International Conference
on Dynamics of Composite Structures

June 2-4, 2015

Arles, France

Program

HGL Dynamics

IRT JULES VERNE

m+p INTERNATIONAL

DYNCOMP'2015 International Conference on Dynamics of Composite Structures takes place in the Convention Center of the city of **Arles** in the south-east of France from **June 2nd to June 4th 2015**.

This event is organised by **ADYVA**, the French Association for Structural Dynamics and Vibroacoustic, with the help of **AFM** (the French Association of Mechanics), **SFA** (the French Society of Acoustics), **CSMA** (the French Association for Computational Structural Mechanics) and **AMAC** (the French Association for Composite Materials).

We sincerely thank our sponsors **HGL Dynamics**, **IRT Jules Verne** (the French Institute on Advanced Manufacturing for Composite, Metallic and Hybrid Structures) and **M+P International**.

Organizing committee

Prof. Bernard Troclet	Chairman	AIRBUS Defence & Space (FR)
Prof. Emmanuel Foltête	Co-chairman	FEMTO-ST, ENSMM (FR)
Prof. Mohamed-Ali Hamdi		Roberval, UTC (FR)
Prof. Mohamed Ichchou		LTDS, École Centrale de Lyon (FR)
Prof. Pierre Ladevèze		LMT, ENS Cachan (FR)
Prof. Charles Pézerat		LAUM, Université du Maine (FR)

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Prof. Noureddine Atalla	University of Sherbrooke (CA)
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Philippe Pattyn	Bombardier Transportation (FR)
Éric Portal	PSA Peugeot Citroen (FR)
Prof. Fabrizio Scarpa	University of Bristol (GB)
Prof. Christian Soize	MSME, Université Paris-Est (FR)

Information for participants

Registration

The registration desk will be open from 8:00 to 18:00 on Tuesday 2nd, from 8:30 to 16:30 on Wednesday 3rd and from 8:30 to 13:00 on Thursday 4th June. Each registered participant will receive a conference badge and a bag containing the conference paper program and electronic proceedings. Please wear your badge at all times.

Venue

The Convention Center address is the following:

Palais des Congrès
Avenue de la 1ère Division France Libre, 13200 Arles
Latitude: 43.6716333 - Longitude: 4.6182335

The conference opening and closing and the plenary lectures will take place in the Mistral room. For session's talks, three parallel sessions will run in the Mistral, Serris and Cézanne rooms.

Internet access

You can access the Internet via Convention Center's Wi-Fi network using your own devices. No password is needed.

Important note to speakers

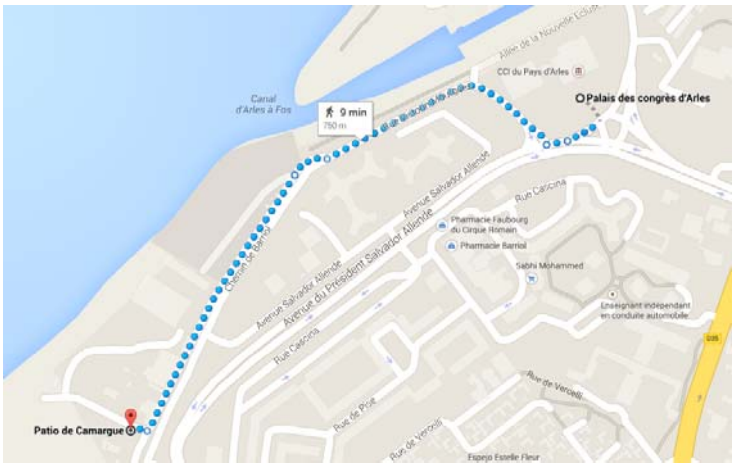
A personal computer with projector will be provided in each room on which all speakers should load their presentations. Speakers should arrive at the rooms at least 20 minutes before the start of their session. Assistance in loading presentations onto the computers will be provided. Note that only PC format will be supported so authors using Macs must save their presentations for projection in PC format (ppt, pptx, pdf). The duration of each talk should not exceed 20 minutes in order to let enough time for questions and discussions.

Gala dinner

The gala dinner is planned on **Wednesday 3rd from 19:30 to 23:00** at the **"Patio de Camargue"** (49 Chemin de Barriol, 13200 Arles) within a walking distance of the Convention Center.

Participants can arrive earlier and have a drink at the Rhone's bank.

Accompanying persons are welcome, please contact the registration desk for registration and payment (75 € per person).



Guided Tours

Guided tours can be organized for participants or accompanying persons (from 2 to 4 hours, from 120 to 150 euros per group). Please contact the registration desk if you are interested.

DYNCOMP'2015 - International Conference on Dynamics of Composite Structures

Tuesday, June 02, 2015

8:00 - 9:00	Registration					
9:00 - 9:15	Conference Opening - *Bernard Troclet (Airbus D&S, FR)*					Room Mistral
9:15 - 10:00	Plenary I - Lightweight Design of Fiber Composite Structures with Emphasis on Vibration Behavior *Prof. Dr.-Ing. Horst Baier (TU Muenchen, DE)*					Room Mistral
10:00 - 10:30	Coffee break					
10:30 - 12:00	Lightweight Structures Design *Prof. C. Pézerat (LAUM, FR)*	Room Mistral	Shocks and Impacts on Composite Structures *Prof. D. Coutellier (ENSIAME, FR)*	Room Serris	Vibration Control of Composite Structures *J. Buffe (Thalès Alenia Space, FR)*	Room Cézanne
12:00 - 13:30	Lunch					
13:30 - 14:15	Plenary II - Damage analysis of composite structures: a software editor point of view and illustration on industrial applications *Prof. Dr. Michael Bruyneel (Siemens, BE)*					Room Mistral
14:15 - 15:00	Plenary III - Mechanics of ultra-thin ply composite laminates *Prof. Pedro. P. Camanho (University of Porto, PT)*					Room Mistral
15:00 - 16:00	Dynamic Modeling of Composite Structures *V. Le-Gallo (Airbus D&S, FR)*	Room Mistral	Acoustic and Vibration *P. Pattyn (Bombardier, FR)*	Room Serris	Lightweight Structures Design *Prof. C. Pézerat (LAUM, FR)*	Room Cézanne
16:00 - 16:30	Coffee break					
16:30 - 18:00	Dynamic Modeling of Composite Structures *S. Muller (Airbus D&S, FR)*	Room Mistral	Acoustic and Vibration *Dr. H. Riou (ENS Cachan, FR)*	Room Serris	Damage Tolerance Design *Dr. M. Bruyneel (Siemens, FR)*	Room Cézanne

