Did you know...?

Topology optimisation is a mathematical approach that optimises material layout within a given design space, for a given set of loads and boundary conditions.

Objective:

To use Topology Optimisation to reduce the weight of a pair of brackets that is designed to carry payloads on an UAV, in order to achieve a more energy efficient flight without compromising the natural frequency.

Approach

- **Phase 1:** Input 3D CAD
- **Phase 2:** Find the first natural frequency using modal analysis
- **Phase 3:** Topology Optimisation
- **Phase 4:** Find the best combination of parameters
- **Phase 5:** Update the new 3D CAD model until its weight and natural frequency reaches the optimised target
- **Phase 6:** Check the first natural frequency of updated part
- **Phase 7:** Design finalisation

Results and Discussion

The simulation result obtained from topology optimisation shows the stress densities of the elements (Figure 1):

- Red colour: 1
- Blue colour: 0
- Other colours: between 0 and 1.

The optimisation results showed that:

- Most elements in the front and back plates have stress densities close to 1 during the vibration motion.
- Some elements in the left, right and bottom plate have density close to 0 indicating minimal contributions to the stiffness.

From the analysis, a new 3D CAD model of the bracket is designed (Figure 2) where areas with stress density close to 0 are removed.

Conclusion:

In total, three versions of models were created. The version 3 model (Figure 3) presented the best simulation results: 19.4% weight reduction and only 2.2% of natural frequency decrease.