EASN Interest Group

‘Increased Exploitation of Composites’

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Greece

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Establishment of the Interest Group

- The application of Composite materials in primary aeronautical structures is progressively increasing, e.g.,

  - 26% of the A380 aircraft is made mainly of composites (rear fuselage, central wing box, horizontal and vertical tail plane,.etc)

  - NH9O and TIGRE Helicopters fuselage are 100% constructed in composites

  - the next aircraft generation is expected to have at least 50% of composite material

- The main driver for the continuous CFRP introduction is the direct weight saving providing direct opportunity for additional pay loads or additional systems

Establishment of the Interest Group

- However, the traditional 'metal like' design of composite structures prevents the full exploitation of the material capabilities, leading to very high cost of the final product

- Having in mind this situation, the Interest Group 'Increased Exploitation of Composites' has been established under the EASN structure on June 2003

- This IG is classified, according to the ACARE- ASTERA Taxonomy, under the scientific area "Aerostructures".

- The research interests of the IG fall into Technical Area 2: 'Advanced Materials and Manufacturing'

General objectives of the Interest Group

- To provide missing fundamental knowledge and **tools** for achieving the strategic technological goal of **full exploitation of composites** in critical primary integral aircraft structures

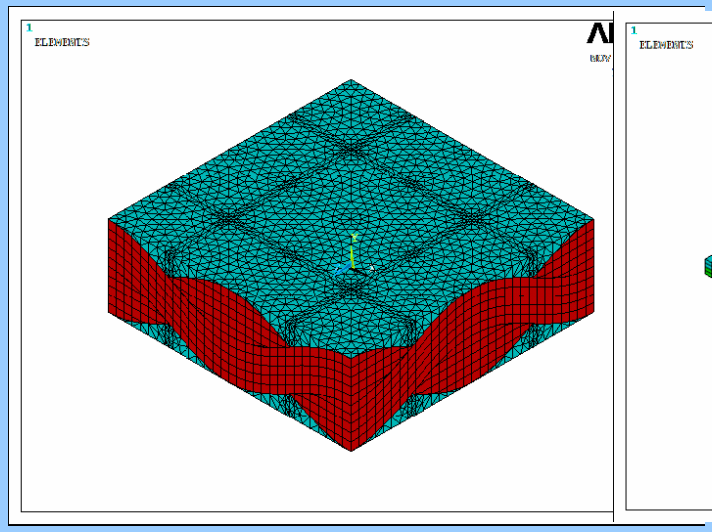
- To establish scientific and research collaboration in the specific area of composite materials

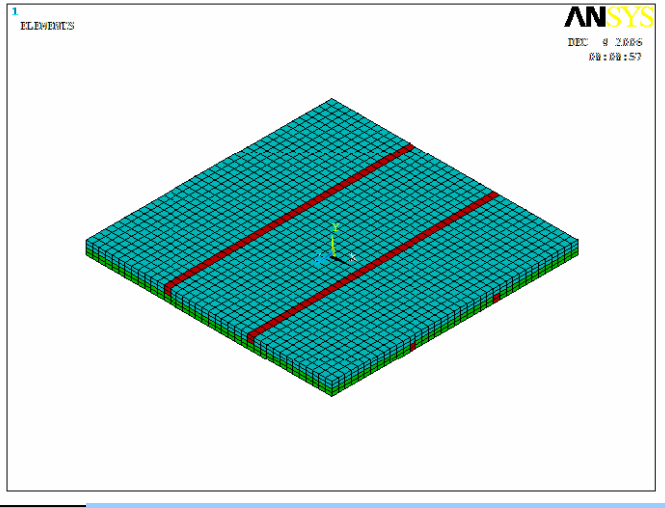
- As a result European & International recognition of the Group as a research collaboration platform is to be expected

