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QUADROTOR FRAME TOPOLOGY OPTIMIZATION: ANSYS DISCOVERY VS FUSION GENERATIVE DESIGN

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Abstract

This study compares topology optimization of an additively manufacturable quadrotor frame using ANSYS Discovery (level-set) and Autodesk Fusion Generative Design under a shared domain, loads, supports, and printing guards: minimum-compliance objective, nominal mass target, 45° overhang limit, and 1.5 mm minimum thickness. In Discovery, increasing the volume-reduction target from 95 to 98 percent yields progressively truss-like morphologies and reduces modeled mass from 3.91 to 1.47 kg while approaching the thickness guard. In Fusion, varying *outcome resolution and adding an explicit deflection constraint expose stiffness–mass trades: at nearly equal mass around 0.31–0.32 kg, predicted static deflection drops from 17.86 to 9.824 mm when lowering outcome resolution; enforcing a maximum-deflection requirement increases mass to 0.596 kg and lowers deflection to 1.496 mm. Absolute cross-solver masses are not directly comparable due to modeling and reporting differences, yet the trends show that solver settings can shift stiffness substantially without large mass penalties and that aggressive pruning risks manufacturability. The present baseline uses a single 2g vertical load and a fixed center of gravity. Future work will introduce combined load cases and CG variation and will validate and extend the workflow with ANSYS Mechanical static structural analysis and optimization.*

Keywords:

Topology Optimization, Drone, Quadrotor, ANSYS Discovery, Generative Design

1. Introduction

The structural configuration of unmanned aerial vehicle (UAV) frames strongly influences efficiency and mission performance. Quadrotors are particularly sensitive to structural weight and its distribution because of their compact geometry and diverse use cases such as mapping, inspection, and delivery; mass placement affects endurance, agility, payload capacity, and vibrational stability. As UAVs evolve toward mission-specific and payload-flexible roles, application-oriented structural optimization becomes essential. Topology optimization (TO) algorithmically removes material from low-stress regions to minimize weight while maintaining stiffness (Qu et al., 2022). Generative design (GD) explores multiple admissible geometries under user-defined constraints for loading, stiffness, and manufacturability (Balayan et al., 2024).

Recent studies demonstrate the promise of TO and GD for UAV structures. TO has produced lightweight airframes with tailored material distributions (Martinez Leon et al., 2021; Qu et al., 2022), and GD in Autodesk Fusion has yielded frames that outperform standard configurations in weight and stiffness (Bright et al., 2021). Table 1 summarizes representative works, including GD plus structural sizing for cargo drones (De Freitas Francisco & Calle Gonzales, 2022) and GD–TO hybrids for agricultural platforms (Balayan et al., 2024). A common limitation across these studies is the assumption of fixed locations for payloads and subsystems. In practice, vertical and planform movement of batteries, sensors, and cargo shifts the center of gravity (CG) and alters load paths through the frame. For example, Martinez Leon et al. (2021) and Qu et al. (2022) optimize with centrally located payloads, and Bright et al. (2021) compares generative and traditional designs with a fixed payload plane. Systematic treatment of CG variability remains underexplored.

The present paper establishes a controlled comparative baseline before addressing that gap. We hold a common domain, boundary conditions, and additive-manufacturing guards, and we contrast two solver families—ANSYS Discovery (level-set TO) and Autodesk Fusion Generative Design—on how their formulations and settings steer material allocation, mass, and predicted stiffness under a single 2g vertical load case with a fixed CG. This design allows a like-for-like assessment of stiffness–mass–manufacturability trade-offs under shared printing limits, namely a 45° overhang constraint and a 1.5 mm minimum thickness. The outcomes reported here provide calibration data for subsequent expansions of the workflow.

The broader research program will extend this baseline by introducing a non-dimensional vertical CG parameter λ to model component and payload shifts, by replacing the idealized single-axis load with realistic combined load cases, and by adding verification and higher-fidelity optimization in ANSYS Mechanical through static structural analysis and solver-internal optimization. In this way, the present comparison covers part of the literature gap—how solver choices under shared constraints affect topology and stiffness at a given mass—while the remaining gap on CG variability is explicitly reserved for future work.

$$\lambda_{component} = \frac{h_{component}}{wheelbase} \tag{1}$$

Table 1: *The Scopes of Current Studies in the Field*

Ref.	Optimization Method	Focus	Component CG Variations Considered?
(Martinez Leon et al., 2021)	Topology Optimization	Lightweight quadcopter frame	No
(Qu et al., 2022)	TO + FEA	UAV frame under multi-load conditions	No
(Balayan et al., 2024)	GD + TO	Agricultural drone chassis design	No
(Bright et al., 2021)	GD (Autodesk Fusion)	Comparative study vs. DJI F450 frame	No
(De Freitas Francisco & Calle Gonzales, 2022)	GD + Structural Sizing	Cargo drone airframe generation	No

Section 2 presents the methods, the modelling assumptions, material selection, manufacturing guards, solver configurations, and related literature. Section 3 presents the comparative results for ANSYS Discovery and Autodesk Fusion GD under the shared setup. Section 4 concludes with the main takeaways and outlines future work on CG variability.