Wednesday, June 03, 2015

8:30 - 9:15	Plenary IV - Vibroacoustics of Gradient Cellular and Multiscale Composite Systems *Prof. Fabrizio Scarpa (University of Bristol, GB)*					Room Mistral
9:15 - 10:00	Plenary V - Numerical optimisation of the specific energy of composite aircraft structures with respect to high energy transient dynamic loads *Habil. Dipl.Ing. Eric Deletombe (ONERA, FR)*					Room Mistral
10:00 - 10:30	Coffee break					
10:30 - 12:30	Dynamic Modeling of Composite Structures *C. Clerc (Vibratec, FR)*	Room Mistral	Acoustic and Vibration *Dr.-Ing. M. Collet (ECL, FR)*	Room Serris	Vibration Control of Composite Structures *J.B. Mouillet (Altair, FR)*	Room Cézanne
12:30 - 14:00	Lunch					
14:00 - 14:45	Plenary VI - Resonant metamaterials to meet the conflicting requirements of low mass and good NVH performance *Prof. Wim Desmet (KU Leuven, BE)*					Room Mistral
14:45 - 15:30	Plenary VII - Optimization and reduced models; new perspectives for the design "process" from architecture trade-off to detailed design *Christophe Brand (CEO DATADVANCE, FR)*					Room Mistral
15:30 - 16:30	Dynamic Modeling of Composite Structures *Dr. D. Chronopoulos (University of Nottingham, UK)*	Room Mistral	Acoustic and Vibration *P. Pattyn (Bombardier, FR)*	Room Serris	Vibration Control of Composite Structures *J.B. Mouillet (Altair, FR)*	Room Cézanne
16:30 - 17:00	Coffee break					
17:00 - 18:00	Dynamic Modeling of Composite Structures *Dr. O. Bareille (ECL, FR)*	Room Mistral	Acoustic and Vibration *Dr. G. Borello (Interac, FR)*	Room Serris	Shocks and Impacts on Composite Structures *P. De Luca (ESI, FR)*	Room Cézanne
19:30 - 23:00	Gala Dinner					

Thursday, June 04, 2015

8:30 - 9:15	Plenary VIII - From admissibility to robustness. The benefits of V&V *Philippe Pasquet (Consultant, FR)*	Room Mistral
9:15 - 10:00	Plenary IX - Robust decision making in model-based design and validation *Dr. Scott Cogan (FEMTO-ST, FR)*	Room Mistral
10:00 - 10:30	Coffee break	
10:30 - 11:15	Plenary X - Damage tolerance of composite aircraft structures under impact loads *Dr. Alaistair Johnson (DLR, DE)*	Room Mistral
11:15 - 12:00	Plenary XI - Adaptive Metacomposites for vibroacoustic control applications *Dr.-Ing. Manuel Collet (LTDS, FR)*	Room Mistral
12:00 - 12:45	Plenary XII *Prof. Serge Abrate (Southern Illinois University, USA)*	Room Mistral
12:45 - 13:00	Conference Closing - *Bernard Troclet (Airbus D&S, FR)*	Room Mistral

DYNCOMP'2015 - International Conference on Dynamics of Composite Structures

Tuesday, June 02, 2015 - Morning

8:00 - 9:00	**Registration**			
9:00 - 9:15	**Conference Opening** - ***Bernard Troclet*** *(Airbus D&S, FR)*			Room Mistral
9:15 - 10:00	Plenary I - Lightweight Structures Design **Lightweight Design of Fiber Composite Structures with Emphasis on Vibration Behavior** by ***Prof. Dr.-Ing. Horst Baier*** *(TU Muenchen, DE)*			
10:00 - 10:30	**Coffee break**			
Sessions	**Lightweight Structures Design** *Prof. Charles Pézerat (LAUM, FR)*		**Shocks and Impacts on Composite Structures** *Prof. Daniel Coutellier (ENSIAME, FR)*		**Vibration Control of Composite Structures** *Jérôme Buffe (Thales Alenia Space, FR)*	
10:30 - 11:00	Analysis of the stiffness contrast of a mechanical structure made of composite materials *Martial Nobou Dassi, Arnaud Gaudin, Zouhir Abbadi, Laurent Gagliardini, Charles Pézerat, François Gautier*	Room Mistral	HyperVelocity impacts on composite overwrapped pressurized vessels *Jérémie Hassin, Kilian Pfaab, Christian Puillet, Jérôme Limido, Jean-Luc Lacome, Pierre-Louis Hereil*	Room Serris	Optimization in the composition of laminated composite structures *Mariam Jaber, Helmut Schneeweiss, Joachim Bös, Tobias Melz*	Room Cézanne
11:00 - 11:30	Sensitivity analysis of transmission loss through composites with acoustic treatment *Jean-Loup Christen, Mohamed Ichchou, Bernard Troclet, Olivier Bareille, Morvan Ouisse*		A new experimental setup to characterize the dynamic mechanical behavior of ballistic yarns *Caroline Chevalier, Norbert Faderl, Christophe Kerisit, François Boussu, Daniel Coutellier*		Viscoelastic characterisation of adhesives using inverse techniques *Lucie Rouleau, Jean-François Deü, Antoine Legay*	
11:30 - 12:00	Experimental and numerical investigation of the mechanical behaviour of an open-cell ceramic foam under multiaxial loadings *Omar Kraiem, Marie Houillon, Nicolas Schmitt, Han Zhao*		Effect of treated zone geometry on the dynamic plastic buckling of steel composite thin tubular structures *Abdellah Ahmed-Ali, Rachid Baleh, Donné Razafindramary, Akrum Abdul-Latif*		Fibers-based composite structures with integrated piezo-ceramics design approach of smart devices *Thibaut Dessolier, Rémy Lachat, Yann Meyer*	
12:00 - 13:30	**Lunch**					

