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Composite Materials and Structures Group

The research activities of the Composite Materials and Structures Group can be split into two main axes:

- SIMU: Structure, Impact, Modelling, Machining of composites
- MaPP: Materials Properties and Processes

SIMU axis (16 permanent people) addresses the following topics:

1/ Composite structures
   - Behaviour under static / dynamic loadings
   - Study of structural details
   - Structural testing
   - Sandwich structures
   - Durability of structures, ageing
2/ Impact / Crash
   - Low / High energy impacts / Crash
   - Residual strength
   - Impact damages on monolithic and sandwich structures
3/ Machining of composite materials
   - cutting tools geometry
   - cutting parameters
   - relationship between machining parameters and resulting defects and
   - Surface, Machining, Materials and Tools Group

MaPP axis (10 permanent people) addresses the following topics:

1/ Simulation of composite manufacturing
   - Chamferology modelling (TDF), crystallisation of TP and inorganic matrices, Phase diagrams, multiphysics studies
2/ Study and simulation of composites manufacturing processes (RTM, infusion, Flatbedmoulding, Adhesive...)
3/ Emerging manufacturing technologies: I.R. Heating, Induction heating systems
4/ Relationships between manufacturing parameters and induced material properties
5/ Tooling development
   - Inorganic matrix composite moulds
   - Carbon/Polymer moulds
   - Tooling instrumentation
6/ Innovative methods for multiscale study of composite materials in composite structures
   - part instrumentation during manufacturing (IRB, MEMS patches)
   - composite separation: new methods, instrumented repair systems, water jet machining
7/ Functionalization of organic matrix composites
   - Improvement of thermal and/or electrical behaviour of polymeric matrices and composites
   - Simulation of physical and mechanical properties of nanofilled composites

MoPP: Materials Properties and Processes

MaPP axis (10 permanent people) addresses the following topics:

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   - Chamferology modelling (TDF), crystallisation of TP and inorganic matrices, Phase diagrams, multiphysics studies
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7/ Functionalization of organic matrix composites
   - Improvement of thermal and/or electrical behaviour of polymeric matrices and composites
   - Simulation of physical and mechanical properties of nanofilled composites

The laboratory is structured into four research groups that are described below and also two transverse axes of research on Machining of Multi-Materials and its Applications. Since January 1st 2015, the laboratory is a CNRS unit (FRE CNRS 3687).

Modelling of Mechanical Systems and Microsystems Group

MSM-group (65 people, PhD students incl.) research topics are oriented towards the development of models and methodologies devoted to the multidisciplinary and multi-scale study of mechanical structures and systems, from the very beginning of the conceptual stage until the ultimate validation/prediction of the structure/system integrity in nominal service and/or when submitted to advenitious events. Scientific activities are grouped in two research axes:

- Systems and Microsystems Engineering
  - Research activities notably aim at developing methods of multidisciplinary optimal design at the preliminary or project stage, in the presence or not of uncertainties. Theoretical and experimental studies are also conducted on the behavior of single phase or two-phase micro-flows encountered inside or generated by microsystems, focusing on specificities induced by high confinement. Design assisting-tools are also developed for dimensioning high technology systems and actuators.
  - Design optimization in multidisciplinary or uncertain environments
  - Microfluidics and mechanical microsystems
  - Onboard systems and actuators

- Metrology, Identification, Control and Monitoring Group
  - Research activities focus on structures and systems both in their nominal use and up to failure conditions. They especially address the nonlinear dynamic response of large structures and complex systems (e.g. rotors), as well as the analysis of structures submitted to accidental overloads (e.g. impact). Current emphases in research are put on structural health monitoring (SHM) and computational methods for strongly nonlinear, structure analysis.
  - Systems and structures dynamics
  - Systems under severe conditions
  - Computational Structural Mechanics

The “Metrology, Identification, Control and Monitoring” group (25 people including PhD students) is dedicated to mechanical and thermal measurements for the characterization of materials and structures (photomechanics), and for process monitoring, and to identification from full-field measurements and NDT/NDE.

The main research topics dealt with by the group are:

- (3D) computer-vision for photomechanics, process control and monitoring, and NDT/NDE
- True temperature measurements by thermography and infrared radiometry
- Modelling of materials/infra-red radiation interaction and characterization of radiative properties
- Instrumentation with Fiber Bragg Grating sensors for strain, temperature and pressure measurements
- Materials and structures characterization and health monitoring using full-field or optical fibre measurements and NDT/NDE techniques
- Identification of constitutive behavior from full-field measurements

A few indicators

Scientific production:
- 20 PhD defended per year and 160 publications per year (peer-reviewed journal papers)

Scientific networks:
- GDR CNRS 2502 "Controle des Decalagements"
- GDR CNRS 2519 "Full-Field Measurements and Identification in Solid Mechanics"
- GDR CNRS 3305 "Micro Nano Systemes, Micro Nano Fluids"
- GDR CNRS 3371 "Composites Manufacturing and Innovated Properties"
- GDR CNRS 3437 "Dynamics of structures and non-linear dynamics approaches"