2. Materials and Methods

This paper establishes a controlled comparative study for a quadrotor UAV frame using two optimization paradigms (ANSYS Discovery (level-set topology optimization) and Autodesk Fusion Generative Design) under a fixed center of gravity (CG) and a single 2g vertical load case, with shared additive-manufacturing guards. The study has several phases and, in this study, Phase I will be covered.

Phase I — Present Study (Comparative Baseline, Fixed CG, 2g-Z Load)

Step 1 — Problem definition (common to both solvers).

Define the optimization domain from the simplified quadrotor frame; fix the central hub; apply four upward thrust loads at motor pads; set material to PLA (see material Table 1); enforce additive manufacturing guards.

Step 2 — ANSYS Discovery (Level-set TO) sweep.

Run a parameter sweep on volume-reduction target (e.g., 95%, 97.5%, 98%) under minimum-compliance objective and the guards from Step 1. Export optimized geometries.

Step 3 — Autodesk Fusion Generative Design sweep.

With the same domain, loads, supports, and guards, vary outcome resolution (e.g., High, Low) and include one

case with an explicit maximum-deflection requirement. Export optimized geometries and solver metrics.

Step 4 — Metrics and Comparisons.

For each case, record: final mass, predicted stiffness proxy (compliance/deflection), feature-thickness compliance

(≥ 1.5 mm), implied printability with the 45° limit, and qualitative load-path morphology. Compare Discovery and

Fusion trends under the shared setup.

2.1 Background

In the literature, the traditional density-based approach to topology optimization is commonly referred to as the Solid Isotropic Material with Penalization (SIMP). In addition to this widely used approach, other notable topology optimization methods include the level-set method (Allaire et al., 2002), evolutionary structural optimization (ESO), topological derivatives, and the phase-field method (Tyflopoulos & Steinert, 2020). The level-set method (LSM) is selected for topology optimization because of its effectiveness and the relative ease it offers during postprocessing. Compared to traditional density-based approaches, LSM generates smooth and well-defined boundaries, which significantly simplifies the transition to computer-aided design (CAD) models and manufacturing processes. In addition, the level-set method is mesh-independent and naturally circumvents checkerboard discontinuities that commonly arise in traditional optimization methods (Tyflopoulos & Steinert, 2020). The level-set method is a boundary tracking technique used to represent and capture moving interfaces. In this approach, the material or structural domain is represented by a level-set function f(x) or ϕ(x), which defines the interface between different regions.

The material distribution can be expressed as:

$$\rho = \begin{cases} 0, & : \phi < 0 \\ 1, & : \emptyset \geq 0 \end{cases}$$

Here, ρ denotes the material property (e.g., density), while $\phi(x)$ is the level-set function that distinguishes one region from another. The level-set function $f(x)$ is typically constructed using nodal values and interpolation over the computational domain.

The boundary or interface corresponds to the zero level-set, given by:

$$\phi(x) = 0$$

In this study, ANSYS Mechanical 2021 R2 will be employed to implement the level-set topology optimization, leveraging its capability to produce optimized geometries that integrate seamlessly with CAD systems and facilitate efficient manufacturing workflows (Satya Hanush & Manjaiah, 2022).

2.2 Tool Descriptions

2.2.1 ANSYS Discovery Topology Optimization

We employ ANSYS Discovery's level-set topology optimization to evolve the quadrotor frame under a fixed center of gravity and a single 2g vertical loading scenario. The design space is the extruded prism derived from the simplified planform, with the central hub fully fixed and equal upward thrusts applied on the motor pads (see Figure 1). The objective is minimum compliance (maximize stiffness) subject to prescribed material removal, a classical formulation established by Bendsøe & Kikuchi (1988) and widely used in aerospace structures (Nobel-Jørgensen et al., 2016). Discovery's level-set representation updates the boundary implicitly to produce smooth, well-defined members that ease CAD handoff and downstream manufacturing—key practical advantages of level-set methods over density-based SIMP noted in the literature (Allaire et al., 2002; Tyflopoulos & Steinert, 2020). Common additive-manufacturing guards are enforced in all runs: a 45° overhang limit and a 1.5 mm minimum feature thickness; material is PLA as specified in the Materials section.

To interrogate solver behavior while holding loads, supports, and guards constant, we sweep the volume-reduction target across representative values (95%, 97.5%, 98%). Each run starts from the same domain and terminates when Discovery's convergence tolerances on compliance change and volume target are satisfied. Discovery outputs smoothed, CAD-ready geometries and solver metrics (including final mass), which we use as calibrated concepts for cross-solver comparison in this baseline study. Higher-fidelity validation and optimization will follow in ANSYS Mechanical under identical boundary conditions (Satya Hanush & Manjaiah, 2022), alongside future extensions to combined load cases and CG variation.