DYNCOMP'2015 - International Conference on Dynamics of Composite Structures

Tuesday, June 02, 2015 - Afternoon

13:30 - 14:15	Plenary II - Damage Tolerance Design **Damage analysis of composite structures: a software editor point of view and illustration on industrial applications** by ***Prof. Dr. Michael Bruyneel*** *(Siemens, BE)*			Room Mistral
14:15 - 15:00	Plenary III - Damage Tolerance Design **Mechanics of ultra-thin ply composite laminates** by ***Prof. Pedro. P. Camanho*** *(University of Porto, PT)*			
Sessions	**Dynamic Modeling of Composite Structures** *Vincent Le-Gallo (Airbus D&S, FR)*	**Acoustic and Vibration** *Philippe Pattyn (Bombardier, FR)*	**Lightweight Structures Design** *Prof. Charles Pézerat (LAUM, FR)*	
15:00 - 15:30	A New Laminate Model for Broadband Frequency Analysis *Gérard Borello*	Measurement of the vibroacoustic indicators of sandwich-composite structures *Raef Cherif, Noureddine Atalla, Andrew Wareing*	Mechanical properties of light weight hybrid thermoplastic based composites *Reda Elhak Ourahmoune, Michelle Salvia*	Room Mistral / Room Serris / Room Cézanne
15:30 - 16:00	High-order wave diffusion in a sandwich plate with bonded coupling element *Christophe Droz, Jean-Pierre Lainé, Mohamed Ichchou*	Sound transmission characterization : application to a sandwich composite space structure *Cyprien Le Plenier*	Dynamic Mechanical Analysis of Carbon-Ceramic Composites *Teresa Gumula, Francisco José Carrión-Vilches, María Dolores Bermúdez*	
16:00-16:30	**Coffee break**			
Sessions	**Dynamic Modeling of Composite Structures** *Stéphane Muller (Airbus D&S, FR)*	**Acoustic and Vibration** *Prof. Mohamed-Ali Hamdi (UTC, FR)*	**Damage Tolerance Design** *Dr. Michael Bruyneel (Siemens, FR)*	
16:30 - 17:00	Mechanical properties identification of composite material using Force Analysis Technique *Bertrand Lascoup, Charles Pezerat, Frédéric Ablitzer*	A two-scale approach for assessment of the honeycomb core shear effects on the transmission loss *Zakaria Zergoune, Mohamed Ichchou, Olivier Bareille, Bilal Harras, Rhali Benamar*	Constitutive law misfit functional for cavities identification *Emna Jaïem, Amel Ben Abda, Sinda Khalfallah, Abdelmalek Zine*	Room Mistral / Room Serris / Room Cézanne
17:00 - 17:30	Coupling phenomena on heavy vehicles: medium frequency experimental analysis and numerical applications *Anna Rita Tufano, Etienne Laligant, Mohamed Ichchou, Olivier Bareille, Cyril Braguy, Nicolas Blairon*	Extension of the Variational Theory of Complex Rays to orthotropic shell structures *Alessandro Cattabiani, Hervé Riou, Andrea Barbarulo, Guillaume Bézier, Bernard Troclet*	Accounting for manufacturing effects in composites virtual prototyping. *Patrick de Luca, Alain Trameçon*	
17:30 - 18:00	Wave propagation in phononic crystal composites plates *Sahar Zouari, Jean-Michel Genevaux, Julien Brocail, Frédéric Ablitzer*	Optimization of vibroacoustic indicators of honeycomb panels *Omar Baho, Mohamed Ichchou, Bilal Harras, Rhali Benamar*	A two steps Damage localization method based on wavelet packet decomposition. Application to multi-layer composite structures *Akli Boumrar, Amar Bouazzouni, Merzak Dahmani*	

