

## **Structural Impact : Interest Group (37 members)**

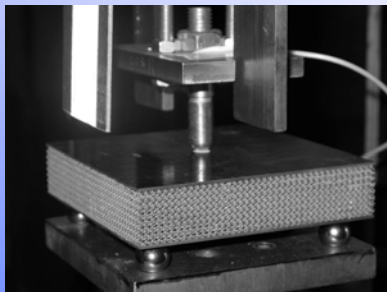
**Leader : Bob Mines, University of Liverpool**  
**Activities 2007-9**

## CELPACT OVERVIEW

CELPACT is an upstream research project concerned with development of breakthrough technologies and design tools for future airframe structures with high efficiency and safety.

The European aircraft industry has strong interest in novel structural concepts for future aircraft fuselage and wing structures with lower fabrication costs and high performance.

An important class of these next generation aerospace materials will employ advanced manufacturing techniques for sandwich structures with cellular core materials giving high strength/weight ratios and improved impact resistance under critical aircraft load cases, such as foreign object impact from birds, tyre rubber and runway debris.



German Aerospace Center (DLR)



University of Liverpool



University of Oxford



University of Patras



University of Aachen



ENS de Cachan



University of Stuttgart



Brno University of Technology



Airbus Deutschland



EADS Innovation Works



ALMA Consulting Group



ATECA



## Cellular Structures for Impact Performance



<http://www.easn.net/supported-projects/celpact/>

Project coordinator: DLR  
Dr. Alastair Johnson  
[alastair.johnson@dlr.de](mailto:alastair.johnson@dlr.de)

Project management: ALMA CG  
Candice Quinon, [cquinon@almacg.com](mailto:cquinon@almacg.com)

Exploitation management: LTSM – University of Patras  
George Lampeas, [labeas@mech.upatras.gr](mailto:labeas@mech.upatras.gr)

## **FP6 Existing Consortium: 2006-2009 – CELPACT**

DLR, ULIV, UOXF, UAA, LMT Cachan, UBRNO, UPAT, CRC-F, CRC-G, Airbus Germany, ATECA

Foreign Object impact performance of sandwich structures with innovative cellular cores: e.g. selective laser melted, brazed and composite foldcore.

**KO Meeting DLR Stuttgart September 2006**

**6M Meeting EADS Paris March 2007**

**12M Meeting UPAT October 2007**

**18M Meeting University Brno March 2008 and CDR Brussels May 2008**

**24M Meeting UOXF October 2008**

**30M Meeting ULIV Feb 2009**

**37M Final Meeting and Workshop EADS G Munich Sept 2009**

## SAMPE Papers 24<sup>th</sup> March 2009

1. Novel structural core sandwich materials for aircraft applications
2. On the development of conventional and micro lattice cellular metals as core materials in aerospace sandwich construction
3. Sandwich structures with folded core: manufacturing, mechanical behaviour and impact performance

## SAMPE Papers 24<sup>th</sup> March 2009

4. The impact performance of sandwich structures with innovative cellular metal and folded composite cores
5. Multi scale characterisation and modelling of metallic cellular materials and structures
6. Sandwich structures with folded cores : mechanical modelling and impact simulation

## Expressions of Interest first Call FP7:

### **1. Properties of Smart Materials using Tri-Function Hopkinson Bar**

**Dr. Ras Hashemi , Cranfield Impact Centre (CIC)**

It is proposed that this test apparatus could be used to explore the properties of a range of SMART materials and components at high rates of strain under both uniaxial and combined loading conditions.

## **2. Crashworthiness of damaged composite structure: Influence of defects due to forming and assembly processes.**

**Franck LAURO, University of Valenciennes**

The increase use of composite material in aircraft structures leads to develop forming and assembly processes which allow a mass production in a short time production. These processes will lead, due to the composite structure itself, to internal defects (bubbles, crack, delamination,...) which condition the composite structure behaviour in crash situation.