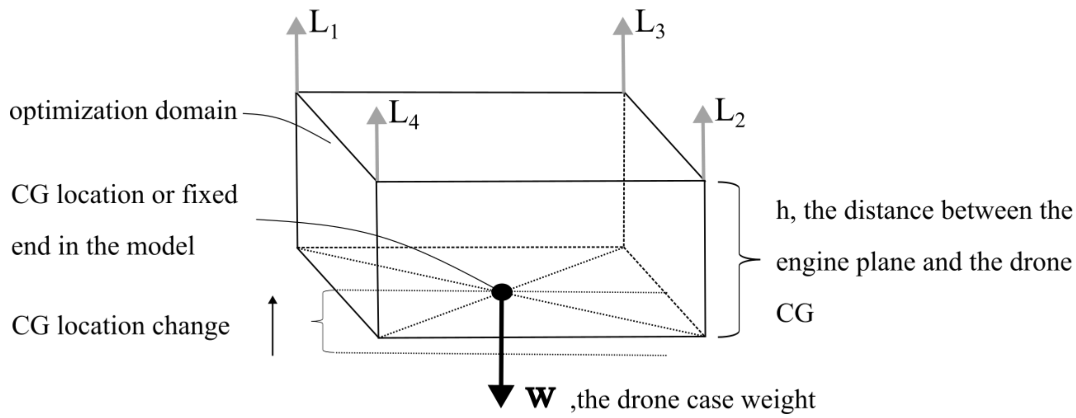

Figure 1: *The Optimization Domain and Boundary Conditions*

2.2.2 Autodesk Fusion Generative Design

Generative design (GD) is an AI-driven design process that autonomously explores structurally efficient geometries based on user-defined constraints such as loads, supports, materials, and manufacturing methods. Implemented in Autodesk Fusion, GD uses evolutionary algorithms and cloud-based solvers to evaluate and refine thousands of candidate geometries, optimizing metrics such as stiffness-to-weight ratio while ensuring manufacturability (Regenwetter et al., 2022). In the context of UAV structures, this method enables the creation of novel frame geometries that respond adaptively to internal load paths. (Bright et al., 2021) demonstrated the effectiveness of GD for quadcopter frames under static loading conditions, but their study assumed a fixed payload location and center of gravity, limiting its applicability to reconfigurable or mission-adaptive UAVs. In contrast, the present study introduces parametric variation in vertical payload location to evaluate GD's response to shifting load distributions, offering new insights into the structural adaptability of drone frames for modular and dynamic applications.

2.3 Study Variables

In this baseline study, the center of gravity (CG) is held fixed to isolate solver effects under a single 2g vertical loading scenario. The CG is located at the geometric center on the propeller plane ($\lambda = 0$), while the central hub is fully constrained. Four equal upward thrust loads are applied at the motor pads, L1=L2=L3=L4=8.83 N, representing the 2g ascending condition used consistently in both ANSYS Discovery and Autodesk Fusion runs. This fixed-CG setup matches the scope of the current results and enables a like-for-like comparison of stiffness–mass–manufacturability trade-offs under shared additive-manufacturing guards (45° overhang, 1.5 mm minimum thickness).

As part of the broader research program, the vertical CG position will be varied using the non-dimensional parameter $\lambda \in [-1,1]$, thereby changing the moment arms and load paths while keeping the thrusts at the four corners. Those CG-variation cases and their implications for optimal topology are reserved for future work and are not included in the present results.

2.4 Baseline Quadrotor

Popular baseline drone frames from specific categories will be selected as a baseline. One of the reference UAVs is a quadrotor drone with the following configuration:

- Maximum Take-off Mass (MTOM): 1800 g
- Estimated Frame Weight (Target): 280 g (~15% of MTOM)
- Payload and Components: 1520 g
- Propeller Layout: Square configuration, 450 mm wheelbase (diagonal)
- Thrust per Propeller (2g ascending case):

$$L_1 = L_2 = L_3 = L_4 = F_{Prop} = \frac{m2g}{4} = \frac{1.8x2x9.81}{4} = 8.83\ N$$

2.5 Solver Setups

The geometry of the baseline quadrotor is simplified, and its 2D top view is shown in Figure 2. The electric motors are represented by 41 mm-diameter circles, and the main body is represented by a 75 mm-diameter circle. The frame planform is a square with a 512 mm diagonal, and the motor circles are tangent to the square's edges. The wheelbase is 450mm.

The optimization volume is generated from the 2D drawing in Figure 2. The 2D profile is extruded to 500 mm, as shown in Figure 3. The central 75 mm circle is fully fixed, and loads are applied to the four 41 mm motor circles. Each applied load is 8.83 N, as described above.

