DESCRIPTION FOR THE GENERAL PUBLIC

The scientific problem aimed to be solved by the proposed project is determine global and local structural disintegration (degradation) due to environmental (cross-relation between moisture and temperature) influence on anisotropic materials. Glass Fibre Reinforced Polymer (GFRP) and Carbon Fibre Reinforced Polymer (CFRP) will be considered and analysed together with their bonding areas (adhesive layer). The proposed tools to solve the present problem will be a combination of modelling methods (Finite Element Method (FEM) and Finite-Difference Time-Domain (FDTD)) and experimental methods (Fibre Bragg Grating (FBG) sensors, Terahertz Time Domain Spectroscopy (THz-TDS) and infrared thermography imaging (IRT)). The FEM models allow to determine strain distribution due to environmental factors influence. The interaction between THz radiation and investigation material will be modelled using the FDTD method. The FBG sensor method will be used for strain changes measurements and determination of damage occurrence development. THz-TDS and IRT allow to observe internal structure of materials under structural disintegration.

Due to environmental factors the structural disintegration can occur. Changes in material structure results in decreasing of its mechanical strength can occur even the sample seems to be intact. Anisotropic materials (fibre reinforced polymers) consist of minimum two components with different chemical and physical properties. Newly-made material properties are not a sum or average of individual components properties. Anisotropic material exhibits different material properties in different direction that results in its different behaviour during exposition on different environmental features. Composite elements are widely used for load carrying structures in aircraft, marine, civil engineering. Mechanical strength of composite materials are very high while their weight is relatively small. But any damage occurrence (matrix cracking, fibre-matrix debonding, delamination, and fibre fracture) results in degradation of its mechanical properties. One of the problems that have to be solved is determination of temperature range where the material can be used without influence on its mechanical strength. Disadvantage of polymers used in composites matrix is their tendency to absorb moisture from ambient. Structural disintegration can be a result of negative/elevated temperature influence, especially in combination with moisture.

The pioneering nature of the project a combination of experimental and modelling methods to analyse disintegration processes occurs in anisotropic materials due to environmental conditions. Advantage of experimental methods is their small interaction with investigated material. Development of combination of the method mentioned above allows to better understand the behaviour and posses knowledge of cross-relation between moisture and (negative/elevated) temperature influence for an anisotropic materials. Possibility of modelling and disintegration level determination of anisotropic materials with complex internal structure (e.g. composite frequently used in many industrial branches) are very important from economic and societal point of view. In many cases very important are safety needs referred to structure maintenance, transport of people and goods. Additionally any failure occurrence results in costs needs to repair the damaged structure. On the other side it can results in environmental contamination (ecological catastrophe).