PROJECT

SIMSAC

Simulating Aircraft Stability and Control Characteristics for use in Conceptual Design

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

**Duration:** Nov 2006 - Jul 2010

**Status:** Complete with results

**Total project cost:** €5,109,387

**EU contribution:** €3,282,343

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

CORDIS RCN : 81469

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**Background & policy context:**

Present trends in aircraft design towards augmented-stability and expanded flight envelopes call for an accurate description of the non-linear flight-dynamic behaviour of the aircraft in order to properly design the Flight Control System (FCS). Hence the need to increase the knowledge about stability and control (S&C) as early as possible in the aircraft development process in order to be 'First-Time-Right' with the FCS design architecture. FCS design usually starts near the end of the conceptual design phase when the configuration has been tentatively frozen and experimental data for predicted aerodynamic characteristics are available. Up to 80% of the cost of an aircraft is incurred during the conceptual design phase so mistakes must be avoided.

**Objectives:**

Key objectives are:

- establish formalised geometry construction protocols to enable varying fidelity AeroModels;
- construct the CEASIOM system for S&C design and assessment at three levels of fidelity;
- including low-fidelity aero-elasticity effects;
- benchmark each numerical tool using established and widely recognized experimental data for existing configurations;
- conventional and unconventional, test and assess CAESIOM by undertaking a selection of design exercises of two types.

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**Methodology:**

To meet these challenges SimSAC develops along two major axes:

1. Creation and implementation of a simulation environment, CAESIOM, for conceptual design sizing and optimisation suitably knitted for low-to-high-fidelity S&C analysis, and
2. an improved pragmatic mix of numerical tools benchmarked against experimental data.

The SimSAC project is organised into four technical work packages (WP) and one demonstration work package.

WP2: Development of the CEASIOM Simulation System: definition, development, implementation and testing the CEASIOM design system including paying special attention to geometry construction procedures and accounts of aero-elastic deformation.

WP3: Aerodynamic Modelling: link the linear aerodynamic models into conceptual design (WP2 and WP5); develop stability and control aerodynamic models from simulation; develop fast CFD methods for data generation to populate stability and control aerodynamic models; and link the high-fidelity aerodynamic models into the design process (WP2 & WP5).
WP4: Benchmark Aerodynamic Model: validate the different numerical tools of WP3 by experimental data of the DLR-F12 geometry; review the accuracy and efficiency of the CFD codes pertaining to WP3; and review numerical data to be used in the stability and control analysis in WP5.

WP5: Stability and Control Analyser/Assessor: compatibility with the CEASIOM Simulation System (WP2) and Aerodynamic Modelling (WP3) modules; integration as a sub-space in the CEASIOM analysis environment; and perform integration and testing according to the results from WP6.

WP6: Test and Assess Design Process: specify requirements for a number of aircraft classes as test cases that span speed range, size and unconventional morphology; demonstrate, test and evaluate the CAESIOM simulation system for each of these cases and show that the enhanced designs are quantifiably better than those obtained with the contemporary design process are.

Related Projects:
VIVACE - Value Improvement through a Virtual Aeronautical Collaborative Enterprise

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:

Kungliga Tekniska Hogskolan

Address:
Teknikringen 8
STOCKHOLM
Sweden

Organisation Website:
http://www.kth.se
EU Contribution: €0

Partner Organisations:

