CAD Final Project:

Parametric Modeling and Assembly of a Drone in Siemens NX

Presented by Adam Skarre

Team Overview

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Agenda

01

Introduction of the Project

Project Overview

- Modeled a drone using Siemens NX to demonstrate advanced parametric modeling and assembly techniques.

Objective

- Create a functional 3D model with over 10 non-trivial parts, including subassemblies, fully constrained sketches, and rendered images.

Key Features

- Parametric assembly variations to showcase design flexibility.
- High-resolution rendered images, including translucent views for internal components.

This drone is the inspiration for my project.

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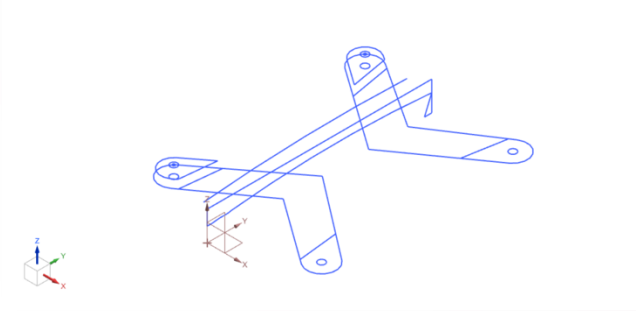
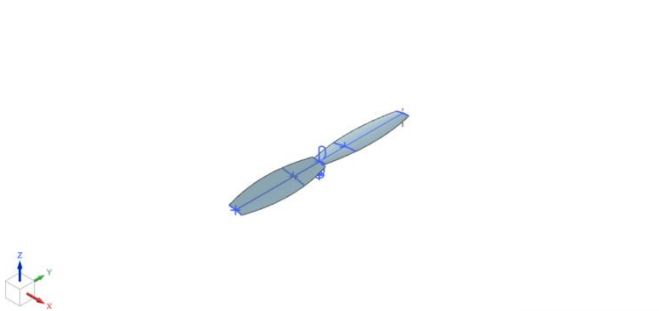
Modeling Approach and Techniques

Parametric Modeling



Body Design:

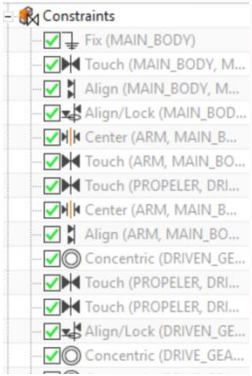
- Detailed sketch defining curved surfaces and attachment points.
- Fully constrained to ensure geometric consistency.
- Dimensions parameterized for flexibility in size and structural updates.



Propeller Design:

- Fully constrained sketch with axial symmetry.
- Key dimensions parameterized for aerodynamic optimization.
- Constraints ensure proportional blade alignment and smooth rotations.

Advanced Constraints



Advanced Constraints Applied:

- Enabled seamless alignment and rotation for **critical components** (e.g., propellers, bolts) using Touch, Align, and Concentric Constraints.
- Enhanced functionality and precision during parametric adjustments.

Structural Integrity and Stability:

- Anchored the drone body with Fix Constraints to serve as a reference point.
- Applied Parallel Constraints to maintain alignment and ensure stability in the overall assembly.

Non-Trivial Part Design:

Focus on Complexity:

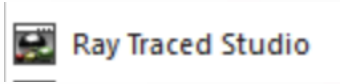
- Parts like **propellers and gear assemblies** feature intricate designs to meet structural and performance needs.
- Leveraged Siemens NX tools for precise modeling and dimensional control.

Key Components Modeled:

- Includes the **main body**, **propellers**, **arms**, **gear assemblies**, and **bolts.**
- Each part involved **detailed sketches, constraints, and parametric adjustments** to ensure adaptability and functionality.

Rendering Tools:

High-Quality Renders:



- Produced using **Siemens NX Renderer** with advanced **Ray Traced Studio settings** for realistic materials and lighting.
- Enhanced clarity with **translucent layers** to reveal internal components and assembly details.

Final Assembly Visualization:

- Detailed renders of key components like the **main body**, **gear assemblies**, and **propellers**.
- Highlighted structural features and assembly precision through high-resolution images.

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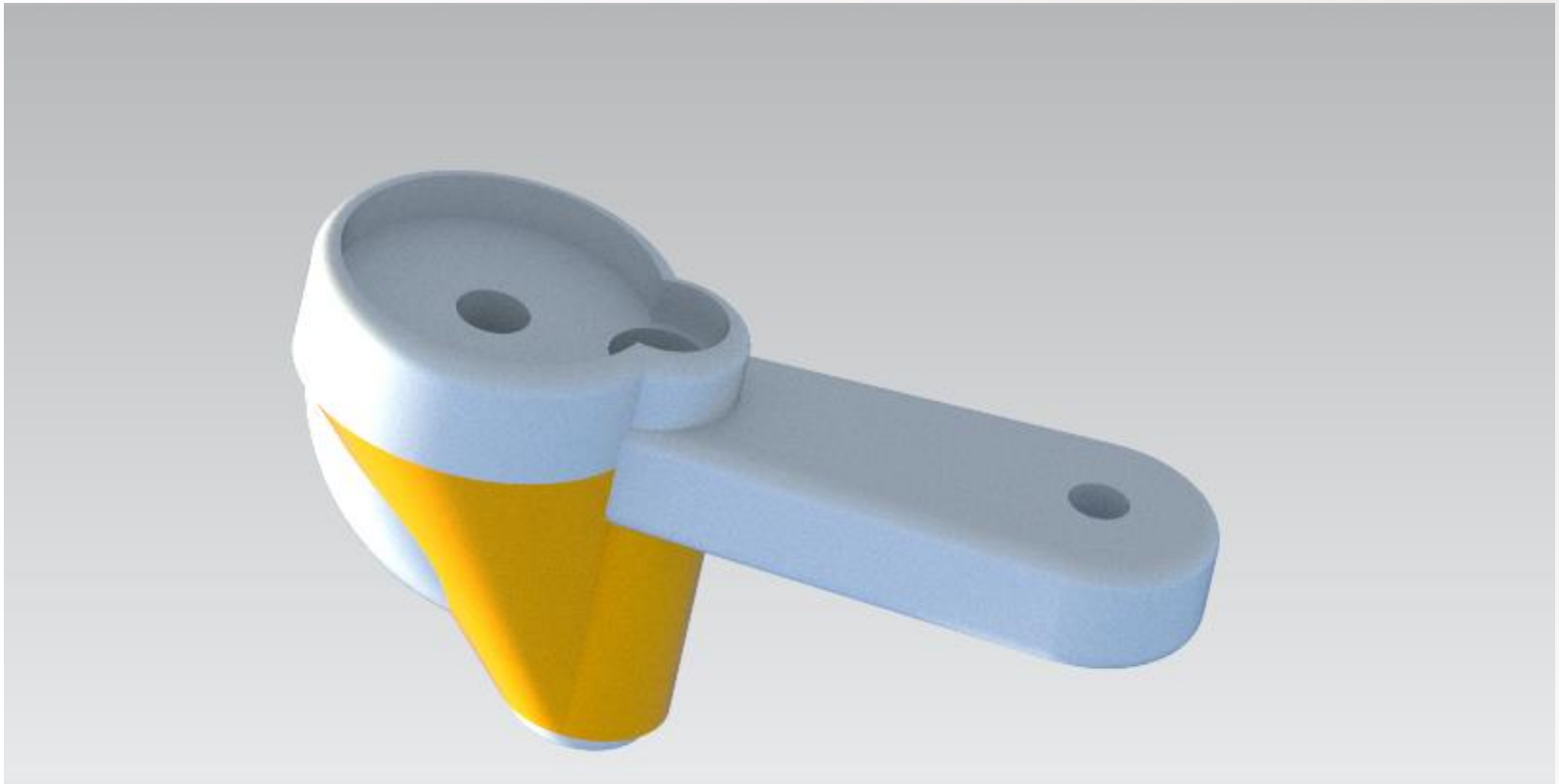
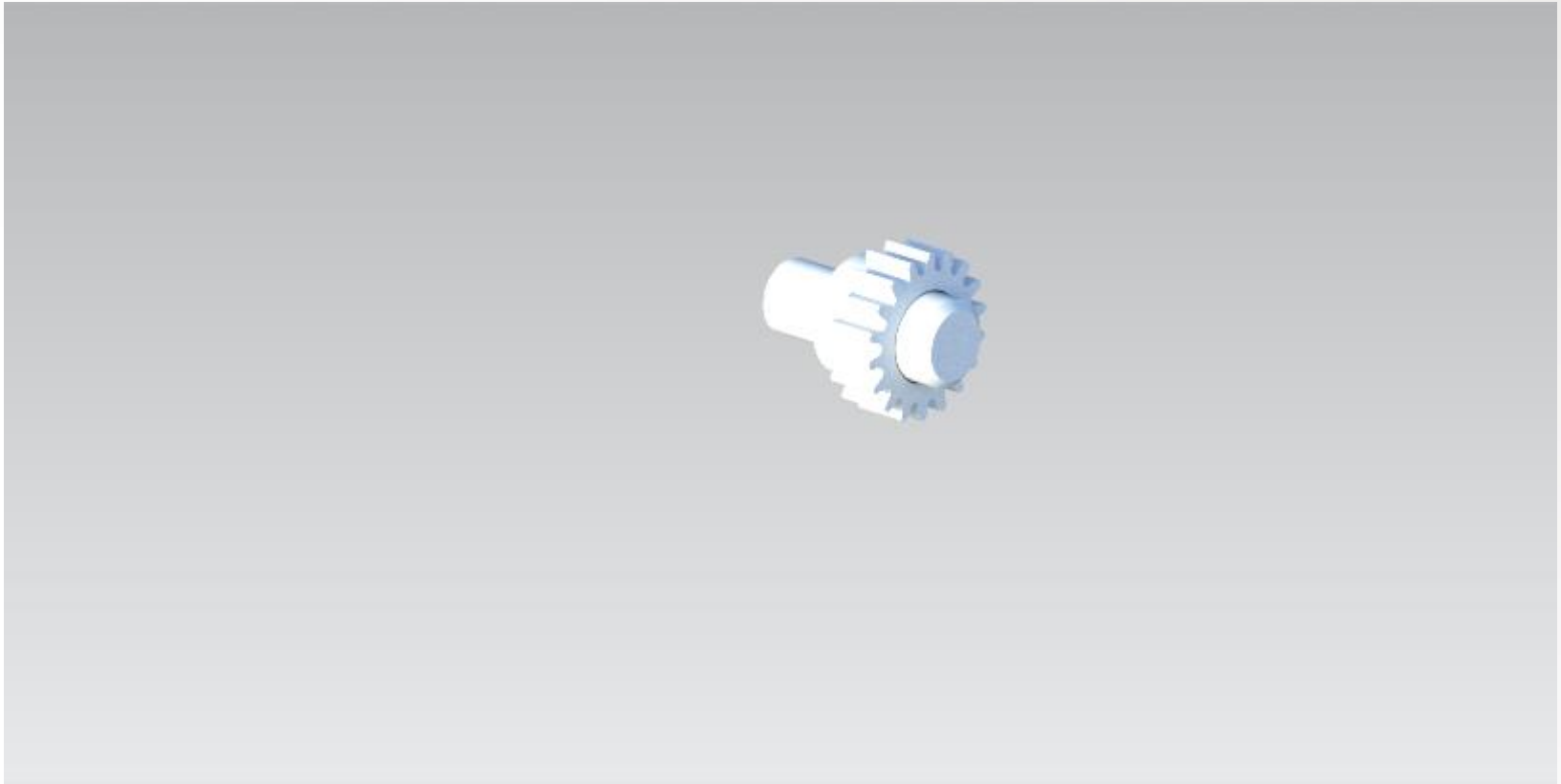
Rendered Image and Final Design