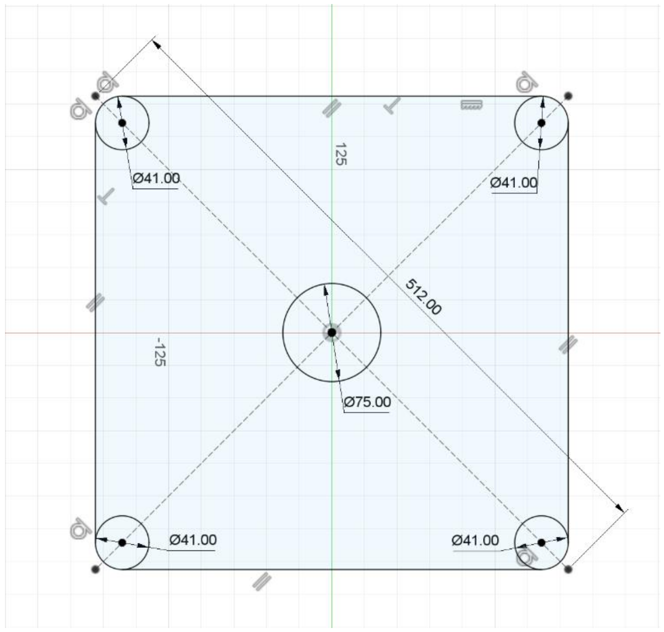

Figure 2. *2D Top View of the Simplified Geometry of the Baseline Quadrotor*

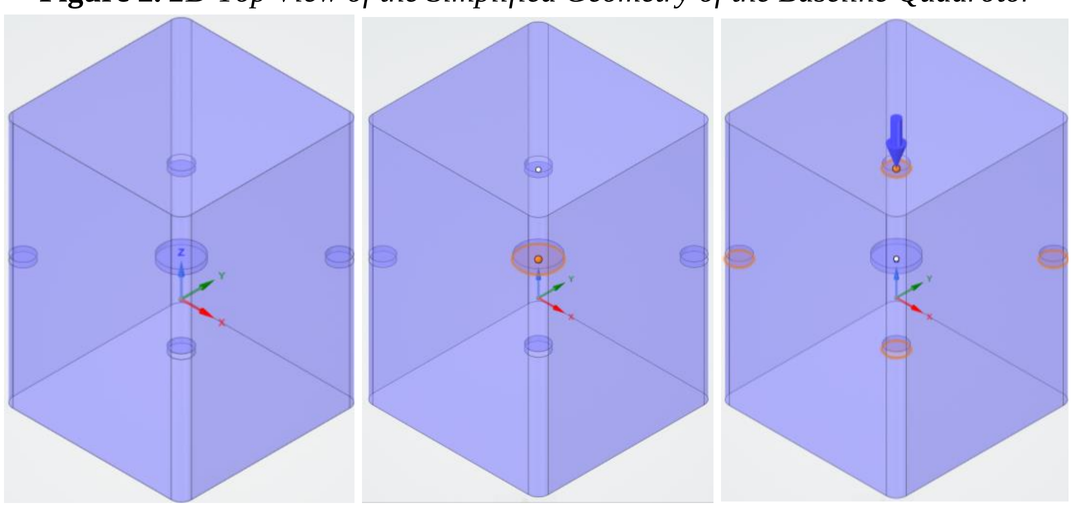

Figure 3. *From Left to Right, The Figures Show the Optimization Volume, The Fixed Support Location, and The Load Application Surfaces used in ANSYS Discovery and Autodesk Fusion*

2.6 Materials

The material Polylactic acid (PLA) was selected for this analysis due to its suitability for additive manufacturing and its ability to produce functional parts with adequate mechanical properties for prototyping purposes. The material properties are presented in Table 2.

Table 2. *Mechanical Properties of a Commercial PLA (Farah et al., 2016)*

PLA	Tensile strength (MPa)	Elastic Modulus (MPa)	Young's Modulus (MPa)	Shear Modulus (MPa)	Yield Strength (MPa)	Elongation at break
	59	3500	1280	1287	70	7%

3. Results and Discussion

Here we report the topology-optimization outcomes for a common quadrotor frame under two solver families, ANSYS Discovery (level-set topology optimization) and Autodesk Fusion Generative Design, using the same domain, loads, and supports. This chapter documents the optimized geometries produced under controlled parameter sweeps and compares how solver formulations and constraints steer load-path formation, mass, and predicted stiffness. Results are organized as image sets for the ANSYS runs (Figures 4–6) and Fusion runs (Figures 7–9), with Tables 2 and 3 consolidating the case definitions and quantitative outcomes for each solver.

For a like-for-like comparison, both solvers were configured with the same baseline targets and manufacturing guards: objective set to maximize stiffness (minimum-compliance), a nominal mass target, a 45° overhang limit, and a 1.5 mm minimum thickness. Tables 2 and 3 list the optimization objectives used in each case alongside the reported final masses and, for Fusion, the predicted tip deflections. These common inputs allow the figures and tables to be read together as a controlled comparison of how each solver allocates material to principal load paths.

