PROJECT

**IDIHOM**

*Industrialisation of High-Order Methods A Top-Down Approach*

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

**Duration:** Oct 2010 - Mar 2014

**Status:** Complete with results

**Total project cost:** €5,659,942

**EU contribution:** €4,166,569

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**Call for proposal:** FP7-AAT-2010-RTD-1

[CORDIS RCN : 96101](https://cordis.europa.eu/rcn/96101)

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**Background & policy context:**

The IDIHOM project is motivated by the increasing demand of the European aerospace industries to advance their CFD-aided design procedure and analysis by using accurate and fast numerical methods, so-called high-order methods. They will be assessed and improved in a top-down approach by utilising industrially relevant complex test cases, so-called application challenges in the general area of turbulent steady and unsteady aerodynamic flows, covering external and internal aerodynamics as well as aero-elastic and aeroacoustic applications.

**Objectives:**

Thus, the major aim is to support the European aeronautics industry with proven-track method(s) delivering an increased predictive accuracy for complex flows and (by same accuracy) an alleviation of computational costs which will secure their global leadership. An enhancement of the complete high-order methods suite is envisaged, including the most relevant methods, Discontinuous Galerkin and Continuous Residual-Based methods, in combination with underlying technologies as high-order grid generation and adaptation, visualisation, and parallelisation.

**Methodology:**

The IDIHOM project is a key-enabler for meeting the ACARE goals, as higher-order methods offer the potential of more accurate prediction and at the same time faster simulations. The plan is to:

- Advance current high-order methods and apply them to complex industrial flows;
- Demonstrate capabilities of high-order approaches in solving industrially relevant (challenging) applications and achieving synergy effects by applications to external and internal aerodynamics;
- Demonstrate that high-order methods can be well applied to multi-disciplinary topics as there are aeroacoustics (noise reduction) and aeroelastics (reduced A/C weight, improved A/C safety);
- Advance the Technology Readiness Level from about 3 to 5;
- Facilitate co-operation between different industries as there are airframe, turbo-engines, helicopters, ground transportation and the EU CleanSky project.

**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)

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**Lead Organisation:**
### Deutsches Zentrum Fr Luft Und Raumfahrt E.v

**Address:**
Linder Hoehe  
51147 KOELN  
Germany

**Organisation Website:**
http://www.dlr.de

**EU Contribution:** €403,569

### Partner Organisations:

#### Institut National De Recherche En Informatique Et Automatique

**Address:**
Domaine de Voluceau- Rocquencourt  
B.P. 105 LE CHESNAY  
France

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

**EU Contribution:** €180,637

#### Totalforsvarets Forskningsinstitut

**Address:**
Gullfossgatan  
164 90 Stockholm  
Sweden

**Organisation Website:**
http://www.foi.se

**EU Contribution:** €197,093

#### Politechnika Poznanska

**Address:**
Pl Marii Sklodowskiej Curie 5  
60965 Poznan  
Poland

**EU Contribution:** €138,508

#### Linkoepings Universitet

**Address:**
Hus Origo Campus Valla  
581 83 LINKOEPING  
Sweden

**Organisation Website:**
http://www.liu.se

**EU Contribution:** €136,173

#### Universita' Degli Studi Di Bergamo

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<tr>
<th>Organisation Name</th>
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<td><strong>Imperial College Of Science Technology And Medicine</strong></td>
<td>Exhibition Road, South Kensington, LONDON SW7 2AZ, United Kingdom</td>
<td>€223,323</td>
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<td><strong>Arts Association</strong></td>
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<td><strong>Airbus Defence And Space GmbH</strong></td>
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<tr>
<td>Ludwig-Boelkow-Allee 1, 85521 Ottobrunn, Germany</td>
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In aeronautical industry numerical flow simulation has become a key element in the aerodynamic design process. However, in order to meet the ambitious goals for air traffic of the next decades, significant investment in enhancing the capabilities and tools of numerical simulations in various aspects is required.
The majority of the aerodynamic simulation tools used in the aeronautical industry for routine applications are mainly based on finite volume methods. Being bound in most of the cases to second order discretization of the underlying governing equations, real-life applications require tens or hundreds of million mesh points to enable accurate solutions and to provide deep insight into complex flow features. In recent years there has been worldwide an ever increasing effort in the development of high-order CFD methods. Compared to its low-order counterparts, high-order methods offer large potential to either increase the predictive accuracy related to the discretization error at given costs or to significantly reduce computational expenses for a prescribed accuracy. However, due to their inherent high complexity, high-order simulation methods require significant investments to reach industrial maturity.

The overall objective of the EU funded ‘Industrialisation of high-order methods – a top-down approach’ (http://www.idihom.de/ (IDIHOM)) project was to enhance and mature adaptive high-order simulation methods for large scale applications in aircraft analysis and design. The project was driven by a top-down approach, in which dedicated enhancements and improvements of the complete high-order simulation framework, including grid generation, flow solver efficiency and flow visualization, were led by a suite of underlying and challenging test cases.

The test case suite included turbulent steady and unsteady aerodynamic flows, covering external and internal aerodynamics as well as aero-elastic and aero-acoustic applications. The challenging application cases defined by the industry formed the basis for the demonstration and assessment of the current status of high-order methods as a workhorse for industrial applications.

IDIHOM was assigned to help to close the gap between current expectations of what high-order methods are capable of and their strongly required use for industrial real-world applications – reaching out for improved, more accurate and time-saving design processes.

Documents:
- Final Report Summary - IDIHOM (Industrialisation of High-Order Methods – A Top-Down Approach)

**STRIA Roadmaps:** Smart mobility and services  
**Transport mode:** Air transport  
**Transport sectors:** Passenger transport, Freight transport  
**Transport policies:** Societal/Economic issues  
**Geo-spatial type:** Other