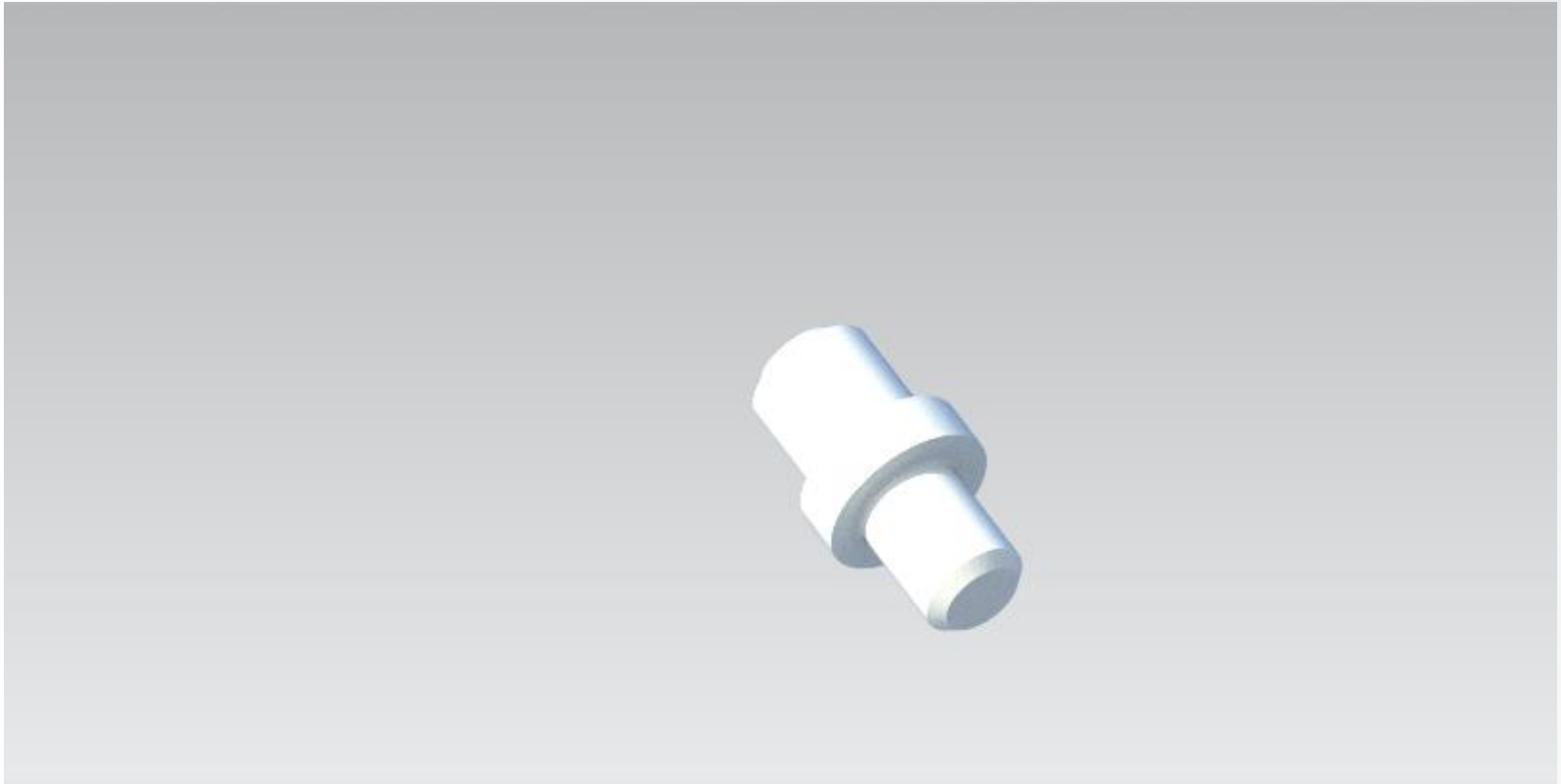
Arm Part



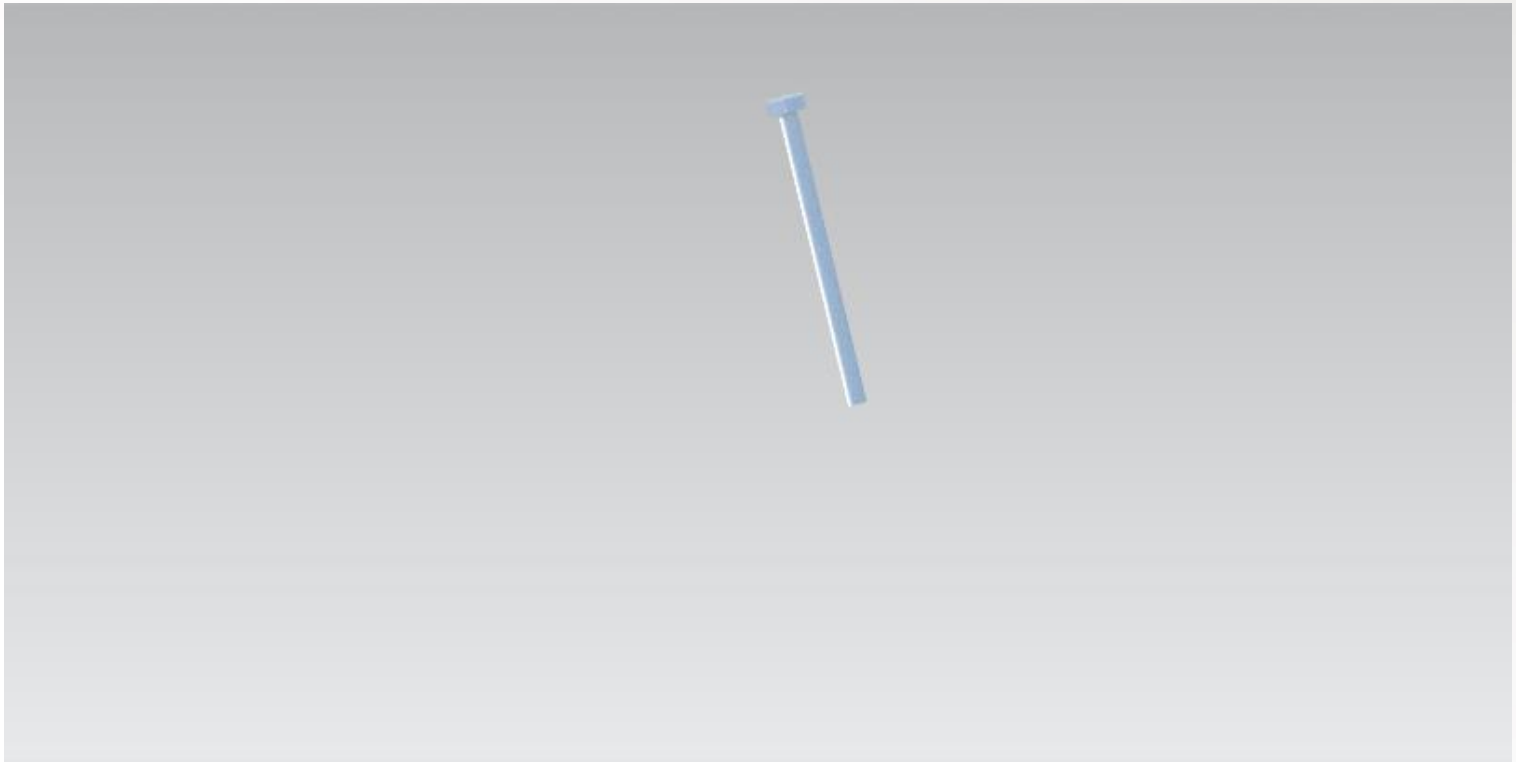
Drive Gear Part



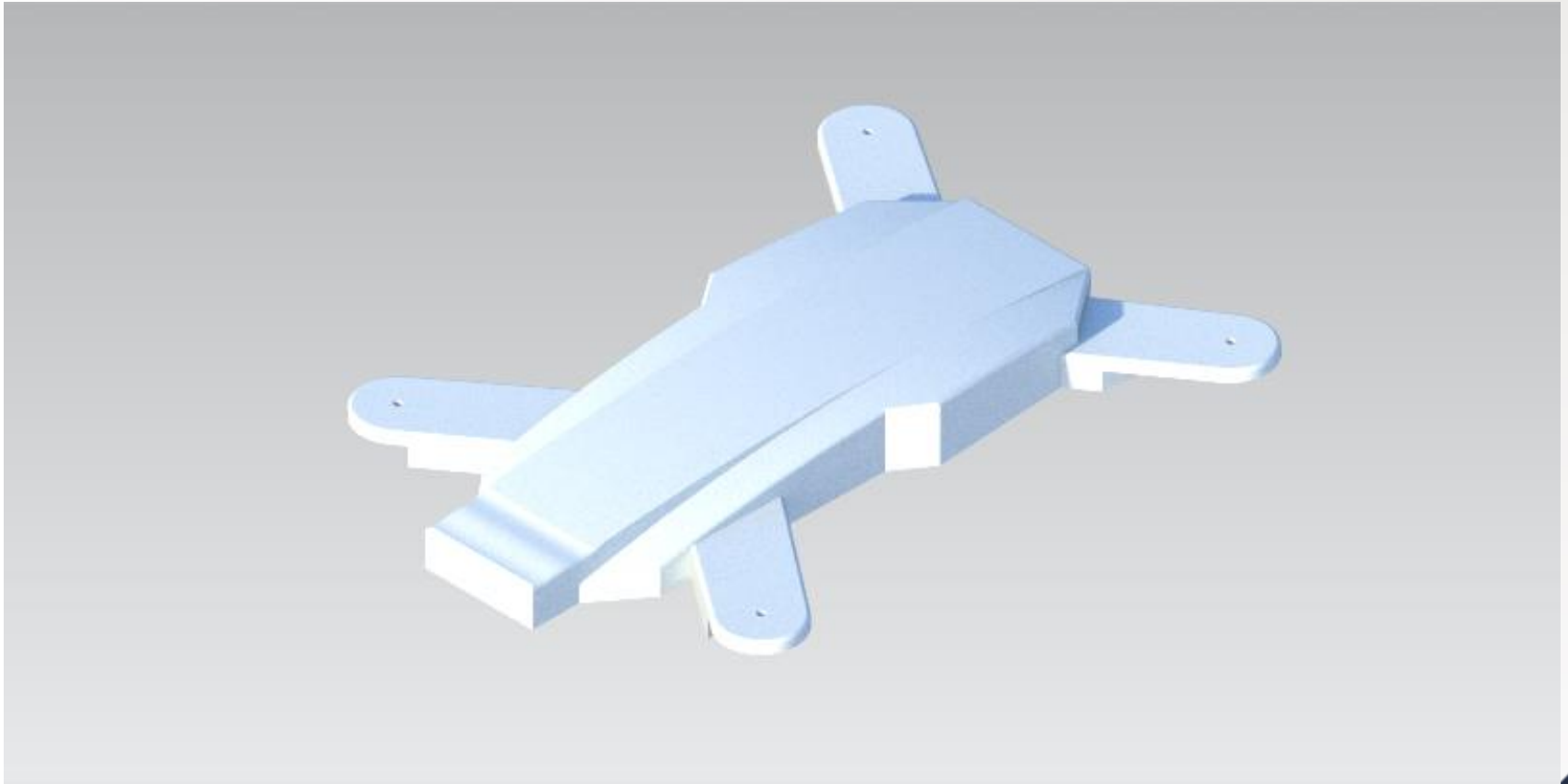
Drive Shaft Part



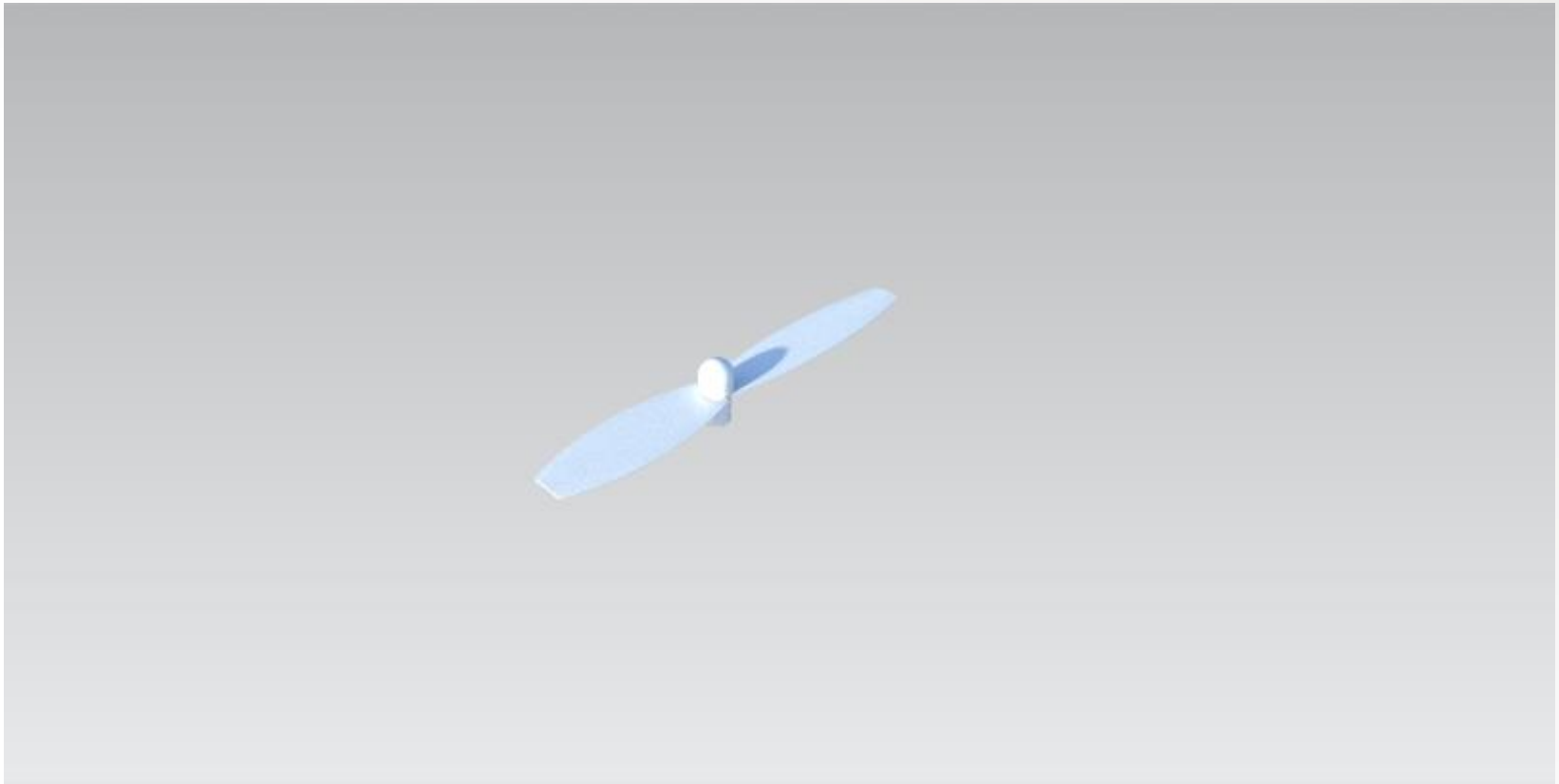
Hex Bolt Part



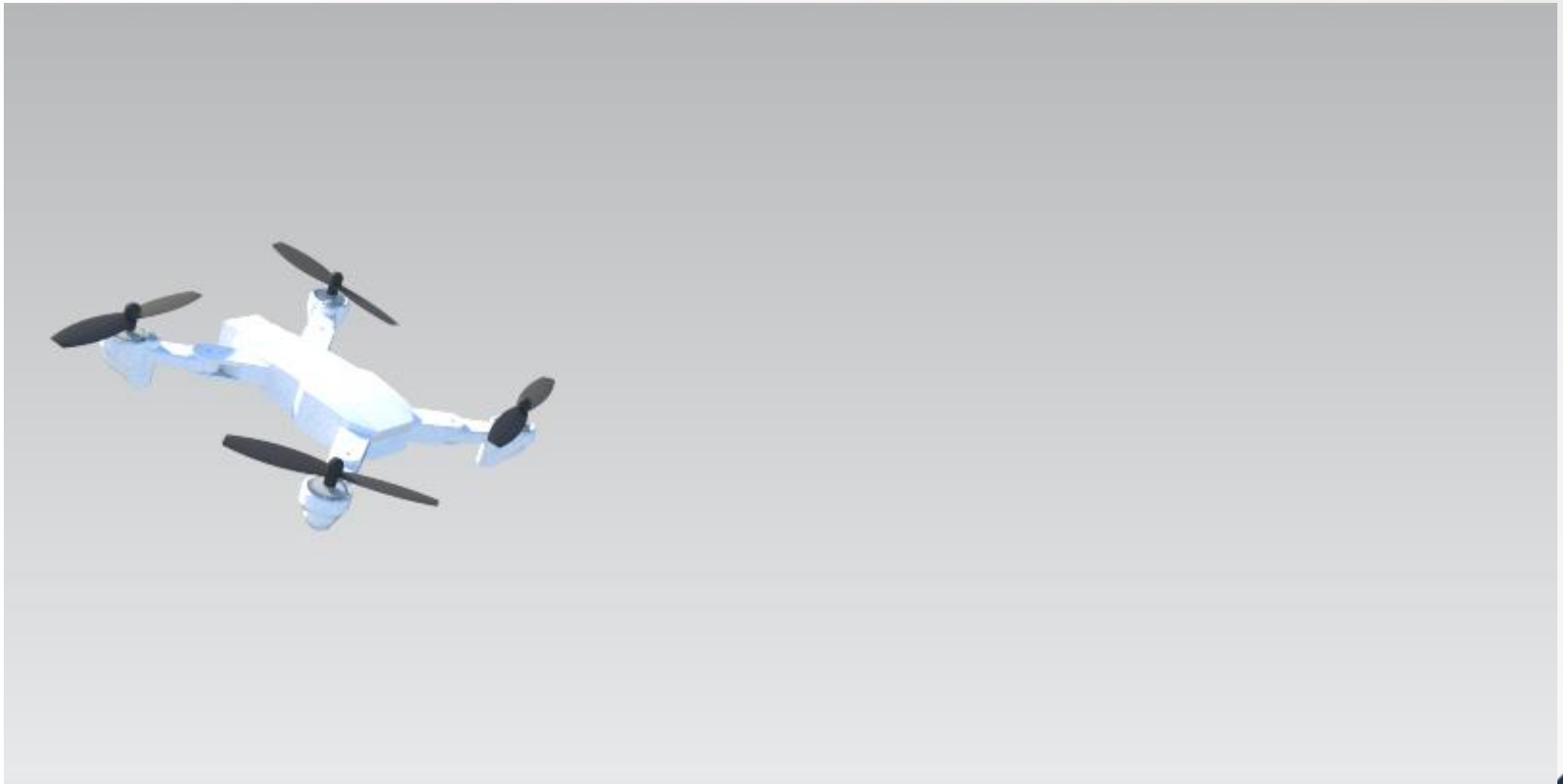
Main Body Part



Propeller Part



Final Assembly



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Challenges and Solution

Challenges

Constraints

- Misalignment of components during assembly due to complex constraints.

Parametric Flexibility

- Difficulty in maintaining consistent relationships when dimensions were modified.

Complex Geometry

- Designing non-trivial parts like the body and propellers with precise dimensions.

Rendering Quality

- Initial renders lacked detail and failed to show translucent layers effectively.

Solutions

Constraints

- Applied Concentric, Align, and Touch constraints with iterative adjustments to ensure proper alignment.

Parametric Flexibility

- Used fully constrained sketches and parametric modeling to link dimensions and ensure scalability.

Complex Geometry

- Referenced manufacturer data and applied geometric constraints for accuracy..

Rendering Quality

- Enhanced material properties, lighting, and rendering settings in Siemens NX.