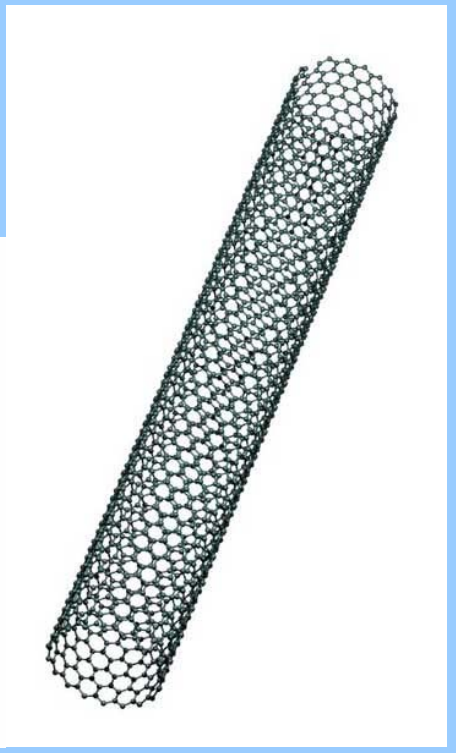
European Aeronautics Science Network

Technological topics for innovative and upstream research

- To develop and exploit innovative superior lightweight composite systems for aerospace applications.