DYNCOMP'2015 - International Conference on Dynamics of Composite Structures

Wednesday, June 03, 2015 - Morning

8:30 - 9:15	Plenary IV - Dynamic Modeling of Composite Structures **Vibroacoustics of Gradient Cellular and Multiscale Composite Systems** by ***Prof. Fabrizio Scarpa*** *(University of Bristol, GB)*			Room Mistral
9:15 - 10:00	Plenary V - Dynamic Modeling of Composite Structures **Numerical optimisation of the specific energy of composite aircraft structures with respect to high energy transient dynamic loads** by ***Habil. Dipl.Ing. Éric Deletombe*** *(ONERA, FR)*			
10:00 - 10:30	**Coffee break**			
Sessions	**Dynamic Modeling of Composite Structures** *Christian Clerc (Vibratec, FR)*		**Acoustic and Vibration** *Dr.-Ing. Manuel Collet (ECL, FR)*	**Vibration Control of Composite Structures** *Jean-Baptiste Mouillet (Altair, FR)*
10:30 - 11:00	Predeformation and frequency-dependence : Experiment and FE analysis *Nidhal Jridi, Michelle Salvia, Adel Hamdi, Olivier Bareille, Makrem Arfaoui, Mohamed Ichchou, Jalel Ben Abdallah*		The sound transmission loss using the Stochastic Wave Finite Element Method *Mohamed Amine Ben Souf, Dimitrios Chronopoulos, Mohamed Ichchou, Olivier Bareille, Mohamed Haddar*	Improvements of Force Analysis Technique for Flaw Detection on Composite Materials *Thibault Wassereau, Charles Pézerat, Jean-Louis Guyader, Frédéric Ablitzer*
11:00 - 11:30	Modeling and identification of a class of hyperviscoelastic material behaviour *Tayeb Adel, Arfaoui Makrem, Zine Abdelmalek, Hamdi Adel, Benabdallah Jalel, Mohamed Ichchou*	Room Mistral	Contact-less full-field optical measurement method to analyze vibrations of structures *Julien Poittevin, Pascal Picart, François Gautier, Charles Pézerat*	Scattering of high-order guided waves in sandwich plates *Christophe Droz, Jean-Pierre Lainé, Mohamed Ichchou*
11:30 - 12:00	Experimental and numerical characterisation of E-glass/Vinylester composites subjected to in-plane and out-of -plane high strain rate compressive loading *Jamal Arbaoui, Mostapha Tarfaoui, Aboulghit El Malki*		Scattering properties of joints in composite plates *Giannoula Mitrou, Jamil Renno*	Application of non-parametric uncertainties method on launchers mechanical specifications *Stéphane Muller, Antoine Alouani*
12:00 - 12:30	Identification of equivalent anisotropic material properties of 3D-heterogeneous structures *Pierre Millithaler, Emeline Sadoulet-Reboul, Morvan Ouisse, Jean-Baptiste Dupont, Noureddine Bouhaddi*		Robust decision making: an application of info-gap method on a dynamic model *Paul Lépine, Scott Cogan, Emmanuel Foltête, Marie-Océane Parent*	Damping Composite Carrying Structures For Future Launchers *Vincent Le-Gallo, Benoît Petitjean, Lionel Zoghaib*
12:30 - 14:00	**Lunch**			

Room Serris

Room Cézanne

DYNCOMP'2015 - International Conference on Dynamics of Composite Structures

Wednesday, June 03, 2015 - Afternoon

14:00 - 14:45	Plenary VI - Acoustic and Vibration **Resonant metamaterials to meet the conflicting requirements of low mass and good NVH performance** by ***Prof. Wim Desmet*** *(KU Leuven, BE)*			Room Mistral
14:45 - 15:30	Plenary VII - Design Optimisation **Optimization and reduced models; new perspectives for the design "process" from architecture trade-off to detailed design** by ***Christophe Brand*** *(CEO DATADVANCE, FR)*			Room Mistral
Sessions	**Dynamic Modeling of Composite Structures** *Dr. Dimitrios Chronopoulos (University of Nottingham, UK)*		**Acoustic and Vibration** *Philippe Pattyn (Bombardier, FR)*	**Vibration Control of Composite Structures** *Jean-Baptiste Mouillet (Altair, FR)*
15:30 - 16:00	Energy flow prediction in piezoelectric-based built-up structures through a hybrid finite element/wave and finite element approach *Yu Fan, Manuel Collet, Mohamed Ichchou, Olivier Bareille, Zoran Dimitrijevic*	Room Mistral	A Wave Based unit cell method to predict absorption and transmission coefficients of poroelastic materials containing periodic inclusions *Elke Deckers, Claus Claeys, Wim Desmet*	High Frequency Dynamic Mechanical Analysis on Shape Memory Polymers *Pauline Butaud, Franck Renaud, Gaël Chevallier, Morvan Ouisse, Emmanuel Foltête*
16:00-16:30	Geometrically Non-Linear Free and Forced Vibration of Fully Clamped Laminated Composite Skew Plates *Bilal Harras, Hanane Moulay Abdelali, Rhali Benammar*		A mixed "Biot-Shell" analytical model for the calculation of sound transmission through sandwich cylinders with poroelastic cores *Julien Magniez, Mohamed-Ali Hamdi, Jean-Daniel Chazot, Bernard Troclet*	Design optimisation *Jingyi Liu, Guy Aubert*
16:30 - 17:00	**Coffee break**			
	Dynamic Modeling of Composite Structures *Dr. Olivier Bareille (ECL, FR)*		**Acoustic and Vibration** *Dr. Gérard Borello (Interac, FR)*	**Shocks and Impacts on Composite Structures** *Patrick De Luca (ESI, FR)*
17:00 - 17:30	Wave based design optimisation of composite structures operating in dynamic environments *Dimitrios Chronopoulos, S. Leerungruang, Manuel Collet, Mohamed Ichchou*	Room Mistral	Weak Trefftz Discontinuous Methods for the resolution of frequency vibrations of composite structures *Hervé Riou, Pierre Ladevèze, Olivier Hao Li*	Low velocity impact on laminate composite with thermoplastic resin *Christophe Bouvet, Pablo Garcia Pérez, Frédéric Dau, Patrick Peres*
17:30 - 18:00			Vibro-acoustic modeling of thick laminates Composite and sandwich Panels using Statistical Energy Analysis *Abderrazak Mejdi, Bryce Gardner, Chadwyck Musser*	Delamination and debonding predictions for tyre impact onto composite A/C components *Michel Fouinneteau*
19:30 - 23:00	**Gala Dinner**			