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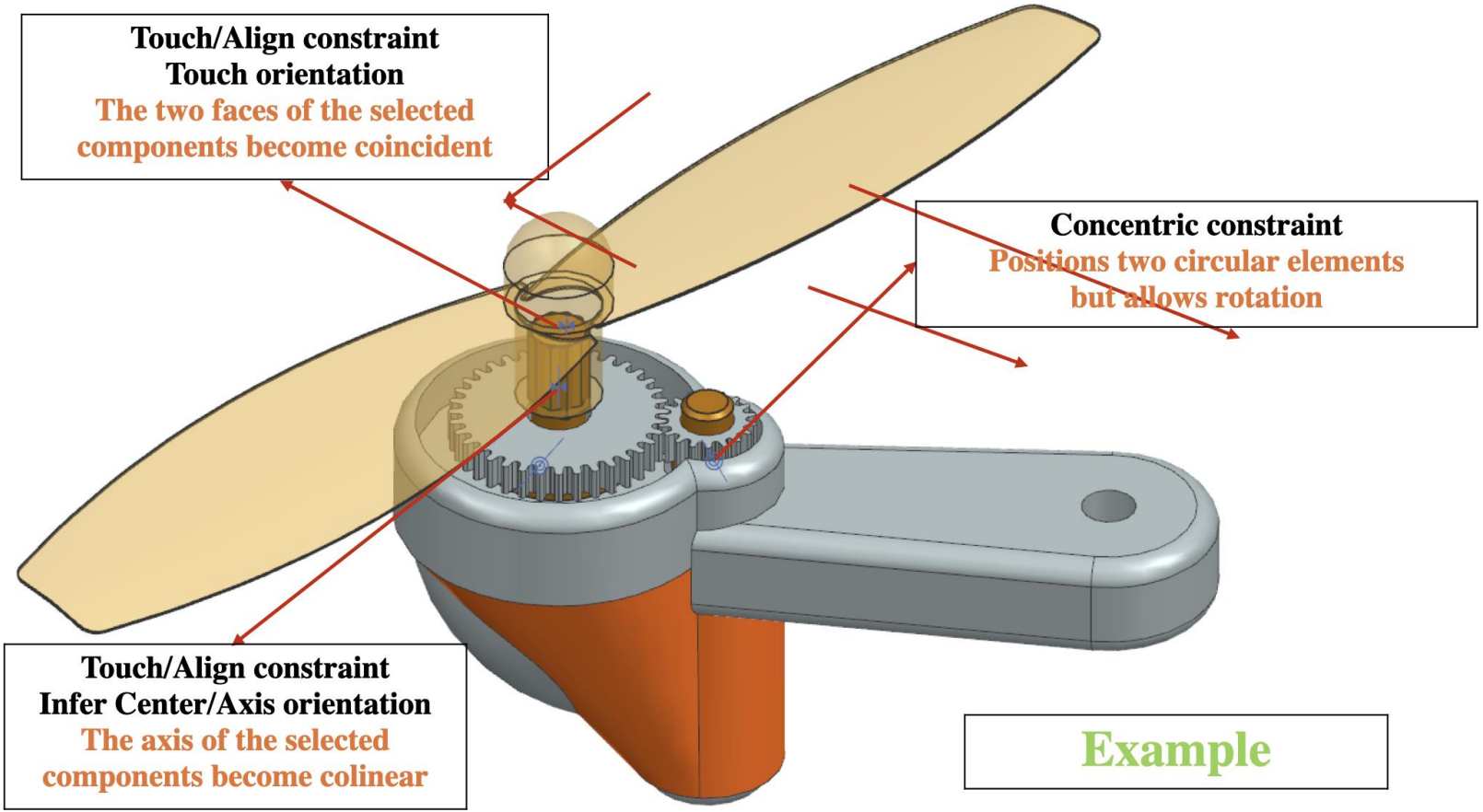
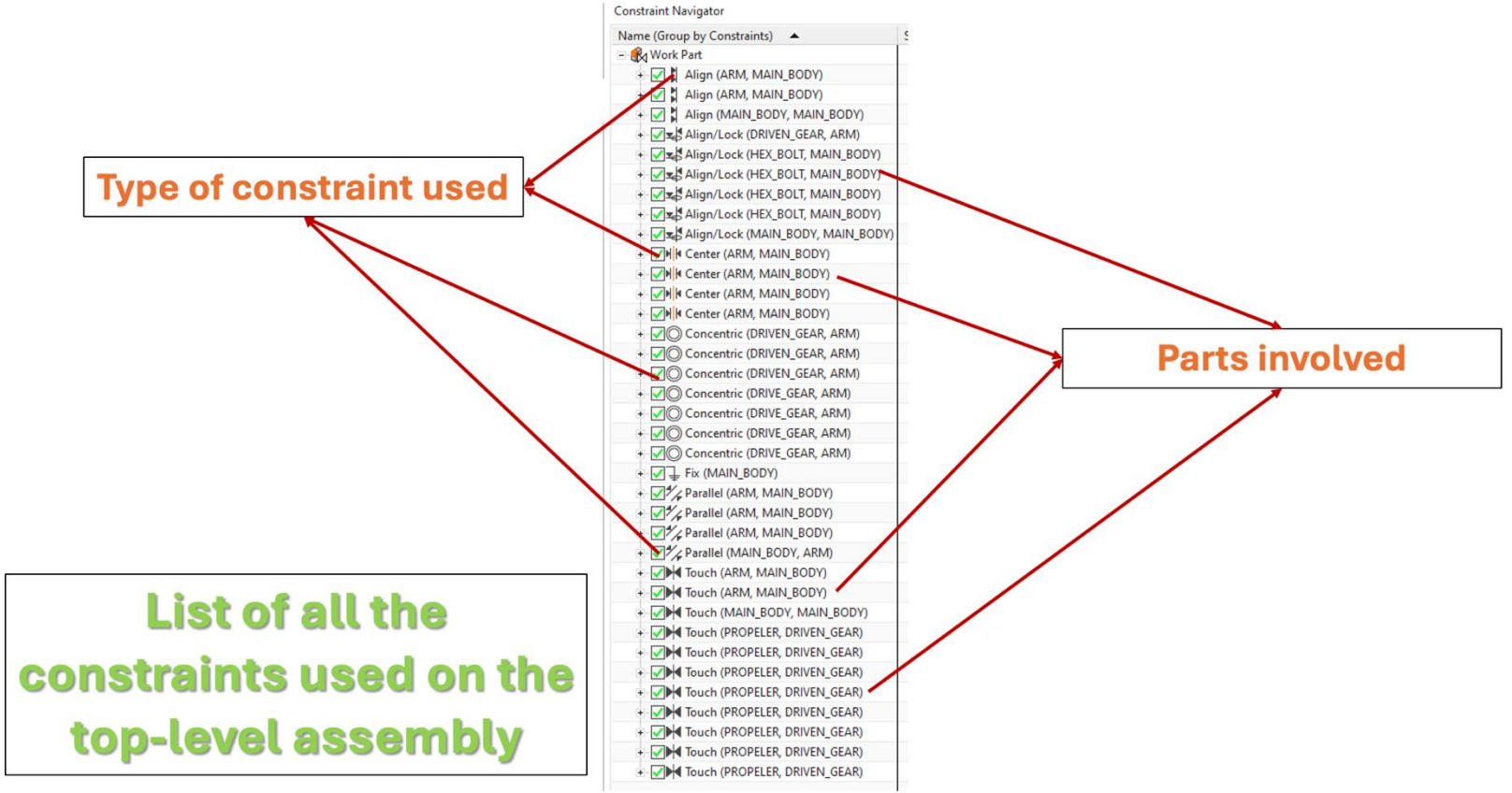
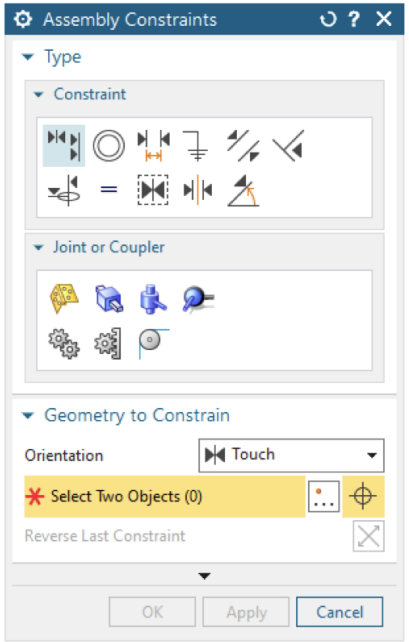
Assembly and Constraint Variants

