Composite sandwich materials offer significant advantages over traditional engineering materials, combining low mass with enhanced stiffness and strength. This makes sandwich materials a very attractive option for engineering applications, where the weight is a critical factor like aircrafts, airspace and high-speed vehicles, sport and medical equipment, etc. The mechanical strength and reliability of composite sandwich panels extremely depend on quality of the interface between the constitutive material layers so-called skin-to-core interface and its effectiveness in transferring internal loading between the core and the skins. Small violations of the bond at the skin-to-core interface due to external loading and/or aggressive environment could lead to a growth of the initially damage (a debond) and a final disintegration of the sandwich structure.

A role of dynamic crack propagation in determining the overall response and reliability of advanced materials is a key factor to assess accurately the residual strength of damaged structures in order to avoid catastrophic events. In this respect, the fracture processes such as initiation and progression of the debonded region within the skin-to-core interface to eventual failure demand a better understanding in order to enhance damage tolerance prior to fracture and to maintain a load bearing capacity of sandwich structures at both static and especially dynamic loads. Therefore, the development of reliable predictions to assess the mechanical behaviour of sandwich panels subjected to dynamic loads is of critical importance to ensure their durability and safety in usage. Moreover, because the results of predictions highly depend on the material data used in the model, reliable experimental techniques, including both the fracture tests and numerical data treatments, should be used for extracting the material fracture parameters prior to the simulations.

This project seeks to address the problem of dynamic fracture of sandwich structures by using analytical-numerical methods and supplied experimental data to improve the ability of accurate and realistic predictions of the behaviour of debonded composite sandwich structures under real-life dynamic working environment in the design stage. The main emphasis is focused on examining new failure models taking place in debonded sandwich composites subjected to dynamic loading and, then, modelling them using the finite element approach. The influence of inertial effects on near-field stress around crack tip, and far-field stress state and deformed form of the studied structure as well as velocities of crack propagation are going to be analysed for both static loading and short-term transient and harmonic dynamic loads. A reliable experimental testing of sandwich specimens for extracting required material parameters and for the sake of comparative purposes is also one of main goals of the project. In the research an advanced tool such as Digital Image Correlation System ARAMIS is applied for tracking fracture test specimens. On the other hand, through the analyses of the test specimens, it is possible to demonstrate adequacy of fracture models developed in the project based on the finite element method to the real dynamic crack propagation phenomenon. As well the use of ARAMIS allows us to get advancement in understanding the singular stress filed in the vicinity of crack tip along the bi-material interface under dynamic loading. In turn it gives us to increase the accuracy of the method proposed for modelling because various real-like effects can be incorporated into the model.