European Aeronautics Science Network

Theodoros Kermanidis; University of Patras, LTSM

Aerostructures

EASN Interest Groups

- Ageing Aircraft (P. Horst)
- Crashworthiness and structural Impact for Commercial a/c (R.Mines)
- Increased Exploitation of Metallic Airframe Materials(E.Hombergsmeier)
- Surface Engg. (C. Rodopoulos)
- Damage Tolerance of Welded Aerostructures (A. Kermanidis)
- Increased exploitation of composites (G.Labeas)
- Recycling (of composites?) and Life-Cycle Management (N.N.)

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Interest Group: Structural Impact

(37 members)

FP6 Existing Consortium: 2006-2009 – CELPACT

IG Leader : Bob Mines, University of Liverpool

Activities 2007-9

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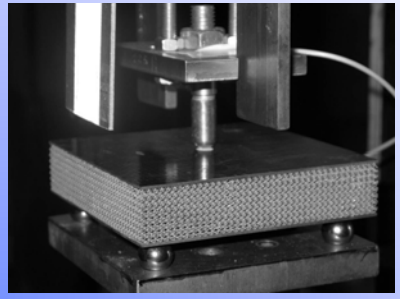
CELPACT OVERVIEW

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

Supported by the European Commission through the Sixth Framework Programme for Research and Technological Development
EC Contract reference: AST5-CT-2006-031038

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

Project coordinator: DLR
Dr. Alastair Johnson
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Project management: ALMA CG
Candice Quinon, cquinon@almacg.com

Exploitation management: LTSM – University of Patras
George Lampeas, labeas@mech.upatras.gr

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Objectives:

- Understanding of how metals and composites behave as load carrying materials under impact
- Introduce crash-worthiness into the fuselage design
- Improve structural integrity of the passenger cabin and provide the highest probability of occupant survival with minimal injuries in the event of a crash
- Development of modeling capabilities under impact conditions, which successfully simulate the energy absorbing process
- Development of innovative material systems capable of absorbing energy and development / validation of material damage models for the novel material systems
- Assessment of the numerical simulation techniques for impact events as a tool for further design improvement

Activities

SAMPE Conference Papers (24th 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

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

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 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.

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 constrains 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 constrain 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 Universitaet 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?)

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Expressions of interest 3rd Call FP7

1. 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 Birch, 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?)

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

Questions .. Proposals…?