## **Mini Symposium at ICEM13, Alexandroupolis, Greece, July 2007 (with some CELPACT Partners):**

“On the Collapse of Micro Lattice Structures” by R.A.W. Mines, S. Tsopanos, S. Kckown, W. Cantwell, W. Brooks and C.J. Sutcliffe.,ULIV

“Failure Behaviour Investigation of Metallic Open Lattice Cellular Structures” by G.N. Labeas and M.M. Sunaric.,UPAT

“Finite Element for Sandwich Panels Based on Analytical Solution for Constitutive Equations” by M. Linke and H.-G. Reimerdes.,UAA

“Impact Damage in Sandwich Composite Structures from Gas Gun Tests” by N. Toso-Pentecôte and A. Johnson.,DLR



## Expressions of Interest second Call FP7:

### 1. **Structural Optimization Thin-walled Aircraft Structures (OPTAS)**

Structural optimisation of thin-walled aircraft structures with main function of weight and with respect of technological and material constraints and with high level of efficiency.

The main goal of the project is to develop and verify optimization methods, derivation of goal function and function of constraint limitation.

**Proposer: Prof. Antonin Pistek, University of Brno**

**Partners:** Technical University Braunschweig

University of Patras

Warsaw Technical University

University of Oxford, Department of Engineering Science, Impact Engineering Team

EDA, Engineering Design & Analysis Company, Ankara Department of Aerospace Engineering, Middle East Technical University, Ankara

Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia

## 2. Contribution to impact damage group (IMPACT)

-for "standard" impact: hybrid materials impact resistant structures with damage indicators (there seems to be a lot available, but there are also a lot of contradictions and hardly clear design rules)

-for high/hyper velocity impact: structural behaviour for structural topologies established by a combination of metal sheet, kevlar, and stiff part; simulations, building and testing of specimen and components

### **Prof. Horst Baier, Institute of Lightweight Structures, Germany**

Nik Petrinic, Impact Engineering Team, University of Oxford

Dr. Andrew Walton, Cranfield Impact Centre (CIC)

Prof. Dr.-Ing. K. Wolf, Technische Universität Dresden

Institute of Aerospace Engineering

Noel O'Dowd, Department of Mechanical and Aeronautical Engineering, University of Limerick

Dr. Guclu Seber, Department of Aerospace Engineering

Middle East Technical University, Ankara Turkey

## 3. Blast Loading of Aircraft Structures (BLAST)

Explosive loading is becoming a major issue in the design of modern aircraft as a result of terrorist threats and the increased expectation of aircraft safety. New materials and structures are now available that allow the design of innovative structural solutions.

**Coordinator; Bob Mines, University of Liverpool**

Current Partners: University of Liverpool (Bob Mines, Wesley Cantwell, Graham Schleyer)  
DLR (Alastair Johnson)  
Onera (David Delsart, Eric Deletombe)  
ESI (Argiris Kamoulakos)  
Politecnico di Torino (Giovanni Belingardi)  
University of Cape Town (Gerald Nurick)  
Bulgarian Academy of Sciences (Dora Karagiozova)  
University of Patras (George Labeas)  
EADS IW Germany (Peter Middendorf)  
Airbus France/EADS IW France (Yannick Girard?)

## Expressions of interest 3<sup>rd</sup> Call FP7

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Airbus France/EADS IW France (Yannick Girard?)

## 2. Mitigation of engine blade fragment damage

**Protection of critical aircraft components against fragment impact as a result of unconstrained failure of an engine is the main objective of this proposal by CIC. Quantification of the hazards of such fragments impacting the fuselage and identification of countermeasures to mitigate the effects, such as the incorporation of high-strength fabrics within the airframe to act as a ballistic barrier, will be the aim of the work. The proposed work program will consist of a package of analytical modelling and associated materials testing.**

**Dr Ras Hashemi, CIC  
Cranfield University Materials Department –School of Applied  
Sciences(SAS)**

## Future activities:

1. Re vitalise Interest Group – via Celpact Workshop?
2. Focus on more innovative materials and structural concepts
3. More industry targeting, e.g. EADS F, EADS G

**Any questions?**