DYNCOMP'2015 - International Conference on Dynamics of Composite Structures

Thursday, June 04, 2015 - Morning

8:30 - 9:15	Plenary VIII - Certification and Validation **From admissibility to robustness. The benefits of V&V** by ***Philippe Pasquet*** *(Consultant, FR)*	Room Mistral
9:15 - 10:00	Plenary IX - Certification and Validation **Robust decision making in model-based design and validation** by ***Dr. Scott Cogan*** *(FEMTO-ST, FR)*	
10:00 - 10:30	**Coffee break**	
10:30 - 11:15	Plenary X - Shocks and Impacts on Composite Structures **Damage tolerance of composite aircraft structures under impact loads** by ***Dr. Alaistair Johnson*** *(DLR, DE)*	Room Mistral
11:15 - 12:00	Plenary XI - Vibration Control of Composite Structures **Adaptive Metacomposites for vibroacoustic control applications** by ***Dr.-Ing. Manuel Collet*** *(LTDS, FR)*	
12:00 - 12:45	Plenary XII - Shocks and Impacts on Composite Structures **(to be confirmed)** by ***Prof. Serge Abrate*** *(Southern Illinois University, USA)*	
12:45-13:00	**Conference Closing -** ***Bernard Troclet*** *(Airbus D&S, FR)*	

Plenary Talks

Plenary I – Tuesday 02 June 2015, 09:15 - 10:00

Lightweight Design of Fiber Composite Structures with Emphasis on Vibration Behavior

Prof. Horst Baier
Institute of Lightweight Structures, Technische Universität München,
D-85747 Garching
Email: baier@tum.de

The vibration behavior and related design steps of Carbon fiber reinforced plastic (CFRP) structures are addressed. Though on the one side the macro-scale behavior in principle not so much differs from that of structures made out of other (e.g. metallic) materials, it are mainly the higher number of design degrees of freedom of such composite structures in addition to their favorable mass and functional properties which makes their application interesting in many cases. For a concrete discussion, vibration behavior and vibration attenuation measures are outlined for three study cases taken from aerospace applications. These are the vibration of aircraft wings due to gust excitation, vibro-acoustic problems in satellite launchers, as well as launch and in-orbit vibration attenuation of large and highly flexible satellite appendages. Though such fiber composites materials and structures put some challenges for proper design, simulation and manufacturing, it is shown that the higher number of design degrees freedom allows a good adaption to goals and requirements and improves structural efficiency also for vibration aspects.

Plenary II – Tuesday 02 June 2015, 13:30 - 14:15

Damage analysis of composite structures: a software editor point of view and illustration on industrial applications

Michael Bruyneel[1,2]
[1] Samtech s.a., A Siemens Company, Liège, Belgium
[2] University of Liège, Belgium

The presentation starts with the enumeration of challenges in the modeling of composite materials and structures, and then focusses on damage analysis.
In order to propose predictive simulation tools for composites, material models able to represent the different modes of degradation of the plies forming the laminate must be used. Delamination must also be taken into account in the problem. Both inter and intra-laminar damages in laminated composites are considered here, in the case of static analyses. The simulations are conducted with the LMS Samtech Samcef implicit finite element code.
The material model for the intra-laminar damage is based on the continuum damage mechanics. It was initially developed by Cachan (Ladevèze). In each ply, damage variables impacting the stiffness are associated to the different failure modes, representing the fiber breaking, matrix cracking and decohesion between fibers and matrix. The specific damage model is first presented as well as the parameter identification procedure. This procedure relies on a very limited number of tests at the coupon level. The obtained parameter values are then validated on a coupon with a stacking sequence not used for the identification.
The cohesive elements approach is used for modeling inter-laminar damages. The Cachan model is used (Allix and Ladevèze). The material model is assigned to interface elements to represent the possible delamination and inter-laminar crack propagation can be simulated. The inter-laminar damage model and the parameter identification procedure are presented.
The linear and non-linear material properties identified at the coupon level are then used at the upper stages of the pyramid, on an L-shaped beam, an impacted plate and on stiffened composite panels. Comparison between tests and simulation demonstrate the efficiency of the modeling and analysis approaches implemented in LMS Samtech Samcef. Results are provided for UD, woven fabrics and NCF plies. Fatigue is also considered as an extension of the approach.

Michaël Bruyneel, graduated in 1995 as Mechanical Engineer from the Faculté Polytechnique de Mons (Belgium). He obtained his PhD in 2002 at the University of Liège (Belgium) in the field of optimization of composite structures. Senior Manager, he is the Head of the SAMCEF Solver Group at Samtech s.a. (a Siemens Company), working in the field of finite element numerical simulation and optimization. He is a developer of the SAMCEF finite element code and of the BOSS Quattro optimization toolbox. His fields of expertise and scientific interests are structural optimization using the finite element method, optimization algorithms, computational fracture mechanics for metallic (including XFEM) and composite materials, and design of composites structures. Over the last 18 years, he's been involved in more than 20 R&D projects (mainly for composites) with top industrial players of the aeronautics, space and automotive industries. He is senior member of the American Institute for Aeronautics and Astronautics (AIAA), member of the European Aeronautics Science Network (EASN), and member of the NAFEMS Composite Working Group. He is author and co-author of more than 150 publications in books, journals, conferences and scientific workshops. He serves as a referee for several international journals, such as AIAA Journal, Computers & Structures Journal, Computer Methods in Applied Mechanics and Engineering, and Structural & Multidisciplinary Optimization Journal. He is a member of the Editorial Board of the International Journal of Composite Materials. He is Assistant Professor at the University of Liège (Belgium), where he teaches the Mechanics of Composites, and Visiting Professor at ISMANS Engineering School (France) for the classes on Computational Fracture Mechanics and Structural Optimization.

Plenary III – Tuesday 02 June 2015, 14:15 - 15:00

Mechanics of ultra-thin ply composite laminates

Pedro P. Camanho, PhD, DIC
Professor of Mechanical Engineering
DEMec- Faculdade de Engenharia
Universidade do Porto, PT

Recent developments in tow-spreading technologies enable the fabrication of composite laminates with ply thickness as low as 0,02mm. This presentation will describe the potential benefits of using ultra-thin ply laminates, in particular in the mitigation os transverse cracking and delamination in multidirectional composites. Computational models developed at different length scales will be used to explain some of the trends observed, and the main results of an experimental test plan that included notched and untouched laminates will be discussed.

