** Vehicle design and manufacturing

**Transport mode:** Air transport

**Transport sectors:** Passenger transport, Freight transport

**Transport policies:** Decarbonisation

**Geo-spatial type:** Other