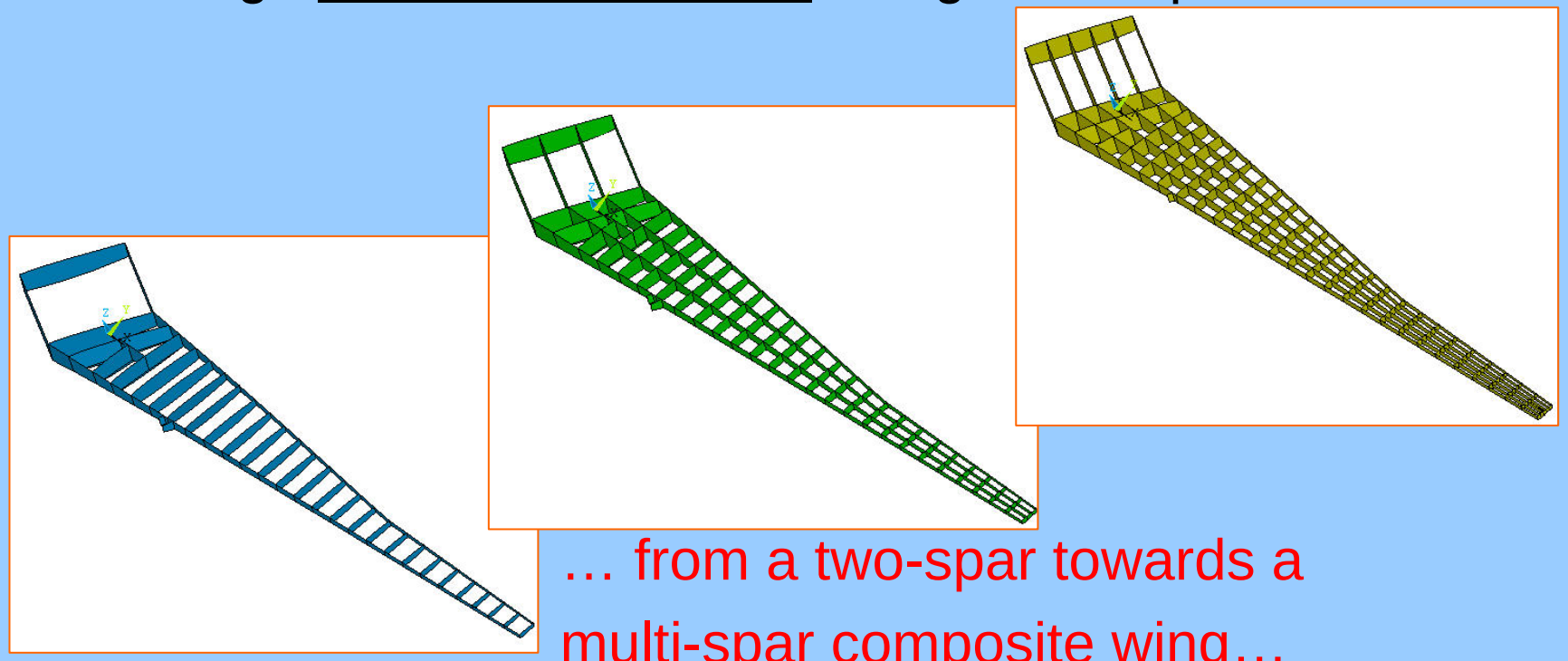




… from conventional UDs to woven, NCF 3D reinforced systems, or even to carbon nanotubes and composite nano / or cellular materials ….

Technological topics for innovative and upstream research

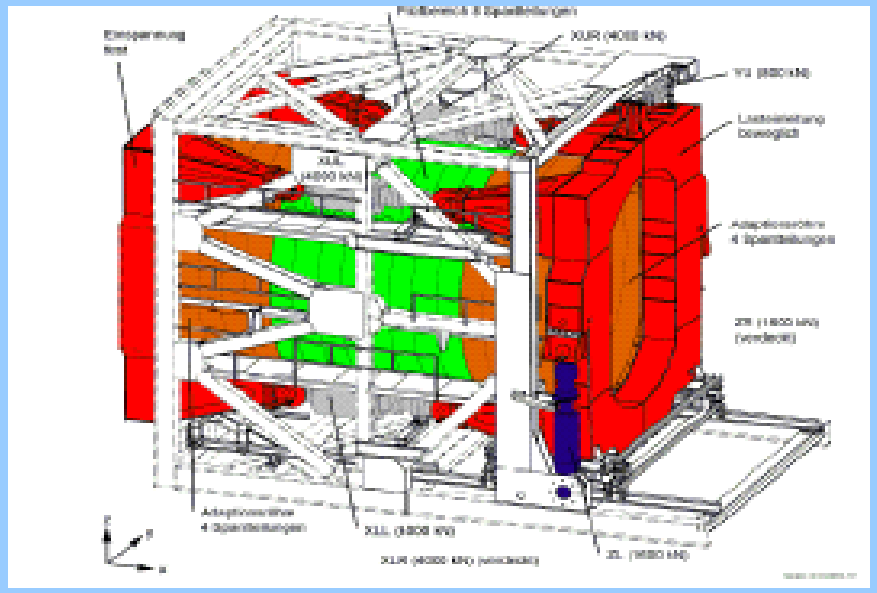
- To develop low-cost composite aircraft structures through innovative ‘tailored’ design concepts