Plenary IV – Wednesday 03 June 2015, 08:30 - 09:15

Vibroacoustics of Gradient Cellular and Multiscale Composite Systems

Prof. Fabrizio Scarpa
University of Bristol, GB

Cellular materials and multiscale composites are the object of increasing interest within the vibroacoustic R&D community because of recent advances in materials manufacturing and 3D printing that facilitate the fabrication of these material systems. The talk will describe some recent work on the mechanics and the vibroacoustics of gradient core sandwich structures made with Kirigami (Origami and cut) techniques, auxetic lattices and nanocomposites coatings and materials for vibration damping. We will also describe the damping and energy absorption behaviour of multiscale porous entangled structures (metal rubber), and how to use morphing wing technologies to develop energy absorption damping devices under large amplitude loading.

Dr Fabrizio Scarpa obtained a MEng in Aeronautical Engineering and a PhD in Machine Design at the Politecnico of Torino, Italy. In 1997 he joined the Dynamics Research Group at the University of Sheffield to work in the field of negative Poisson's ratio materials for vibroacoustic applications. He then became Lecturer and Senior Lecturer at the Department of Mechanical Engineering of Sheffield working as Aerospace Departmental Coordinator and International Student Exchange Officer. He joined the Department of Aerospace Engineering in Bristol in 2005.
His research activities span the field of auxetics (foams and honeycombs), shape memory alloy honeycombs, smart multifunctional cellular solids, viscoelasticity and structural-acoustic coupling. Dr Scarpa is Principal Investigator in EPSRC, European Framework 6, Transfer Technology partnerhips and DTI projects, working also in International Collaboration projects with US Army ARO and Georgia Institute of Technology.
Dr Scarpa is a member of the Royal Aeronautical Society and features in the Editorial team of the Aircraft Engineering and Aerospace Technology Journal.

Plenary V – Wednesday 03 June 2015, 09:15 - 10:00

Numerical optimisation of the specific energy of composite aircraft structures with respect to high energy transient dynamic loads - Principles, prerequisites and case study (hydraulic ram in fuel tanks)

Habil. Dipl.Ing. Éric Deletombe
ONERA, FR

Reducing vulnerability of aeronautical structures to dynamic threats can be achieved through improved configuration, damage tolerance and damage resistance. Damage resistance is mostly a question of materials and structural design. Because of their high mechanical performances and low weight, the use of lightweight composite materials, e.g. Glass or Carbon Fibre Reinforced Plastic, is today of great interest and are being massively introduced in aeronautics for ten years. But CFRP composite structures are also well known to exhibit brittle behaviours under impacts.

Hence advanced nonlinear numerical models are required to design composite structures with a reduced vulnerability – meaning here high specific energy and acceptable rupture level/residual strength – with respect to dynamic transient loads. Such behavioural models also need to be properly characterised, meaning here with respect to the dynamic behaviour and rupture of composite constitutive materials, which is already a challenging issue. Then an efficient numerical optimization methodology and strategy must be defined and assessed to come out with the best compromise between static requirements, dynamic resistance and final weight of the composite structure.

The presented works address the topic of the numerical optimisation of composite aircraft structures with respect to high energy transient dynamic loads. General prerequisites are first presented that concern the characterisation and modelling of dynamic behaviour and rupture of CFRP materials. Then various issues related to the numerical optimisation of composite structures are discussed: cost function and constraints, FE tools and models, CPU costs, etc. Once these general principles and prerequisites reminded, a particular case study is given, which concerns the improvement of composite aircraft fuel tanks with respect to hydrodynamic ram (HRAM) loads after high speed/high energy ballistic impacts. To prevent from such dynamic threats, the impact hardening through armouring the structure is an ultimate solution which is hardly acceptable in aeronautics for obvious mass penalty reasons. The reduction of fuel tanks vulnerability then turns to become not separable from this difficult optimisation exercise with respect to its mass.

Eric Deletombe has been Head of the "Structural Design and Dynamic Resistance" Research Unit at the French Aerospace Lab (Office National d'Etudes et de Recherches Aerospatiales) from January 1999 till December 2009. He started at ONERA in 1991 as a Research Engineer and worked on the modelling of the crash behaviour of metallic aircraft structures. The research scope has been spreading since the beginning of the 90's, combining both experimental and numerical activities. The key Research subjects of the SDDR research unit concern: Metallic and Composites Materials, Joints, Behaviour, Damage and Rupture, Transient Dynamic Loads (crash, impacts, etc), and Fluid/Structure Interactions (ditching, explosions, etc). Eric Deletombe is now Special Scientific Advisor of the Aeroelasticity and Structural Dynamics Department of ONERA of the Materials and Structures scientific Branch of ONERA.

Plenary VI – Wednesday 03 June 2015, 14:00 - 14:45

Resonant metamaterials to meet the conflicting requirements of low mass and good NVH performance

Prof. Wim Desmet
KU Leuven, BE

Weight reduction is an emerging tendency in industrial machinery and transportation industry in order to reduce costs and ecological impact. Lightweight materials come to the fore, such as composites and sandwich structures. These material concepts are currently mainly designed for high static stiffness and strength, and good impact resistance. However, reduced mass comes with significantly deteriorated noise and vibration properties, such that in current practice lightweight material systems typically need to be treated with trim materials to achieve affordable noise and vibration levels, thus annihilating partly or even entirely the originally envisaged mass reduction.

In order to comply with the conflicting goals of low mass and proper NVH behaviour, new material concepts arise, including resonant and non-resonant metamaterials, double porosity materials and multilayer systems. Metamaterials contain inclusions or resonators, double porosity materials contain perforations which may be filled with another constituent and multilayer materials combine a number of layers with different properties. The rationale behind these concepts is to add mass in an optimised way to obtain the best (dynamic) performance.