Alenia Aermacchi Spa

Address:
Viale Dell'aeronautica Snc
80038 Pomigliano D'arco (Na)
Italy

Organisation Website:
http://www.aermacchi.it
EU Contribution: €0

University Of Bristol

Address:
Senate House, Tyndall Avenue
Bristol
BS8 1TH
United Kingdom

Organisation Website:
http://www.bristol.ac.uk/
EU Contribution: €0
<table>
<thead>
<tr>
<th>Organisation Name</th>
<th>Address</th>
<th>EU Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centre Europeen De Recherche Et De Formation Avancee En Calcul Scientifique</td>
<td>Avenue Gaspard Coriolis 42, 31057 Toulouse, France</td>
<td>€0</td>
</tr>
<tr>
<td>Cfs Engineering Sa</td>
<td>Epfl Innovation Park Batiment A, 1015 Lausanne, Switzerland</td>
<td>€0</td>
</tr>
<tr>
<td>Dassault Aviation</td>
<td>9, Rond-Point des Champs-Elysées - Marcel Dassault, 75008 PARIS, France</td>
<td>€0</td>
</tr>
<tr>
<td>Swedish Defence Research Agency</td>
<td>Gullfossgatan 6, Kista, STOCKHOLM, Sweden</td>
<td>€0</td>
</tr>
<tr>
<td>The University Of Liverpool</td>
<td>Brownlow Hill 765 Foundation Building, Liverpool, L69 7ZX, United Kingdom</td>
<td>€0</td>
</tr>
<tr>
<td>J2 Aircraft Dynamics Ltd.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organisation</td>
<td>Address</td>
<td>Organisation Website</td>
</tr>
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<td>-------------------------------------------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>4 Norton Vale</td>
<td>THORNTON United Kingdom</td>
<td></td>
</tr>
<tr>
<td><strong>Office National D' Etudes Et De Recherches Aérospatiales</strong></td>
<td>29, avenue de la Division Leclerc BP72 CHÂTILLON CEDEX France</td>
<td><a href="http://www.onera.fr">http://www.onera.fr</a></td>
</tr>
<tr>
<td>Politecnico Di Milano</td>
<td>Piazza Leonardo Da Vinci 32 20133 Milano Italy</td>
<td><a href="http://www.polimi.it">http://www.polimi.it</a></td>
</tr>
<tr>
<td><strong>Federal State Unitary Enterprise Aerohydrodynamic Institute</strong></td>
<td>1, Zhykovsky str. ZHUKOVSKY, MOSCOW REG 140180 Russia</td>
<td><a href="http://www.tsagl.ru">http://www.tsagl.ru</a></td>
</tr>
<tr>
<td>Politechnika Warszawska</td>
<td>Plac Politechniki 1 00 661 Warszawa Poland</td>
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Key Results:

The results of the SimSAC project are:

1. Up to 80% of the life-cycle cost of an aircraft is incurred during the conceptual design phase.
2. SimSAC brings MDO into the early conceptual phase with the advantages to:
   - Design the right control system
   - Predict new aircraft performance
   - Analyse existing aircraft
   - Suggest ways to improve performance
3. The SimSAC Consortium provides solutions to:
   - Design greener, quieter, and safer aircrafts
   - Reduce the risks, cost and time of the conceptual design phase
   - Predict, design, improve aircraft performances
4. The SimSAC Toolbox contains a turn-key software framework: CEASIOM
   - CEASIOM is built upon the web services concept that provides the interoperability to the user to select that fidelity of the modeling best suited to his design task.

Innovation aspects

CEASIOM offers an interactive, integrated design and decision making environment. The interoperable modules include:

- Parametric solid-model CAD
- Buffet onset prediction
**Policy implications**

The SimSAC project aims to address 'right first time' design, in which testing is about design verification with a minimum of post-freeze problem solving. The achievement of 'right first time' will initially lead to cost and time-to-market advantages resulting from minimising laboratory and flight-testing, and then a robust design methodology will allow the contemplation of bolder designs and radical new aircraft concepts. This is crucial since it is widely recognised that current aircraft concepts are not likely to be adaptable to meet the Vision 2020 targets for environmental impact. To this end, the nature of the SimSAC approach is intentionally of a generic nature, such that it will be applicable to most novel aircraft morphology configurations.

Documents:
- SimSAC Flyer (Other relevant documents)

STRIA Roadmaps:  Vehicle design and manufacturing
Transport mode:  Air transport
Transport sectors:  Passenger transport, Freight transport
Geo-spatial type:  Network corridors