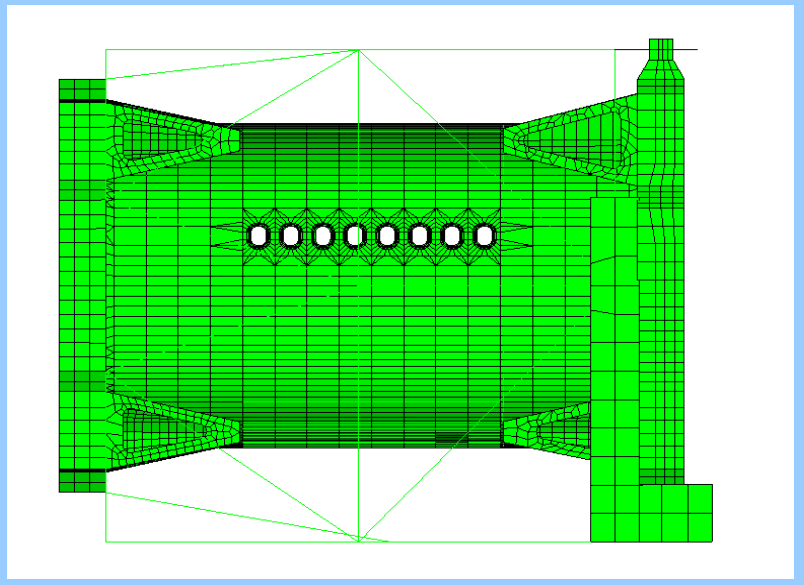


… from a two-spar towards a multi-spar composite wing…

Technological topics for innovative and upstream research

- Development and application of ‘virtual testing’ simulation methods for the large-structure behaviour in the non-linear regime

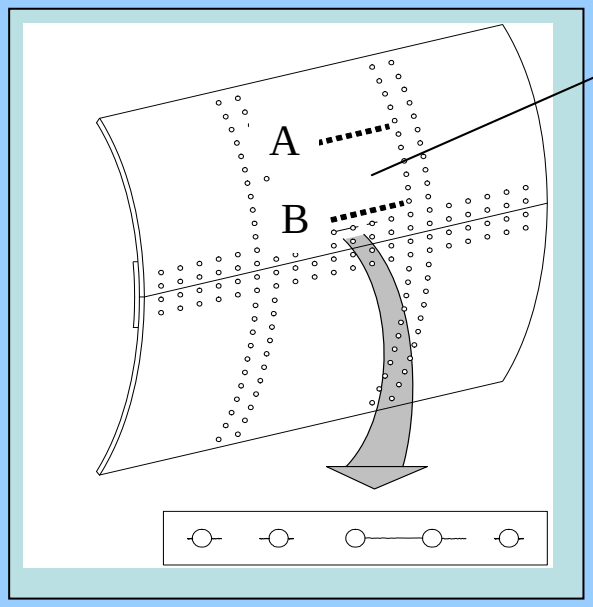


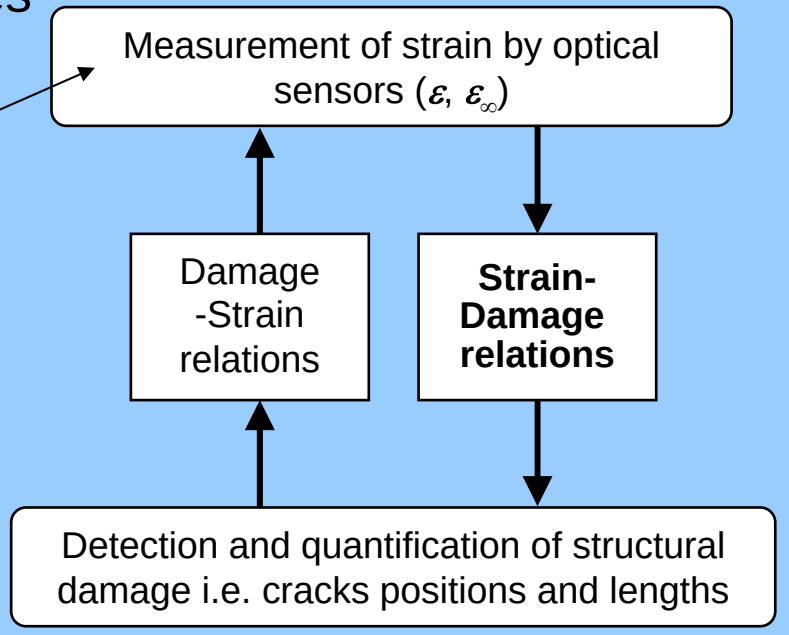


… from a real full-scale barrel testing towards a ‘virtual’ composite barrel testing…

Technological topics for innovative and upstream research

- To develop fatigue <u>damage tolerance</u> methodologies for critical <u>primary</u> aircraft composite structures

