TOP TEN

Panayiotis Tsokanas
University of Patras

Category: **Airborne** | Country: **Greece**

Research Area 3: **Innovative Infrastructure for Europe 2030** | Idea Number: **58**

Fracture analysis of non-conventional layered structures: a novel framework

Inspired by a tangible problem in the aerospace industry, this project proposes an analytical framework—currently being developed by the author for the fracture analysis of hybrid structures with a beam geometry. The structural elements under consideration may feature several peculiarities: they may consist of multiple layers of dissimilar materials; they may have asymmetries in thicknesses; they may feature elastic couplings; they may contain environmental stresses; they may be loaded by a multitude of mechanical loads; etc. The technological problem that sparked the study concerned the fracture analysis of a titanium and Carbon Fiber Reinforced Plastic (CFRP) to be applied in the Hybrid Laminar Flow Control system of future aircraft. With this problem as a springboard, the project proceeded to build a generic analytical theory for the determination of the fracture toughness of beam structures with all the peculiarities mentioned above. Classical theories of the mechanics discipline (e.g., beam theory, mechanics of composite materials, energy methods) and important tools in the field of fracture mechanics (J-integral, crack-tip element, crack closure integral, etc.) were employed during developing this novel framework. After extensive literature review, the proposed analyses and solutions extend the existing level of knowledge, and provide the possibility of studying a variety of new geometries, hybrid material systems, different testing setups, etc. All new solutions were confirmed based on thorough numerical analyses. A handful of experimental, analytical, and computational studies of the fracture toughness of various material systems and configurations have been carried out, and many of them have already been published in scientific journals.