# Utilization of Topology Optimization and Generative Design for Drone Frame Optimization

Michał Kowalik, Michał Śliwiński, Mateusz Papis
Institute of Aeronautics and Applied Mechanics, Faculty of Power and Aeronautical Engineering,
Warsaw University of Technology, Nowowiejska 24 Street, 00-665 Warsaw, Poland

Abstract:

This study presents the process of optimizing a DJI F450 quadcopter using two optimization methods: topology optimization and generative design. The goal was to improve the overall performance of the unmanned aerial vehicle by altering its geometry and comparing the use of different materials. The primary objective was to reduce the mass of the original DJI F450 frame by 10%.

To enable optimization using both methods, modifications were made to the original DJI F450 frame. A total of five cases were prepared: one for the original DJI F450 frame, three for topology optimization, and one for generative design. Appropriate constraints were applied to simulate the real-world forces acting on the drone during flight.

The various optimized frame designs underwent static analysis to evaluate stress, strain, displacement, and safety factors. These results were then compared with those of the original DJI F450 frame, which also underwent static analysis. The comparison focused on the performance and mass of the original frame versus the optimized versions.

The results revealed that the optimized DJI F450 frames (Fig. 1) could achieve improved performance under flight-like load conditions, with reduced mass and comparable stress and strain levels. This demonstrates that engineering optimization, combined with additive manufacturing, can yield superior results, producing lighter, more capable organic structures compared to traditional frames.

a) b) c)

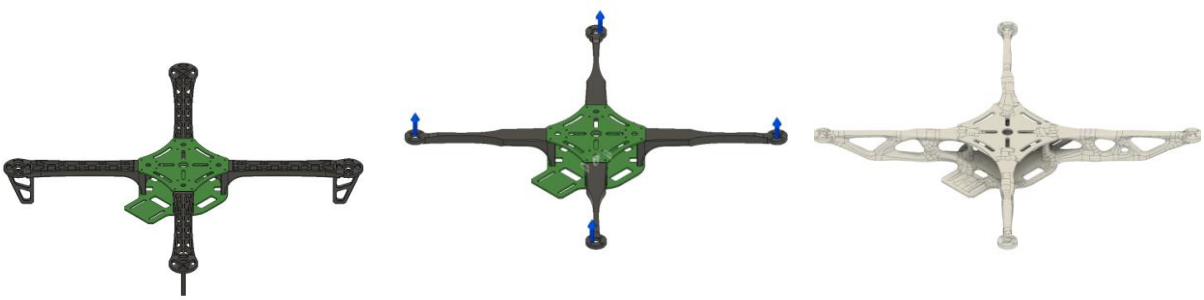

Fig. 1. DJI F450 frame: a) initial geometry, b) after topology optimization, c) using generative design