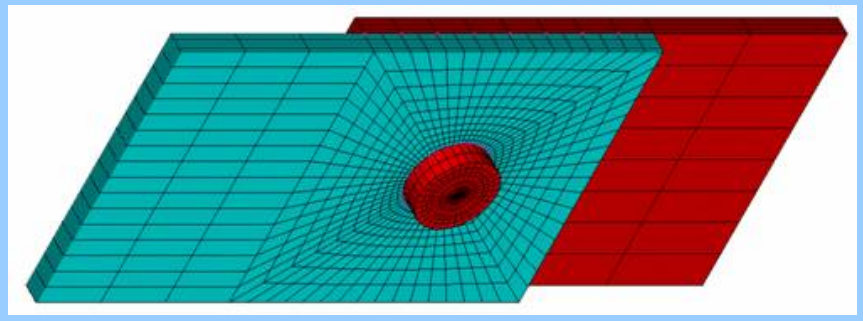




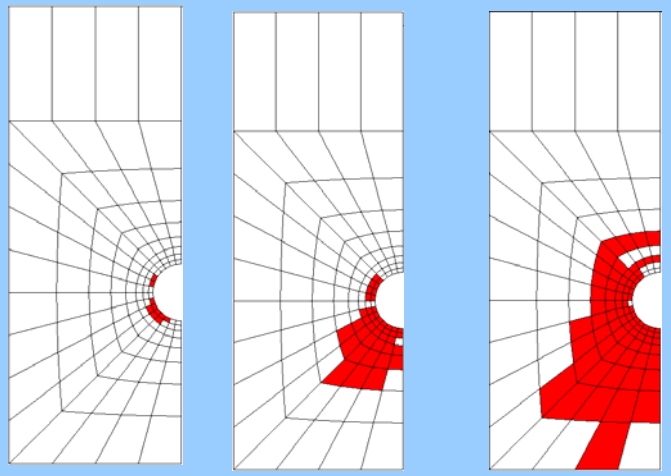
… from the 'damage no-grow' concept to a 'continuous health monitoring' composite smart structure …

Technological topics for innovative and upstream research

- To develop accurate prediction methodologies for damage evolution by exploiting the Progressive Damage Modelling principles in fatigue design



… from the low-level stressed structures towards an accurate prediction of the fatigue behaviour …



12MPa 48MPa 81MPa

Participants of the Interest Group

University Partners

- LTSM, University of Patras (Greece)
- University of Pisa (Italy)
- IFL-TU Braunschweig (Germany)
- University of Limerick (Ireland)
- CTU Prague, Brno University of Technology (Czech Republic)
- LMT- Cachan, Ecole de Mines Saint- Etienne (France)

- **More ?… if you are interested you are welcome… EASN is a University network**

Participants of the Interest Group

Collaborating Research Establishments

- DLR (Germany)
- NLR (The Netherlands)
- IDMEC (Portugal)
- EADS- CCR (France)

- **More ?… EASN is an open network…**

Participants of the Interest Group

Collaborating Aircraft manufacturers & SMEs

- Airbus (France)
- Physical Acoustics LTD, (UK)
- INASCO (Greece)

- **More ?… EASN promotes collaboration to the industry and SMSs…**

Activities so far - general

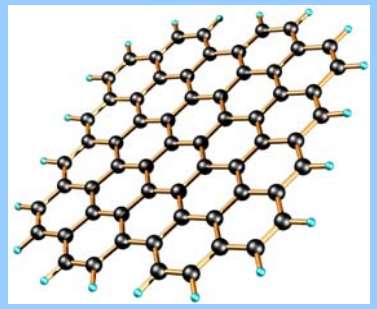
- Establishment of communication routes between the partners of the Interest Group for the exchange of information and ideas relative to the scientific interests and objectives of the Interest Group
- Submission of the upstream research proposal EXCOM for the 2nd FP6 call, which unfortunately has been rejected
- Contribution to the preparation of FP7, by providing research priority topics in the area of composite materials
- Preparation for proposals, ideas, through the 'EoI' procedure for the 2nd FP7 call

