

# Damage Tolerance of Welded Aerostructures

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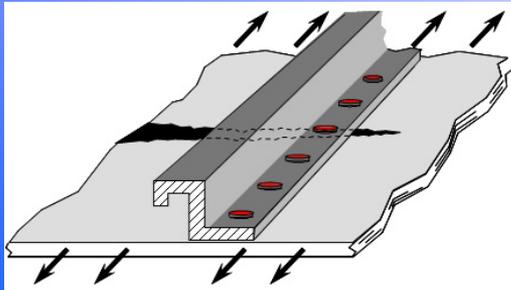
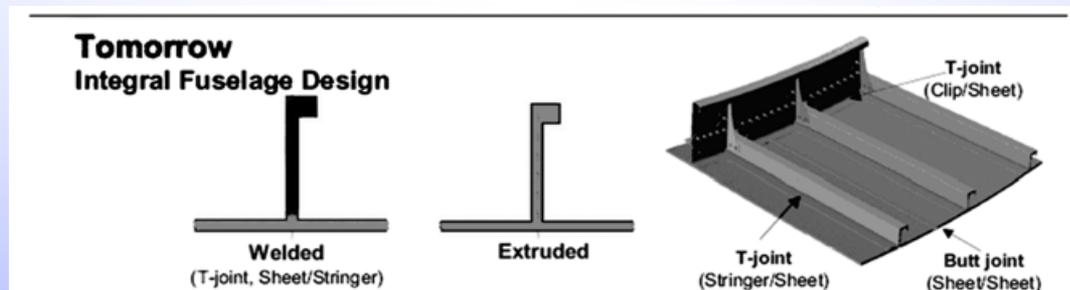
Institution: University of Thessaly,

Laboratory of Mechanics and Strength of Materials, Volos, Greece

Recently established IG (2007)

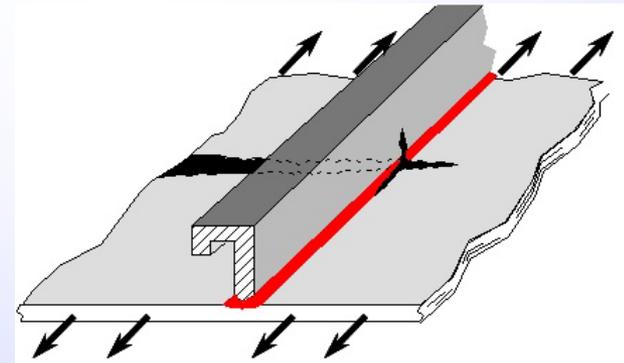
Main technological area: Aerostructures

Main research topics: Structural Integrity of welded airframes, fatigue/fracture behaviour of welded joints, modelling of microstructure/residual stresses influence on DT, structural design for improved DT of welded joints



Welded airframe structures offer reduced weight and lower manufacturing/operational costs compared to riveted parts

EASN Workshop  
14-15 May 2009, Istanbul, Turkey



## IG members

<b>Universities</b>	
Ecole Polytechnique Fédérale de Lausanne (EPFL)	Switzerland
University of Parma (UPARMA)	Italy
University of Patras (LTSM-UPatras)	Greece
<b>Research Establishments</b>	
GKSS Research Centre (GKSS)	Germany
National Aerospace Laboratory (NLR)	Netherlands

## Recent Activities :

Active IG in the preparation of research proposals in FP7

Submission of 2 Collaborative Project proposals in 2007, 2008

2 meetings held during 2007-2008 to establish research content for proposal submission in the Aerostructures thematic area (Aircraft Safety, Green Aircraft, Aircraft Development Cost, Aircraft Operational Cost)

Exchange of information/scientific ideas within IG through electronic email

## Preparation/Submission of Proposals:

### 1<sup>st</sup> Call FP7:

**REMIGRA** (advanced damage tolerance analysis of welded aluminum aero-structures considering **RE**sidual stress and **MI**crostructural **GRA**dients)

### 2nd Call FP7: (resubmission)

**LOCAL** (Tailored Damage Tolerance of Laser Beam Welded Airframe Structures via **Local** Engineering )

Aim of proposed research: Development of methodologies to tailor/improve DT performance of welded airframes by accounting for the effects of modified microstructures/local material properties and RS fields of the welds in assessment of DT performance

## Future actions for financing activities of the IG:

- Consideration of proposal preparation for 3<sup>rd</sup> Call in FP7

### Issues for discussion:

Metallic materials?