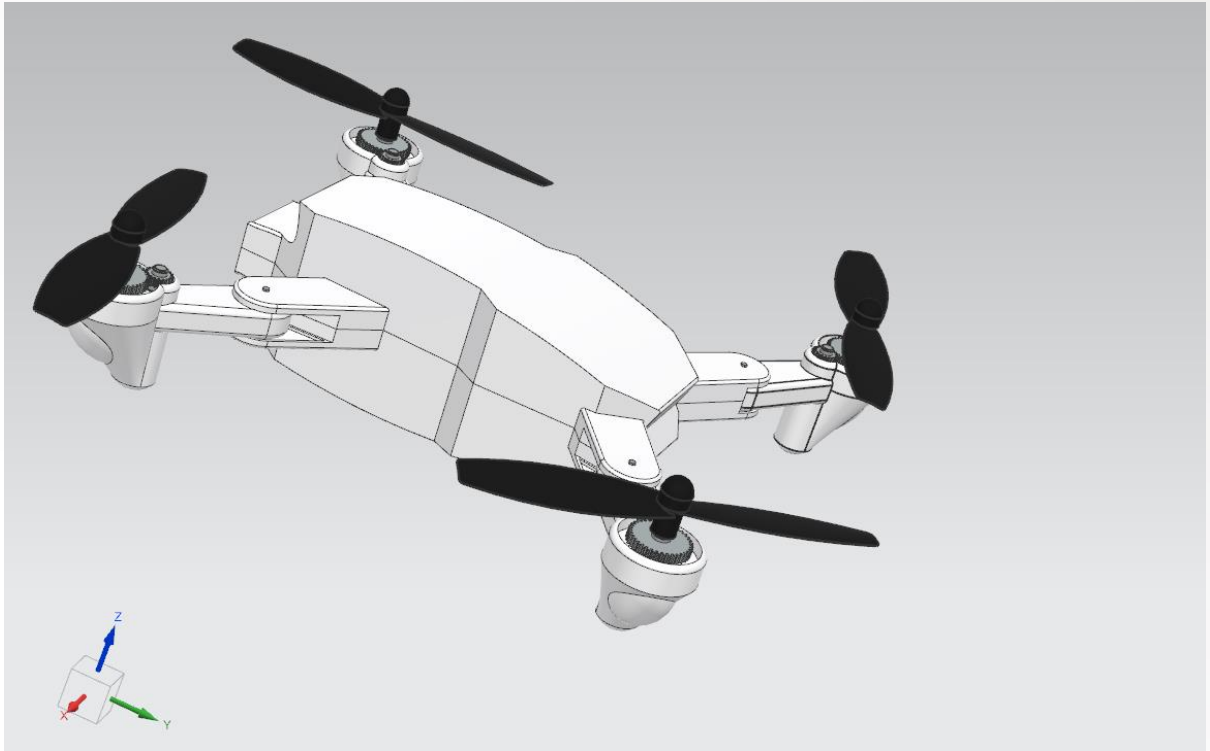

Touch/Align constraint
Touch orientation
The two faces of the selected components become coincident
Concentric constraint
Positions two circular elements but allows rotation
Touch/Align constraint
Infer Center/Axis orientation
The axis of the selected components become colinear
Example

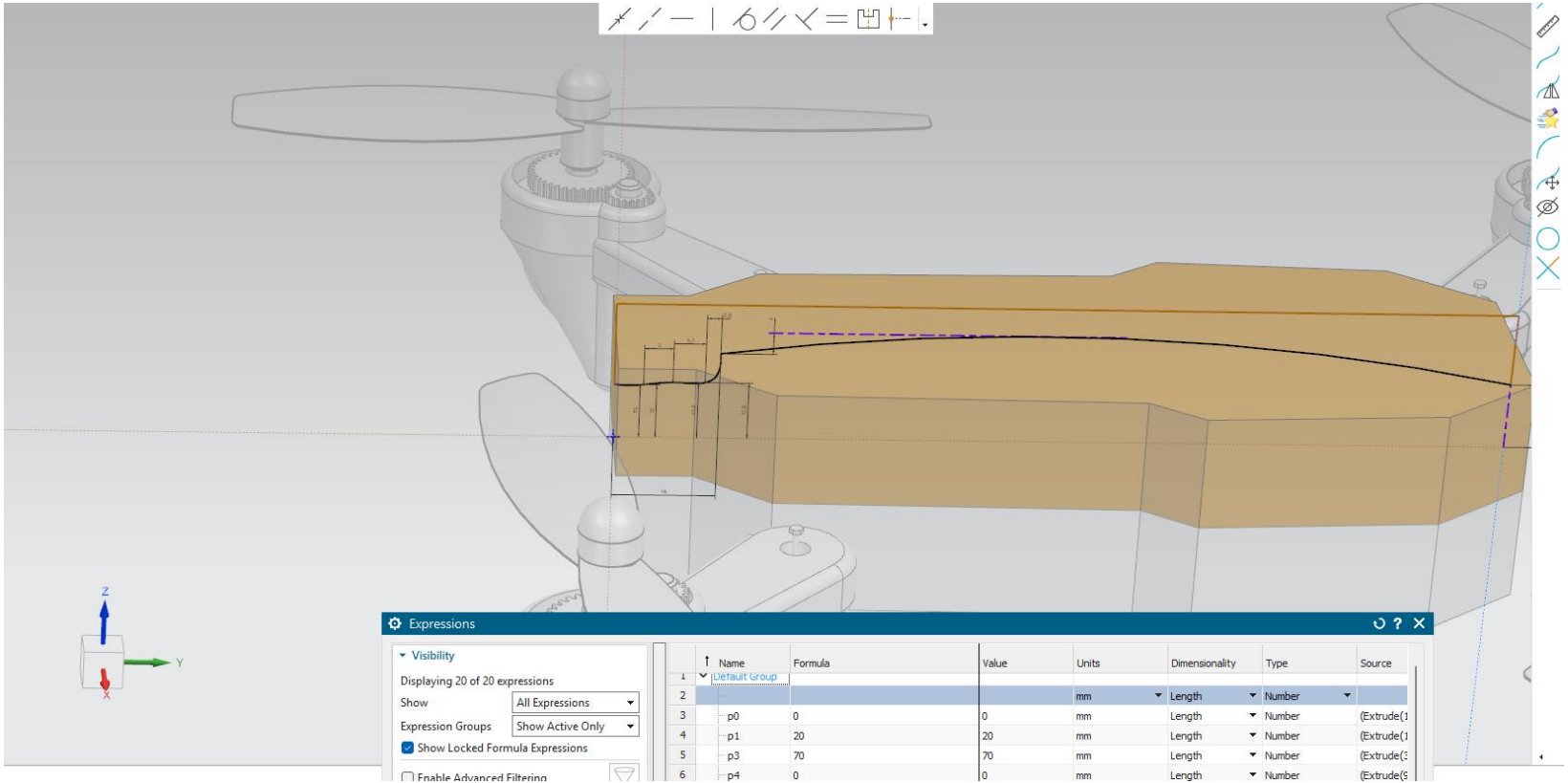

Type of constraint used
Parts involved
List of all the constraints used on the top-level assembly
Constraint Navigator
Name (Group by Constraints)
Work Part
Align (ARM, MAIN_BODY)
Align (ARM, MAIN_BODY)
Align (MAIN_BODY, MAIN_BODY)
Align/Lock (DRIVEN_GEAR, ARM)
Align/Lock (HEX_BOLT, MAIN_BODY)
Align/Lock (HEX_BOLT, MAIN_BODY)
Align/Lock (HEX_BOLT, MAIN_BODY)
Align/Lock (HEX_BOLT, MAIN_BODY)
Align/Lock (MAIN_BODY, MAIN_BODY)
Center (ARM, MAIN_BODY)
Center (ARM, MAIN_BODY)
Center (ARM, MAIN_BODY)
Center (ARM, MAIN_BODY)
Concentric (DRIVEN_GEAR, ARM)
Concentric (DRIVEN_GEAR, ARM)
Concentric (DRIVEN_GEAR, ARM)
Concentric (DRIVE_GEAR, ARM)
Concentric (DRIVE_GEAR, ARM)
Concentric (DRIVE_GEAR, ARM)
Concentric (DRIVE_GEAR, ARM)
Fix (MAIN_BODY)
Parallel (ARM, MAIN_BODY)
Parallel (ARM, MAIN_BODY)
Parallel (ARM, MAIN_BODY)
Parallel (MAIN_BODY, ARM)
Touch (ARM, MAIN_BODY)
Touch (ARM, MAIN_BODY)
Touch (MAIN_BODY, MAIN_BODY)
Touch (PROPELER, DRIVEN_GEAR)
Touch (PROPELER, DRIVEN_GEAR)
Touch (PROPELER, DRIVEN_GEAR)
Touch (PROPELER, DRIVEN_GEAR)
Touch (PROPELER, DRIVEN_GEAR)
Touch (PROPELER, DRIVEN_GEAR)
Touch (PROPELER, DRIVEN_GEAR)
Touch (PROPELER, DRIVEN_GEAR)



