Abstract

Unmanned Aerial Vehicles (UAVs) have had a significant increase in popularity in recent times, being utilized in many industrial and recreational applications. Military operations, recording movies and pictures from above, keeping an eye on dangers like fires, mapping land, evaluating crops, and search and rescue operations are just some of the many things that these devices can be used for. The intended function of a UAV can differ based on its design, shape, method of power transmission, and duration of flight. The scientific topic addresses the complexity of constructing laminated composite structures, requiring careful specification of various variables for each ply and consideration of multiple design criteria such as mass, stiffness, and buckling. Traditional design approaches frequently produce inferior solutions because they rely on engineering heuristics. This study promotes rational analysis and design methodologies, which enable an automated and optimized design process that continuously improves to efficiently satisfy operational requirements.

The major goal is to use optimization approaches based on classical laminate theory to discover the most effective stacking sequence, resulting in higher performance metrics while drastically reducing the overall weight of the composite structure. This weight reduction is critical for increasing UAV endurance and fuel efficiency, as lighter structures use less energy during flight. The doctoral dissertation includes two case studies: T-joint structural analysis and sandwich core optimization approaches.

During work related to the doctoral thesis, four distinctive T-joint geometrical models were developed and analysed with different material, thickness, and shape, which were included in the doctoral dissertation as one of the case studies. The study involved the fabrication and optimization of a prototype bio-composite material with a focus on environmental sustainability.

The optimized results from the genetic algorithm by Ansys were also verified with laboratory tests. The results achieved are suitable for aerospace applications and especially designed for UAV structures. This eco-friendly material enhances the structural integrity of composites while aligning with broader initiatives aimed at reducing the environmental impact of aerospace engineering.