Within this framework, the ANSYS set varies the volume-reduction target, which progressively prunes noncritical material and lowers mass from 3.91 kg to 1.47 kg across Disc-Case-1 to Disc-Case-3 (Table 2), while the Fusion set varies outcome resolution and, in one case, applies a maximum-deflection requirement that trades higher mass for markedly lower deflection (Table 3). The figures provide the optimized morphologies, and Tables 2 and 3 anchor the discussion that follows by quantifying the stiffness–mass trade-offs observed in each family of runs.

3.1 Ansys Discovery Results

The ANSYS Discovery study varies the volume-reduction target while holding the load and support definition and manufacturing guards fixed, namely a stiffness-maximizing objective, a nominal mass target, a 45° overhang limit, and a 1.5 mm minimum thickness. The domain is fixed at the central hub and loaded at the four motor locations, as shown earlier, so principal load paths are expected to form between the motor pads and the hub.

Table 3. *Results of ANSYS Discovery Topology Optimizations*

Case No	Optimization Objective	Final Mass
Disc-Case-1	%95 Volume Reduction	3.91 kg
Disc-Case-2	%97.5 Volume Reduction	1.91 kg
Disc-Case-3	%98 Volume Reduction	1.47 kg

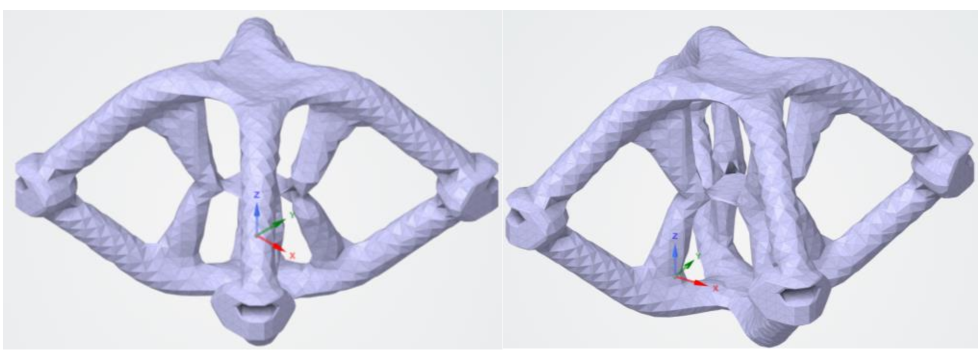

Figure 4. *The Optimized Geometry with 95% Volume Minimization Objective (Disc-Case-1)*

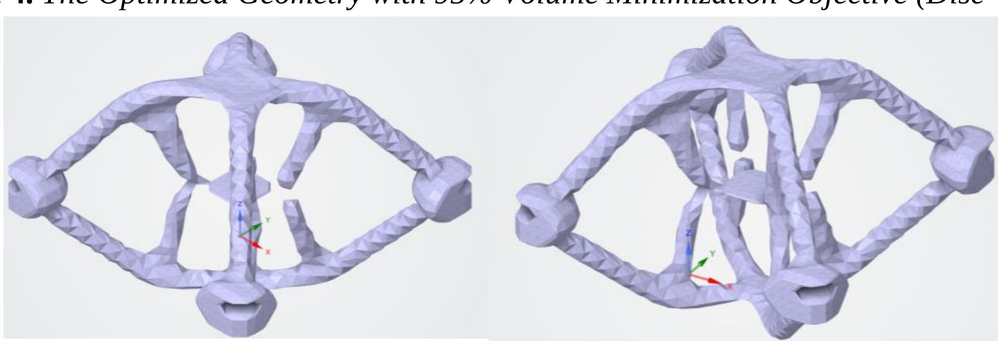

Figure 5. *The optimized geometry with 97.5% volume minimization objective (Disc-Case-2)*

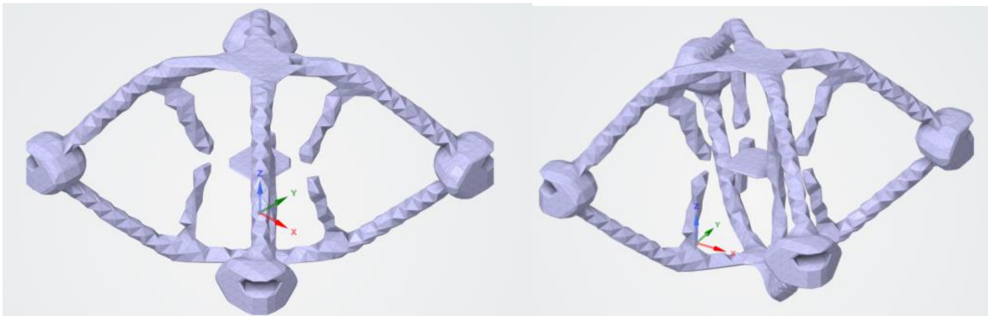

Figure 6. *The optimized geometry with 98% volume minimization objective (Disc-Case-3)*