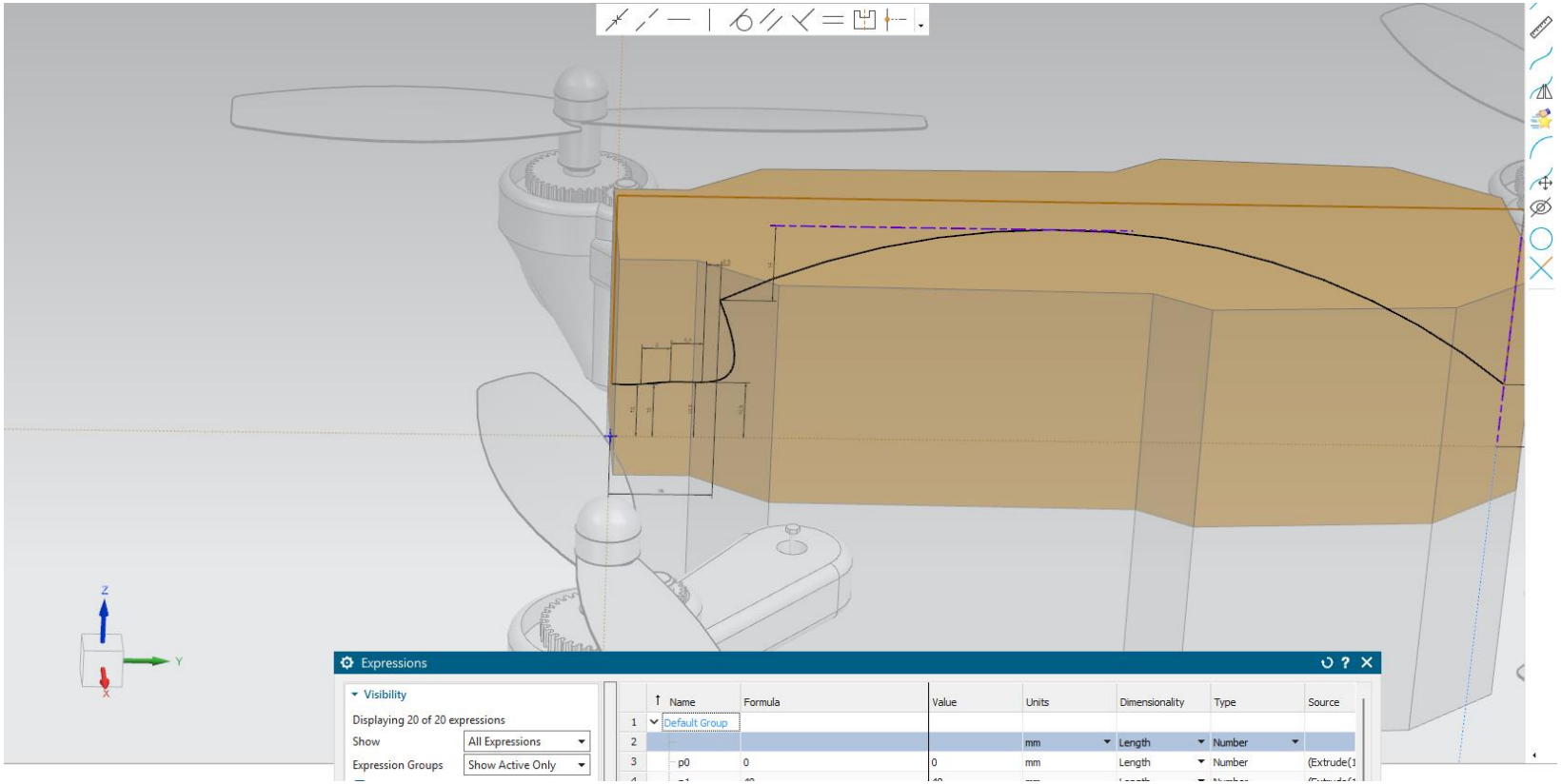
Assembly Constraints dialog box

Manipulating Parameterization





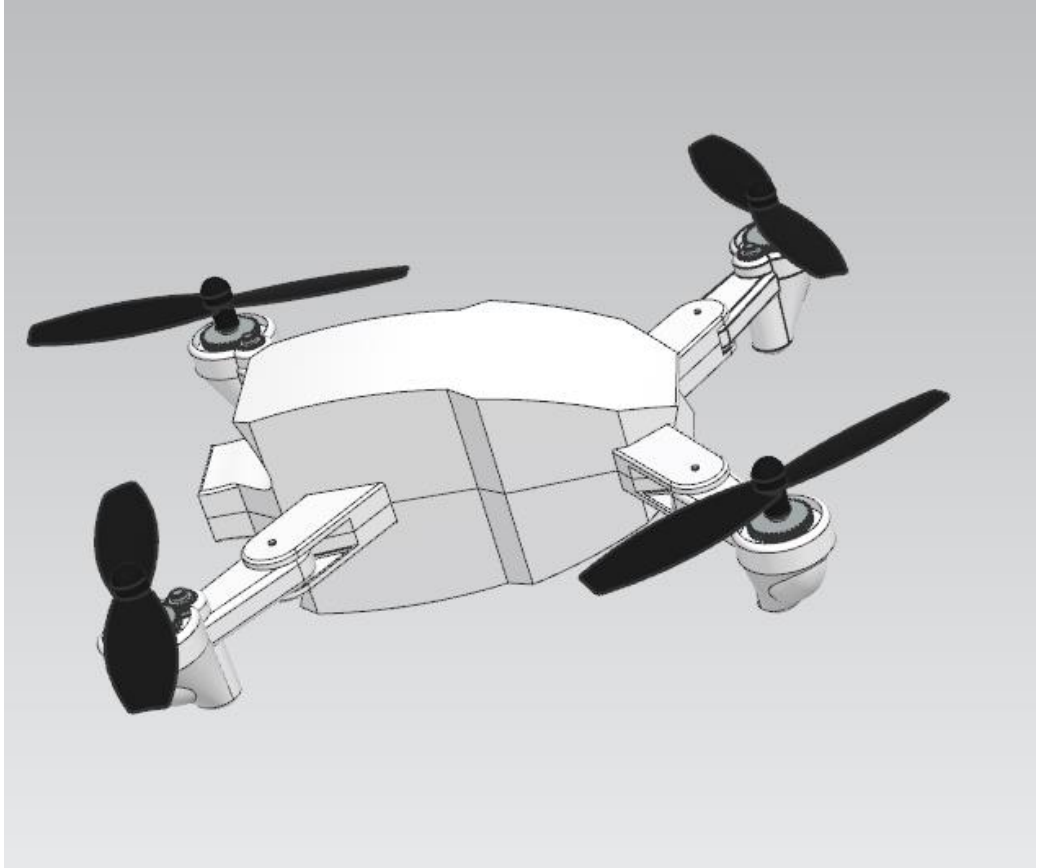
Parametric modeling allowed for easy updates to body size and alignment with other components.