Established consortia experts in the field but still evaluation comments critical on consortium content

Resubmission of mature proposal based on reviewer comments still below threshold

- Participation in Marie-Curie Human Mobility Program

Aim: exchange of students within Universities for conducting PhD thesis, exchange of scientific expertise and knowledge

- Participation in ERASMUS Program

Aim: collaboration of Universities within IG through exchange of students for conducting Diploma thesis, travels of Professors, exchange of knowledge

# *Pioneer Nanomaterials for Aerospace Applications*

## **IG Leader:**

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european aeronautics science network

## **Contact Person:**

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***Institution: Polytechnic University of Marche, Dept. SAIFET – Physical Sciences Section, Via Breccie Bianche, 60131 Ancona, Italy***

Main technological area: Innovative concepts and scenarios

Main research topics: materials science in a wide range of applications (biology/medicine, cultural heritage, ..., aerospace)

*in particular*: characterization by neutron and X-ray/synchrotron radiation techniques

- Neutron/X-ray diffraction for residual stress determination
- Microstructural characterization (defects, precipitates, particles, voids,) by
  - small angle scattering of neutrons (SANS) or X-rays (SAXS)
  - neutron radiography/tomography and synchrotron radiation microtomography



# European Aeronautics Science Network



## *Polytechnic University of Marche Dept. SAIFET – Physical Sciences Section*

- Regular access to European Large Scale Facilities (neutron and synchrotron radiation sources)
- Home facilities: XRD, SEM/TEM, AFM

## *Present IG members*

	Name	Institution/organisation	email
1	Prof. Gianni Albertini	Polytech. Univ. of Marche, IT	gialbe@univpm.it
2	Prof. Vassilis Kostopoulos	University of Patras, GR	kostopoulos@mech.upatras.gr
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4	Prof. Gabriella Bolzon	Polytechnic of Milan, IT	gabriella.bolzon@polimi.it
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11	Prof. Jan Dusza	Inst. of Materials Res., Slovak Academy of Sciences, SK	jdusza@imr.saske.sk

## *Present IG members*

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21	Dr. Hans-Jurgen Grande	CIDETEC, San Sebastian, SP	hgrande@cidetec.es

## *Present IG members*

- 13 Universities
- 1 Research Institute
- 5 Industries

from:

- 
- Austria (1 University)
  - Czech Republic (1 University)
  - France (1 University)
  - Germany (1 Research Institute)
  - Greece (1 University)
  - Italy (3 Universities, 1 Industry)
  - Poland (3 Universities)
  - Slovakia (1 University)
  - Spain (1 University, 2 Industries)
  - United Kingdom (1 University, 2 Industries)

- This IG is established in order to collect and exchange information and expertise at an European level, concerning novel nanotechnologies and nanomaterials for applications in aerospace technology.
- The IG **main goals** can be:
  - i) to verify if **already existing nanotechnologies and nanomaterials**, presently applied to other technological fields, can find applications in aerospace industry;
  - ii) to explore **new materials, routes and methods** to produce nanomaterials for aerospace applications;
  - iii) to assess **advanced numerical and experimental methods** for the thermo-mechanical and microstructural characterization of nanomaterials and of their performances with respect to aerospace applications.
  - iv) open to other **suggestions**
- As for other IG's, also this one should lead to the gathering of partners in order to prepare University-driven European Projects.

# European Aeronautics Science Network



**Proposal :** 233899  
**Acronym :** ADEFKO  
**Program :** FP7  
**Call :** FP7-AAT-2008-RTD-1  
**Funding scheme :** Small or medium-scale focused research project - CP-FP  
**Duration :** 48 months  
**Activity :** 2008.7.1.1 - Greening

**ADEFKO**  
 ADVANCED ENVIRONMENTALLY FRIENDLY COATINGS FOR THE AERONAUTICS  
 INDUSTRY

**Proposal submitted by :**

N°	Proposer name	Country	Total cost (€)	%	Grant requested (€)	%
1	CERAMICS AND REFRACTORIES TECHNOLOGICAL DEVELOPMENT COMPANY S.A.	Greece	1,033,200	14.76	800,400	15.89
2	HELLENIC AEROSPACE INDUSTRY S.A.	Greece	502,000	7.17	256,000	5.08
3	UNIVERSITY OF PATRAS	Greece	203,760	2.91	154,320	3.06
4	PYROGENESIS SA	Greece	414,000	5.91	299,200	5.94
5	Università Politecnica delle Marche	Italy	438,000	6.26	330,000	6.55
6	MBN Nanomaterialia S.p.A.	Italy	405,800	5.80	286,360	5.69
7	PLASMA JET	Romania	350,000	5.00	228,560	4.54
8	UNIVERSITAT DE BARCELONA	Spain	479,400	6.85	361,800	7.18
9	FUNDACIÓN CIDETEC	Spain	500,908	7.15	369,530	7.34
10	TRAITEMENTS COMPOSITES POUDES ET PROCESS	France	369,200	5.27	254,800	5.06
11	Southside Thermal Sciences (STS) Ltd.	United Kingdom	600,550	8.58	421,694	8.37
12	Cranfield University	United Kingdom	585,400	8.36	429,400	8.52
13	Materials Engineering Research Laboratory Ltd	United Kingdom	436,700	6.24	329,775	6.55
14	Imperial College London	United Kingdom	382,000	5.46	288,000	5.72
15	Institute of Surface Chemistry of the National Academy of Sciences of Ukraine	Ukraine	301,000	4.30	227,250	4.51
	<b>Total</b>		<b>7,001,918</b>	<b>100%</b>	<b>5,037,089</b>	<b>100%</b>