Across the three cases, increasing material removal produces a consistent morphological progression toward slender, truss-like webs that concentrate material along those principal paths. The 95% case preserves relatively broader members, while the 97.5% and 98% cases progressively thin secondary regions and open larger voids, leaving a more lattice-like skeleton that channels stiffness where it is most effective. These visual trends correspond to Figures 4–6. The quantitative response is monotonic: final mass drops from 3.91 kg at 95% removal (Disc-Case-1) to 1.91 kg at 97.5% (Disc-Case-2) and 1.47 kg at 98% (Disc-Case-3). While the absolute values reflect the modeled domain and material assumptions, the relative trend confirms that higher removal targets prune noncritical regions without disrupting the primary load paths defined by the boundary conditions. These results are summarized in Table 2 and illustrated in Figures 4–6.

Table 4. *Results of Autodesk Fusion Topology Optimization*

Case No	Optimization Objective	Final Mass, kg	Deflection, mm
Fusion-Case-1	High (70%) Outcome Resolution	0.311	17.86
Fusion-Case-2	Low (30%) Outcome Resolution	0.317	9.824
Fusion-Case-3	Low (30%) Outcome Resolution with Maximum Deflection of 1 mm Constraint	0.596	1.496

From a manufacturability standpoint, pushing to 98% removal creates members that approach the 1.5 mm minimum thickness and rely on print orientations that respect the 45° overhang limit. In practice, this suggests that the most aggressive case may demand tighter process control or modest local thickening and filleting at junctions, whereas the 95–97.5% range offers a more forgiving balance between mass reduction and print robustness under the stated constraints.

3.2 Autodesk Fusion Generative Design Results

The Fusion study explores three configurations under the same domain, loads, supports, and manufacturing guards used for the ANSYS runs: maximize stiffness (minimum-compliance), nominal mass target, 45° overhang limit, and 1.5 mm minimum thickness. The levers varied are the outcome resolution—set to High (70%) and Low (30%)—and, in one case, an explicit maximum-deflection requirement. Figures 7–9 show the resulting geometries, and Table 3 reports the final masses and predicted static deflections.

At essentially the same mass budget, changing only the outcome resolution shifts stiffness markedly. The High-resolution case (Fusion-Case-1) converges to 0.311 kg with a predicted deflection of 17.86 mm, whereas the Low-resolution case (Fusion-Case-2) is 0.317 kg yet lowers deflection to 9.824 mm, a reduction of about 45% relative to the High-resolution outcome. This indicates that, for this frame and load path, coarser outcome resolution promotes stiffer load-carrying members at nearly unchanged mass.

Imposing a maximum-deflection requirement produces the expected mass–stiffness trade. The constrained case (Fusion-Case-3) increases mass to 0.596 kg and drops predicted deflection to 1.496 mm—roughly twelve times lower deflection than the High-resolution case—yielding a clearly bulkier yet much stiffer topology consistent with the added constraint. These data anchor the comparative discussion that follows on how solver settings steer material allocation along principal load paths.

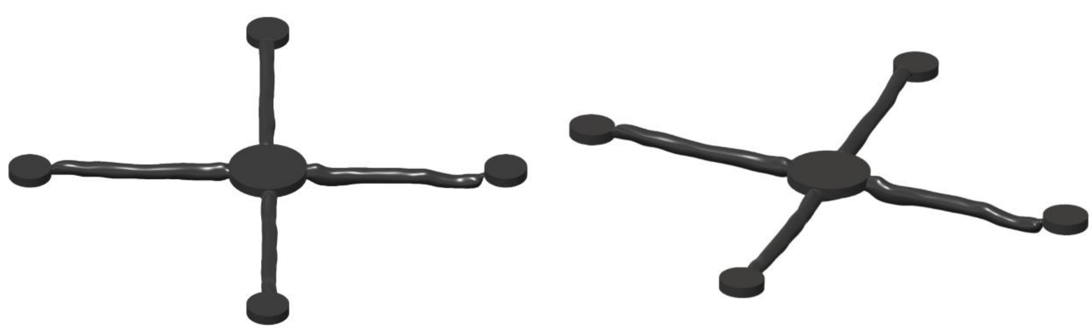

Figure 7. *The Optimized Topology with High (70%) Outcome Resolution (Fusion-Case-1)*