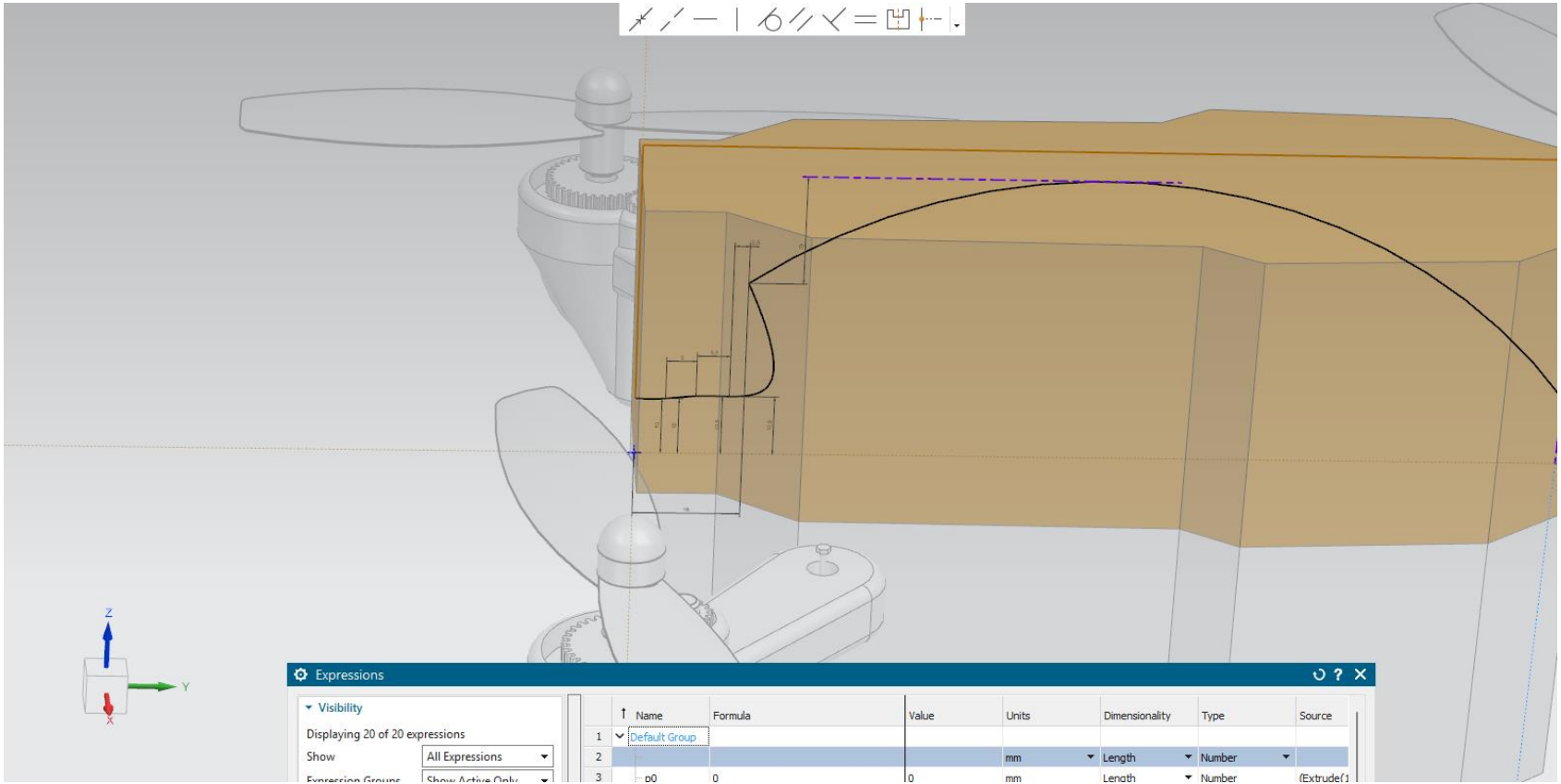
Rendered assembly showcasing the drone with altered parameters: manipulating the P3 value in expressions to adjust the size of the drone body and modifying the height for design flexibility

	Name	Formula	Value	Units	Dimensionality	Type	Source
1	Default Group						
2				mm	Length	Number	
3	p0	0	0	mm	Length	Number	(Extrude(1
4	p1	40	40	mm	Length	Number	(Extrude(1
5	p3	90	90	mm	Length	Number	(Extrude(3
6	p4	0	0	mm	Length	Number	(Extrude(9
7	p5	30	30	mm	Length	Number	(Extrude(9
8	p63	60	60	mm	Length	Number	(Extrude(1
9	p64	0	0	mm	Length	Number	(Extrude(1
10	p65	8	8	mm	Length	Number	(Extrude(1
11	p66	0	0	mm	Length	Number	(Extrude(1
12	p67	5	5	mm	Length	Number	(Extrude(1
13	p68	1	1	mm	Length	Number	(Shell(17)
14	p69	1	1	mm	Length	Number	(SKETCH_(
15	p70	0	0	mm	Length	Number	(Extrude(1
16	p71	2	2	mm	Length	Number	(Extrude(1
17	p72	1	1	mm	Length	Number	(SKETCH_(
18	p129	-1	-1	mm	Length	Number	(Extrude(2
19	p130	2	2	mm	Length	Number	(Extrude(2
20	p194	1	1	mm	Length	Number	(Edge Blen
21	p202	1	1	mm	Length	Number	(Edge Blen
22	p210	1	1	mm	Length	Number	(Edge Blen

Expressions table showing fully constrained sketch parameters used to generate three assemblies through parametric manipulation.



Drone assembly after parametric manipulation, showcasing the updated dimensions and configurations based on adjusted expression values.


Z
Y
X
Expressions
Visibility
Displaying 20 of 20 expressions
Show
All Expressions
Name
Formula
Value
Units
Dimensionality
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Source
1
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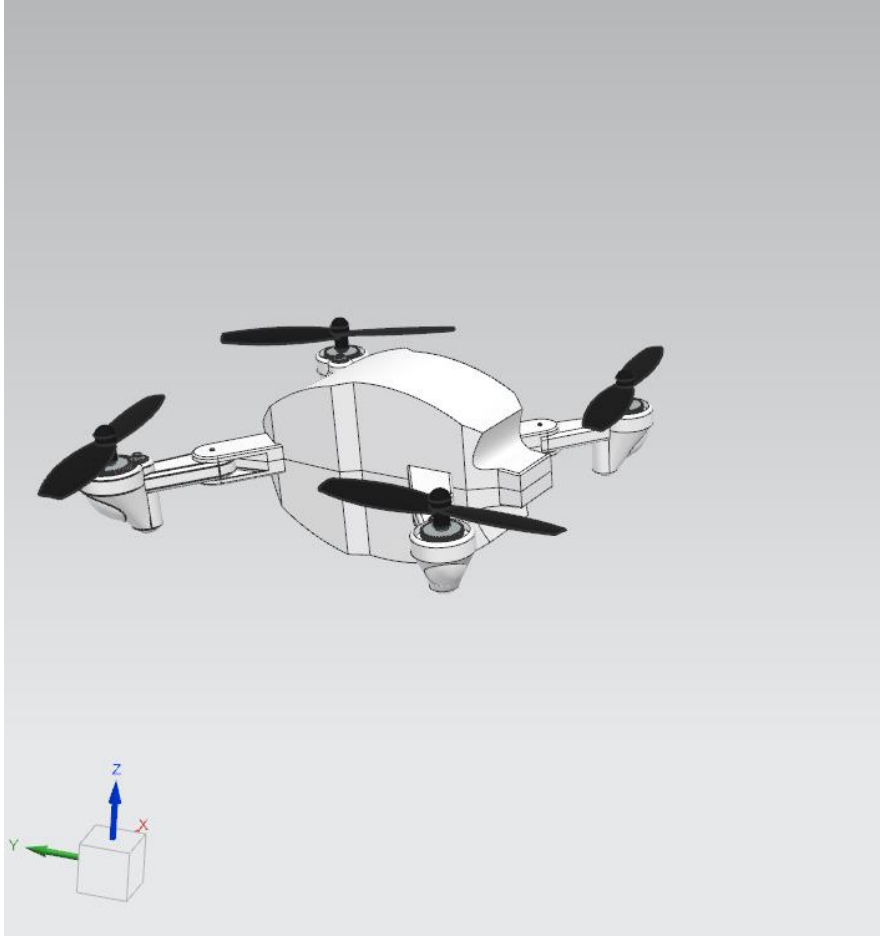

Rendered assembly showcasing the drone with altered body dimensions, demonstrating the flexibility of parametric modeling and the adaptability of constraints to accommodate design variations.

05

Conclusion and Future Scopes

Conclusion

- Achieved a fully parametric and scalable drone model using Siemens NX.
- Successfully integrated advanced constraints to ensure accurate assembly and alignment.
- Produced high-quality renders, including translucent views, to effectively display internal and external components.
- Demonstrated the adaptability of the model through assembly variations and design flexibility.

Future Scope

- Explore advanced features like motion simulation to test drone functionality.
- Optimize the design for manufacturing by reducing material usage and increasing part efficiency.
- Integrate electronics and sensors into the model to simulate real-world drone applications.

Thank You

Thank you for your time!

Special thanks for a great semester and the opportunity to explore this project.

Extra Credit

Non-Trivial Parts

Model contains **over 20 non-trivial parts**, including:
Drone body, arms, propellers, gears, bolts, and assembly components.

NX Rendering

High-quality renders created using Siemens NX Renderer with:

- Custom materials for translucency and realism.
- Advanced illumination settings to enhance visual clarity and detail.

REFERENCES

- Drone On Survey. (n.d.). *4K dual camera*. https://droneonsurvey.co.uk/product/4k-dual-camera
- Modelforce. (n.d.). *Drone DJI Mini 2 Fly More Combo*. https://modelforce.eu/en/product/drone-dji-mini-2-fly-more-combo