**Final evaluation: 11**

## Micro and Nanocrystalline Functionally Graded Materials for Transport Applications

### MATRANS

**Call identifier FP7-NMP-2008-SMALL-2**

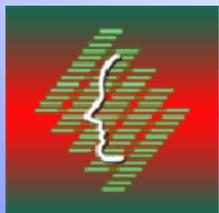
List of participants:

Participant no.	Participant organisation name	Short name	Type	Country
1 Coordinator	European Virtual Institute on Knowledge-based Multifunctional Materials AISBL (KMM-VIN)*	KMM-VIN	OTH	Belgium
2	Fraunhofer-Institut für Fertigungstechnik und Angewandte Materialforschung	FRAUNHOFER	RES	Germany
3	National Technical University of Athens	NTUA	HE	Greece
4	Wroclaw University of Technology	WRUT	HE	Poland
5	Institute of Materials and Machine Mechanics, Slovak Academy of Sciences	IMSAS	RES	Slovakia
6	Cardiff University	CU	HE	UK
7	EADS Deutschland GmbH	EADS	IND	Germany
8	TRW Automotive GmbH	TRW	IND	Germany
9	Centro Ricerche FIAT	CRF	IND	Italy
10	Steinbeis Advanced Risk Technologies GmbH	R-TECH	IND / SME	Germany

KMM-VIN is a grouping according to FP7 definition, including in the MATRANS project the following core members:

1. Institute of Electronic Materials Technology (ITME), Poland; RES
2. Institute of Fundamental Technological Research, Polish Academy of Sciences (IPPT), Poland; RES
3. Institute of Metallurgy and Materials Science, Polish Academy of Sciences (IMIM), Poland; RES
4. Technische Universitaet Darmstadt (TUD), Germany; HE
5. Politecnico di Torino (POLITO), Italy; HE
6. Università Politecnica delle Marche (UNIVPM), Italy; HE

## Life Cycle Management



Contact Person: Dimitris MOURTZIS  
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Institution: Laboratory for Manufacturing Systems & Automation,  
Department of Mechanical Engineering & Aeronautics, University  
of Patras

Main technological area: Integrated Design and Validation

Main research topics:

**- Life-cycle Integration**

Design for Maintainability

Life-cycle cost analysis

Integrated development

**- Methods and IT tools for Collaborative Product & Process Engineering**

Enhanced Aeronautical Concurrent Engineering

Virtual environments for Collaborative working

Product Lifecycle interaction

## LCM research priorities according to **ACARE SRA**

- **The Highly Cost Efficient Transport System (HLTC)**
  - A maximised standardisation of the aircraft and its systems
  - Lower operating and maintenance costs
  - Life cycle cost driven multidisciplinary optimization
  - Customised missions
  - Simulation of Disposal/Recycling processes and their cost implications
- **The Ultra Green Air Transport System**
  - Novel aircraft concepts to reach emissions reduction
  - Adaptive structures to fuel-efficient missions
  - Low environmental impact throughout its life cycle from manufacture through service operations to disposal.
  - The Environmentally Friendly Aircraft

## ACARE SRA: Towards the future – Long-term research possibilities in terms of LCM

- The processes of design and manufacture will be increasingly *automated especially with respect to assembly*
- The air vehicles of the future will require very little or no *routine maintenance* and will have *monitors of condition built into all the principal systems*
- At the end of their life they will be totally *re-cycled or re-used*

## Present & Future IG activities

- ❑ *Co-ordinate contacts* and activities for *proposals preparation* under the EASN umbrella
- ❑ *Establish interactions* with running projects to *disseminate knowledge and promote synergies*
- ❑ Prepare *scientific contributions / technical presentations* for EASN events
- ❑ *Establish links with LCM* related initiatives and *key stakeholders at European level*
- ❑ *Web-based seminars & workshops* to *demonstrate R&D work and discuss synergies*

# Surface Engineering Treatments

Contact Person: Chris Rodopoulos  
rodopoul@mech.upatras.gr

Institution: University of Patras,

Laboratory of Technology and strength of Materials, University of  
Patras, Greece

Main technological area: Aerostructures

Main Research topics:

- SETs and Fatigue Damage
- SETs and Corrosion Damage
- SETs and Ageing Aircraft (Multiple Site Damage)
- Optimisation of SETs
- SETs and Fretting
- SETs and Manufacturing
- SETs and Composite Materials

## Recent Activities :

- The IG managed to increase its active member base to 21 members from 17 in 2006.
- Proposed 1 EU proposal (HERA FP7 1st call).
- Members of the IG participated/ing in 2 FP6/FP7 Projects (DATON, COMPACT).
- Members of the IG participate in the FP7/3call proposal (LASPAA)
- The IG Proposed 1 new EU proposal FP7/3<sup>rd</sup> call (CERTAIN)
- Published 31 papers in Journals and Conferences.
- Individual members Completed 3 Industrial Projects.

## Basic Description of Projects of Individual Participation of IG Members

- Increase the Fatigue Damage Tolerance of Integral Structures (**FP6 DATON**) via Ultrasonic Impact Treatment.
- Computational Modelling of Shot Peening (**FP6 COMPACT**)
- Examination of Ultrasonic Impact Treatment on High Temperature SCC of Stainless Steel Welds for Rolls-Royce Marine.
- Examination of Ultrasonic Impact Treatment on High Temperature Corrosion for US-Navy and BAE Systems.
- Use of Supersonic Particle Deposition for the development of Metal-Metal and Metal-Composite Sandwich panels.
- Use of High Velocity Oxygen Fuel coatings for Protection of Fuel Tanks and landing gear castings.
- Development of Supersonic Particle Deposition Robot for the repair of oil pipes.
- Use of Supersonic Particle Deposition for Increasing the Structural Integrity of Integral Structures.
- Use of Supersonic Particle Deposition for crack damage repair instead of composite patches.
- Real-Time Neutron Diffraction of Relaxation of Residual Stresses from FSW under Variable Amplitude Loading.

## New Technologies included in the IG

- **Water-Jet Peening**

Similar to shot peening but with significantly higher and deeper residual stresses.

- **Thick Metallic Coatings**

Coating able to withstand corrosion and being scratch resistant

- **Ballistic Particle Manufacturing**

A fast and cost effective way of developing 3D structures, i.e. Ti stiffeners on skin sheet.

- **Nano-Particle Manufacturing (Laser Pyrolysis Process)**

A novel technology able to create metal/polymer matrix composites of high quality. The nano-particle manufacturing can also create 3D reinforcing stencils, cells, crosses, etc able to significantly increase the load bearing capacity of composites.

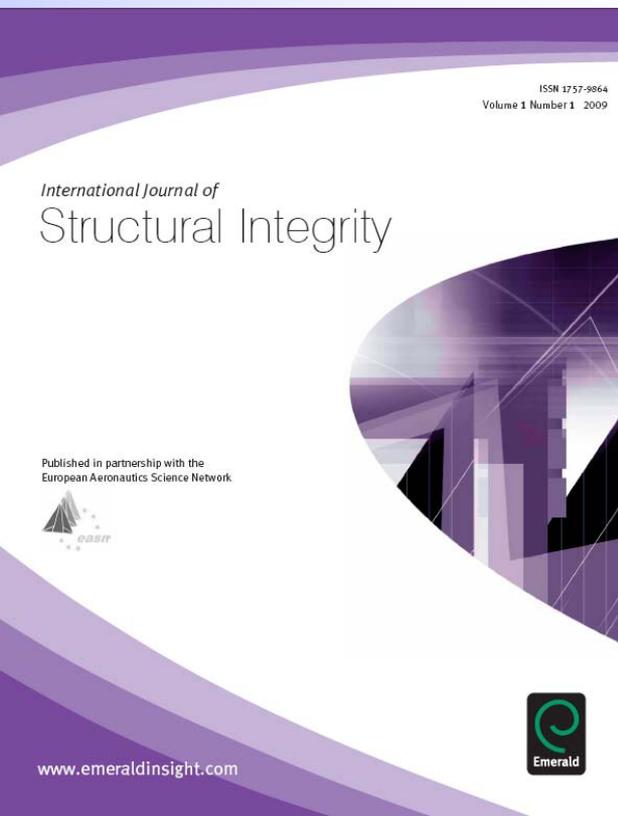
## Future actions for financing activities of the IG:

In order for the IG to fulfil its mission and have the necessary funding for scientific collaboration, exchange of ideas, etc it is necessary to increase its financial base. On that the IG leads participation into:

- Optimisation of Surface Engineering Treatments to increase the Damage Tolerance of the Integral Structures (FP7, CERTAIN),
- Exploit the potential of engaging Human Mobility Calls.

## Successful Initiative

- Undertook the Editorial Responsibilities of the International Journal of Structural Integrity



### Editorial team

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