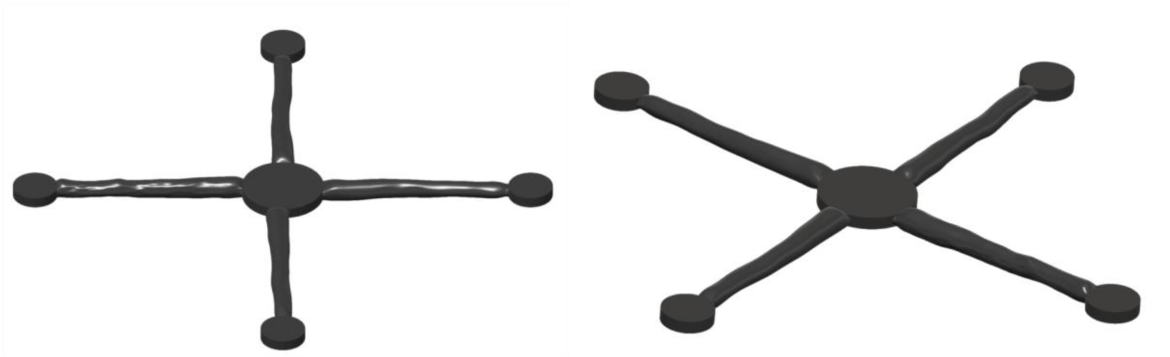

Figure 8. *The Optimized Topology with Low (30%) Outcome Resolution (Fusion-Case-2)*

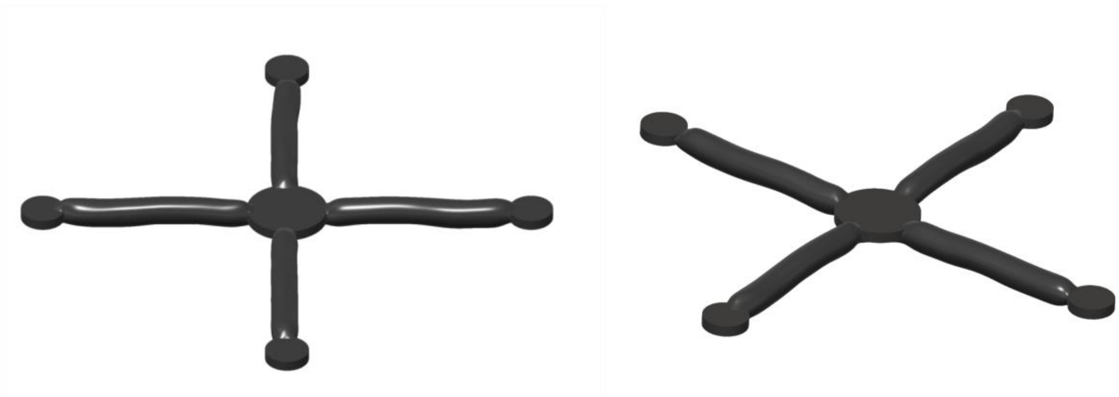

Figure 9. *The Optimized Topology with Low (30%) Outcome Resolution with Maximum Deflection of 1 mm Constraint (Fusion-Case-3)*

3.3 Discussion of the Results

Both solvers were run on the same domain, loads, supports, and manufacturability guards, enabling a controlled comparison of how their formulations steer material into principal load paths. In ANSYS Discovery, the study variable is the volume-reduction target; in Autodesk Fusion Generative Design, the variables are outcome resolution and, in one case, an explicit maximum-deflection requirement. This design of experiments lets us read figures and tables side by side to see how solver settings translate into topology, mass, and stiffness.

Discovery shows a monotonic mass trend with progressively slenderer, truss-like morphologies as removal increases: final mass drops from 3.91 kg at 95 percent removal to 1.91 kg at 97.5 percent and 1.47 kg at 98 percent, while preserving the hub-to-motor load paths. Fusion, by contrast, highlights stiffness sensitivity at nearly constant mass: at about 0.31–0.32 kg, lowering outcome resolution reduces predicted deflection from 17.86 mm to 9.824 mm, and adding a deflection constraint increases mass to 0.596 kg while cutting deflection to 1.496 mm.

These differences underscore that small changes in objectives or resolution can shift stiffness substantially without large mass penalties.

This aggressive volume reduction was intentionally selected because the initial bulk volume of the structure is relatively large, and our design objective emphasizes achieving high geometric flexibility. By imposing a severe mass constraint, we encourage the optimizer to explore highly slender, adaptive configurations while still maintaining the essential load paths between the hub and the motor.

A direct absolute mass comparison across solvers is not yet meaningful because the modeling and reporting conventions differ, but several practical inferences hold. First, Discovery is effective for mapping how aggressive pruning reshapes the load-carrying skeleton under shared printing limits, with the most aggressive case approaching the 1.5 mm thickness guard. Second, Fusion is useful for quantifying stiffness–mass trades at near-fixed mass and for demonstrating how explicit displacement limits drive bulkier yet stiffer topologies. Read together, the two sets outline the stiffness–mass–manufacturability envelope for the present 2g vertical load case and provide a baseline for the planned extensions with combined loads, CG shifts, and validation in ANSYS Mechanical.