This presentation will shed some light on the basic concepts of the resonant metamaterials, as they are being developed at KU Leuven. These materials exhibit superior noise and vibration insulation properties, be it at least in some targeted and tuneable frequency ranges, referred to as stopbands. These are frequency zones for which free wave propagation is prevented throughout the metamaterial, resulting in frequency zones of pronounced wave attenuation. KU Leuven is currently investigating honeycomb based metamaterials with embedded resonator structures that exhibit vibro-acoustic stopband behaviour. A key element in this concept is that waves can be affected by incorporating structural resonator elements of sub-wavelength sizes, i.e. features that are actually smaller than the wavelength of the waves to be affected. As a result, superb noise insulation performance can be obtained in the currently very-hard-to-address lower frequency ranges that match the typical operational ranges of noise disturbance in many (automotive) applications.
In addition, an overview will be given of the dedicated numerical and experimental methods that are used to characterize the NVH behaviour of these lightweight material concepts. Also, various practical realisations of the same concept, involving different manufacturing processes, will be presented.

Wim Desmet (°1969, Belgium) obtained an MSc degree (1992) and a PhD degree (1998) in Mechanical Engineering from KU Leuven, Belgium. He is a Full Professor in Dynamics and Mechatronics at the KU Leuven Department of Mechanical Engineering, where he is currently the head of the Noise and Vibration Research group, which consists of 15 postdoctoral researchers and 60 PhD candidates. He holds also the LMS Chair on Vehicle Mechatronics. He serves also as Director of the Mechatronics and Design Department of the Flanders Make – Strategic Research Centre for the Manufacturing Industry – in Flanders, Belgium.

His major research interests include vibro-acoustics, aeroacoustics, multibody dynamics, smart system dynamics, vehicle mechatronics, virtual prototyping techniques, noise control engineering, dynamics of lightweight materials, condition monitoring, uncertainty and variability in dynamics, green transportation, wind turbine dynamics, mechatronic simulation.

Plenary VII – Wednesday 03 June 2015, 14:45 - 15:30

Optimization and reduced models; new perspectives for the design ""process"" from architecture trade-off to detailed design

Christophe Brand
CEO DATADVANCE, FR

Numerical optimization exists since ages and has been employed in industry since a bit less than half a century. Aerospace and automotive are using it intensively. However, there are still a lot of reluctances to jump to numerical optimization favoring a manual design exploration. The presentation tends to perform a state-of the art of today optimization capabilities as a whole in the industry and understand if optimization is a threat or an opportunity. Aerospace composite structure optimization presents specificities link to the high dimensionality of the problem and the discrete nature of the material. The recent aerospace product developments have pushed optimization community to face these challenges and provide industrial solutions. A panorama of the different strategies that have been implemented is performed demonstrating industrial feasibility.

Christophe BRAND graduated from ENSAE (Ecole Nationale Supérieure de l'Aéronautique et de l'Espace – Toulouse France) in 1988. He started his career at Airbus as transient dynamic simulation engineer before leading this activity. Then, he became head of stress A320 front fuselage. In 1999, he moved to manufacturing as head of production line for two years. He was back to engineering in 2001, where he led the advanced numerical simulation department. In 2005, he took the responsibility to coordinate structure capability developments needed for A350 program. In 2007, he joint EADS Corporate Technical Office as Vice President Head of Global Innovation Network. In the field of structures, his mission was to define the group R&T strategy and to develop the synergies between the different EADS divisions. Since 2012, Christophe is CEO of Datadvance, a software company specialized in predictive modelling, intellectual data analysis and multidisciplinary optimization.

Plenary VIII – Thursday 04 June 2015, 08:30 - 09:15

From admissibility to robustness. The benefits of V&V

Philippe Pasquet
Consultant, FR

To make a structural (or fluids) analysis we need skills, materials, softwares, time, money, of course. But also, to know for what we ask, what we have to obtain the result, to know the importance and the place of the simulation in the design's cycle. In this paper, we shall give some useful or essential ingredients, which every particular case will have to adapt by taking into account available ways, to make a good simulation that we look for an acceptable result or a robust result. As main thread, we shall choose the structural mechanics but the process is identical whatever the physics is and whatever the method of analysis is. The well-known V&V process is a huge help. This paper is mainly focused on the verification aspects (codes, models/solutions/analyses) and Uncertainty Quantification for practical applications.

With almost forty years of extensive experience in engineering simulation, Philippe Pasquet has covered the full range of technical responsibility in this domain, both with research institutes (PhD 1977) and various consulting firms and software houses: development of software, development of methods, advanced studies, team management, scientific and technical management etc. Powered by his passion for pedagogy and simulation technology, he has presented at several conferences and talks at high level towards efficient use and good practices of simulation in the industry, motivating students and engineers for those fascinating engineering simulation jobs. Among his main skills: Non Linear, Optimisation, fast dynamics, multiphysics…

Plenary IX – Thursday 04 June 2015, 09:15 - 10:00

Robust decision making in model-based design and validation

Dr. Scott Cogan
FEMTO-ST Institute, FR

The design of high-consequence systems leverages expert judgment, experimental prototyping and physics-based models to support product development. More stringent certification requirements and increasingly competitive markets have encouraged engineering firms to reduce costs and time to market by limiting physical prototype testing and this in turn has lead to an increased emphasis on virtual prototyping. The methods and guidelines developed by the V&V (Verification and Validation of Numerical Simulations) community provide a structured framework for establishing the credibility of the model-based decision making process on an application-by-application basis. The bottom line is to quantify the degree of confidence that can be accorded to a simulation used in predicting an outcome of interest.

This presentation will argue that an essential aspect of building confidence in a physics-based model is to establish the robustness of the design decisions of interest to different sources of model uncertainty, including: model form errors, various types of compensating effects, and parameter imprecision. Robustness here is understood to be the degree of uncertainty that can be tolerated without changing a decision of interest. Moreover, the notion of design decision is taken here to be very general and can be understood, for example, as: dimensioning a structure, ranking dominant parameters in effects screening, model-based experiment design, model screening for calibration, and so on. Academic and industrial examples in the field structural dynamics will be used to illustrate how robustness can be investigated in different phases of the V&V process as a way of developing simulating-based expert judgment.

