A study of the multi-axial fatigue damage mechanisms for a glass fiber reinforced thermoplastics (PA66GF30)

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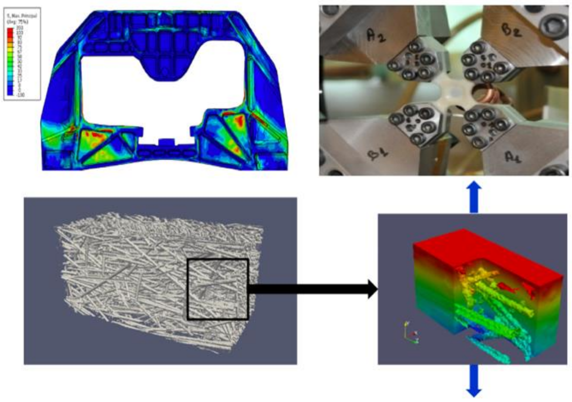

- Identify the behavior laws with their service conditions being taken into account
- Better understand the damage mechanisms with a multi-scale approach
- Establish a multi-axial fatigue criterion to predict their lifetime

Abstract:

Thermoplastics reinforced with fibers which have a good compromise of density and performances are increasingly used to replace metals in both aeronautical and automotive applications. In particular, the use of these materials under the hood allows weight reduction in vehicles and as a consequence a reduction of energy consummation and CO2 emissions. In order to be able to predict the lifetimes of such structures under their condition of service (multi-axial dynamic loads, temperatures up to 100°C, humidity), it is necessary to bring a better understanding of the damage mechanisms which can arise and the constitutive equation which describe them. Then, this study aims to predict the behavior of a given structure under cyclic loading by establishing the damage criteria related to the evolution of the microstructure:

- at macroscopic scale: biaxial tensile fatigue tests were realized in order to predict the fatigue life and to quantify the parameters of a behavior law based on a visco-elasto-plastic damageable rheology model, as well as to take into account the influence of temperature/humidity/solicitation frequency and the influence of internal variables of the material which are responsible for its damage.
- at microscopic scale: in order to improve the understanding of the damage mechanisms of discontinuously charged polymer composites and to bridge micro-scale damage and macro-scale behavior of composite, fatigue crack was interrupted and was imaged post-mortem by synchrotron X-ray tomography.