4. Conclusion

This study compared topology-optimized quadrotor frame concepts generated with ANSYS Discovery and Autodesk Fusion Generative Design under a common domain, boundary conditions, and manufacturing guards. Within Discovery, raising the volume-reduction target produced the expected morphological progression toward thinner, truss-like webs and a monotonic mass decrease from 3.91 kg to 1.47 kg. Within Fusion, solver settings at nearly equal mass budgets yielded markedly different stiffness: the high-resolution outcome reached 0.311 kg with 17.86 mm predicted deflection, while the low-resolution outcome held mass near 0.317 kg but reduced deflection to 9.824 mm. Imposing an explicit deflection requirement increased mass to 0.596 kg while cutting deflection to 1.496 mm. Taken together, these results show that, under shared manufacturing limits, both solvers channel material into principal load paths and that small changes in solver objectives and resolution can shift stiffness at nearly fixed mass. They also highlight a practical ceiling: aggressive material removal drives members toward the 1.5 mm minimum thickness, which can challenge print robustness and post-processing.

The present work intentionally isolates solver behavior under a single, idealized loading scenario and a fixed center-of-gravity location. Methods and results will be updated in future iterations to reflect more realistic operating conditions and to strengthen confidence in the designs. Planned extensions include: (i) incorporating center-of-gravity shifts from battery and payload placement and quantifying their influence on load paths and final topology, (ii) replacing the current single 2g vertical load case with combined load cases that capture thrust eccentricity, motor torque, landing loads, and lateral components, and (iii) validating the optimized geometries with ANSYS Mechanical static structural analysis using identical boundary conditions. We also plan to run optimization directly in ANSYS Mechanical to cross-check Discovery outcomes, close any modeling gaps, and benchmark compliance and stress distributions against higher-fidelity results.

In summary, the current results provide a controlled baseline that clarifies how solver choices and constraints steer mass–stiffness trade-offs for an additively manufacturable quadrotor frame. The forthcoming updates will broaden the load envelope, account for CG variability, and add verification and higher-fidelity optimization in ANSYS Mechanical, moving the workflow from comparative concept generation toward design validation and down-selection.

References

Allaire, G., Jouve, F., & Toader, A.-M. (2002). A level-set method for shape optimization. *Comptes Rendus. Mathématique*, *334*(12), 1125–1130. https://doi.org/10.1016/S1631-073X(02)02412-3

Balayan, A., Mallick, R., Dwivedi, S., Saxena, S., Haorongbam, B., & Sharma, A. (2024). Optimal Design of Quadcopter Chassis Using Generative Design and Lightweight Materials to Advance Precision Agriculture. *Machines*, *12*(3), 187. https://doi.org/10.3390/machines12030187

Bright, J., Suryaprakash, R., Akash, S., & Giridharan, A. (2021). Optimization of quadcopter frame using generative design and comparison with DJI F450 drone frame. *IOP Conference Series: Materials Science and Engineering*, *1012*(1), 012019. https://doi.org/10.1088/1757-899X/1012/1/012019

De Freitas Francisco, J. V., & Calle Gonzales, M. A. (2022). GENERATIVE DESIGN OF A CARGO DRONE. *Proceedings of the 8th International Symposium on Solid Mechanics*. 8th International Symposium on Solid Mechanics. https://doi.org/10.26678/ABCM.MECSOL2022.MSL22-0074

Farah, S., Anderson, D. G., & Langer, R. (2016). Physical and mechanical properties of PLA, and their functions in widespread applications—A comprehensive review. *Advanced Drug Delivery Reviews*, *107*, 367–392. https://doi.org/10.1016/j.addr.2016.06.012

Martinez Leon, A. S., Rukavitsyn, A. N., & Jatsun, S. F. (2021). UAV Airframe Topology Optimization. In A. A. Radionov & V. R. Gasiyarov (Eds), *Proceedings of the 6th International Conference on Industrial Engineering (ICIE 2020)* (pp. 338–346). Springer International Publishing. https://doi.org/10.1007/978-3-030-54814-8_41

Nobel-Jørgensen, M., Malmgren-Hansen, D., Bærentzen, J. A., Sigmund, O., & Aage, N. (2016). Improving topology optimization intuition through games. *Structural and Multidisciplinary Optimization*, *54*(4), 775–781. https://doi.org/10.1007/s00158-016-1443-0

Qu, J., Dong, Y., Gu, X., & He, S. (2022). Integrated Frame Topology Optimization Design of Small Quadrotor UAV. *Journal of Physics: Conference Series*, *2292*(1), 012016. https://doi.org/10.1088/1742-6596/2292/1/012016

Regenwetter, L., Nobari, A. H., & Ahmed, F. (2022). *Deep Generative Models in Engineering Design: A Review* (No. arXiv:2110.10863). arXiv. https://doi.org/10.48550/arXiv.2110.10863

Satya Hanush, S., & Manjaiah, M. (2022). Topology optimization of aerospace part to enhance the performance by additive manufacturing process. *Materials Today: Proceedings*, *62*, 7373–7378. https://doi.org/10.1016/j.matpr.2022.02.074

Tyflopoulos, E., & Steinert, M. (2020). Topology and Parametric Optimization-Based Design Processes for Lightweight Structures. *Applied Sciences*, *10*(13), 4496. https://doi.org/10.3390/app10134496