Scott Cogan received his Bachelor's and Master's degree in Mechanical Engineering from the University of Michigan followed by his PhD at the University of Franche-Comté. He has been a research fellow with the CNRS-France since 1992 and is currently head of the Robust Design and V&V research group at the Department of Applied Mechanics of the FEMTO-ST Institute in Besançon, France.

Plenary X – Thursday 04 June 2015, 10:30 - 11:15

Damage tolerance of composite aircraft structures under impact loads

Dr. Alastair Johnson, Nathalie Toso-Pentecôte, Dominik Schueler
German Aerospace Center (DLR), Institute of Structures and Design, Stuttgart

A critical safety issue for the design of primary aircraft structures is vulnerability and damage tolerance due to foreign object impact from bird strike, hail, tyre rubber and metal fragments. The damage tolerance strategy in the aircraft industry for composite structures requires retention of residual strength for critical damage states which are linked to damage visibility and damage detection during service. Here it is necessary to demonstrate that an impact damaged structure has sufficient residual strength to sustain design limit loads during flight without failure. Results of an experimental damage tolerance study are presented in which composite aircraft fuselage bay panels were impacted in gas gun tests by steel cubes and blunt glass projectiles causing notch and delamination damage respectively. These damaged plates were then tested under quasi-static loads to determine residual tensile and compression strengths. An additional feature was to investigate the influence of tensile or compression preloads representative of design limit loads on damage states and residual strengths.
The influence of preload and impact damage on residual strengths were studied and test results analysed in the context of damage tolerance requirements and aircraft safety. Composite panels in tension and compression with visible impact damage (VID) from hard body notch impact tests with complete penetration showed very good structural integrity, with no significant reduction in strength due to pre-loading. However, blunt impact tests led to large delamination damage regions which had a strong influence on plate bending properties and caused lower compression strengths at failure in buckling. Test results showed that compression pre-load intensified this trend. Aircraft damage tolerance for barely visible impact damage (BVID) in composite panels with and without preloads therefore requires more careful assessment, since the damaged structure has to sustain design limit load in flight up to the next inspection.
To support damage tolerance certification testing validated computational methods are required by the industry. The impact damage states measured here for stress-free and preloaded plates were simulated with composites damage and delamination models implemented in the Abaqus FE code, showing good agreement with damage modes and extent of delamination and ply damage. The FE methodology was then extended to allow the impact damaged plates to be loaded quasi-statically to predict damage growth and residual tensile strength at ultimate fracture. FE simulation of notch impact damaged plates with and without tensile preloads gave promising results but underestimated the measured residual tensile strengths. Future work will consider blunt impact damage and compression strengths in buckled plates. These are challenging load scenarios for the FE codes and the composites damage models under development.

Dr Alastair Johnson studied Mathematics then joined the National Physical Laboratory, Teddington, UK, later becoming Head of the NPL Composites Properties and Design Group. In 1990 he moved to the German Aerospace Center (DLR), Institute of Structures and Design, Stuttgart, with responsibility for design of composite materials and structures within the Structural Integrity Department. Since his retirement he is a consultant in the field of damage tolerance and safety of composite aircraft structures. Extensive experience on structural integrity of composite aircraft structures was obtained through working with international industry and research partners, including coordination of two large EU Aeronautics research projects.

Plenary XI – Thursday 04 June 2015, 11:15 - 12:00

Adaptive Metacomposites for vibroacoustic control applications

Dr.-Ing. Manuel Collet
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Research activities in smart materials and structures represent a significant potential for technological innovations in many industrial domains. The necessity of controlling vibroacoustic performance of industrial systems motivates a broad research effort for introducing active or passive solutions to control noise and vibrations.

Constant interest in developing new materials better adapted for more efficient human applications or engineered to have properties that have not yet been found in nature. behavior, led to study a new class of artificial multifunctional composite materials: the metamaterial. These new materials presenting specific physical properties due to their micro structuring were originally developed to synthesize artificial electromagnetic permittivity indices or negative permeability. Few years ago one has shown that these concepts could be transcribed to other domains such as acoustics, mechanics or even robotics. Thus, the realization of new structured materials has allowed obtaining very interesting new physical features that can lead to the design of integrated multi-functional structures.

In the recent years, technological progresses observed in the areas of Micro Electro Mechanical Systems, 3D printing and Functional Material is merging to produce a real technological breakthrough that will deeply impact the future development of adaptive structures and systems. One can now imagine full integration of hybrid systems consisting of adaptive materials, electronics, computing resources and power systems. The next generation of composite structures that one call "smart metacomposite", should take full advantage of these technological advances for optimizing their behaviors.

These new technologies allow tailoring local material physical behavior for implementing new structural functional properties with regards to vibration and acoustic criteria, among others. In this sense, we can speak of "integrated distributed adaptive metacomposites" that merges with the notion of programmable material.

Talk Outlines

After a short introduction and state of art, the presentation describes theoretical and numerical tools for designing adaptive metacomposite through two specific problems concerning first the control acoustic impedance and those of vibrational power flow. In the first part, the concept of active acoustical skin is introduced. Modeling aspects and optimizations tools are also carried out and validated by an experimental prototype. The second part deals with a smart mechanical interface for controlling absorption and transmission of elastodynamical energy by using periodically distributed set of shunted piezoelectric patches. The numerical optimization tools and results are deeply analyzed. Finally, application on a plate interface allows us to validation the proposed distributed system.

Plenary XII – Thursday 04 June 2015, 12:00 - 12:45

Prof. Serge Abrate
Southern Illinois University, USA

To be confirmed