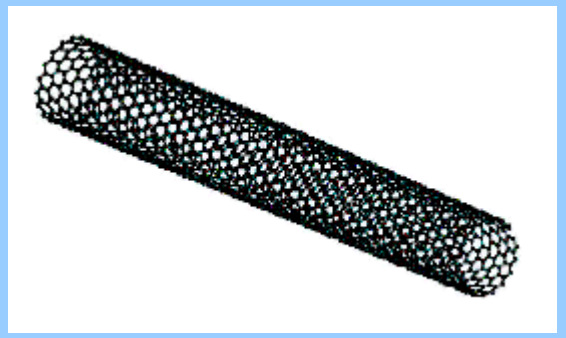
Activities so far – EoI 2nd FP7

Title: Carbon Nanotube Based Lightweight Materials

CNTs

- combine extraordinary mechanical properties and fiber-like structure
- offer unique potential for reinforcing polymers by replacement of conventional fibers
- only 1% (by weight) of CNTs added in a matrix material, the of a results to composite film stiffness increase of about 40% and tensile strength by 25%
- composite laminates filled with CNTs.show lower matrix cracking onset and accumulation





Activities so far – EoI 2nd FP7

Title: Carbon Nanotube (CNTs)-Based Lightweight Materials

Aspects to be addressed in the proposed project

- the interfacial load transfer between the nanotube and the matrix
- the presence of defects in CNTs, such as vacancies and topological defects may influence significantly their mechanical strength,
- the challenging aspect of using 2D or 3D nanotube structures as reinforcements instead of stand alone CNTs aiming to achieve enhancement of the mechanical properties in two or three directions minimizing at the same time the effect of nanotube misalignment

Proposer: Dr. Konstantinos Tserpes, University of Patras
Partners: Univ. Patras, Greece

Activities so far – Proposal submitted 2nd FP7

Title: Buckling Behaviour of Impacted CFRP

- The buckling behaviour of stiffened CFRP structures which suffered an impact will be treated experimentally and theoretically.
- New structural design concepts may be included in the proposed project, as well as new highly impact resistant composite materials.

Proposer: Prof. Peter Horst, IFL – Inst. of Aircraft Design and Lightweight Structures, Germany

Partners: Univ. Patras, LMT Cachan, Leibniz University of Hannover, EASD-IW, Univ. Brno

Activities so far – Conference participation

• *9th Mesomechanics Conference,* Giens, France, May 13-17, 2007 ‘‘Multi-Scale Modeling of Tensile Behavior of Carbon Nanotube-Reinforced Composites’’, K.I. Tserpes, P. Papanikos, G.N. Labeas, Sp. G. Pantelakis

• 1st European Air and Space International Conference CEAS, Berlin, Germany, September 10-13, 2007.
‘‘Crashworthiness of Composite Aircraft Structures’’, G. Labeas

• *2nd International Conference "Supply on the wings"*, Frankfurt/Main, Germany, October 24-25, 2007. ‘‘A new software tool for optimizing composite processes with regard to quality and cost’’, Sp.G.Pantelakis, Ch.V.Katsiropoulos, G.N.Labeas

Planned Future Activities

- Proceed to the preparation and submission of at least one proposal for the 3nd FP7 call (out of the proposed EoIs)
- Exploitation of the existing EASN electronic platform for improving exchanging information routes and for discussing scientific, technological and educational issues of common interest
- Undertake efforts in order to broaden the IG and increase its scientific weight

Planned Future Activities

- Exploit possibilities of existing CEC instruments for strengthening cooperation within the IG, for example by:
- Exchanging scientific and technological information and agreeing upon scientific and technological priorities and needs, through Coordination Actions)
- Exchange of students and Scientists
- Performe Training Activités (e.g. Marie Curie programmes) etc.

Thank you for your attention!

Questions .. Proposals…?