The JAviator Flight Control System

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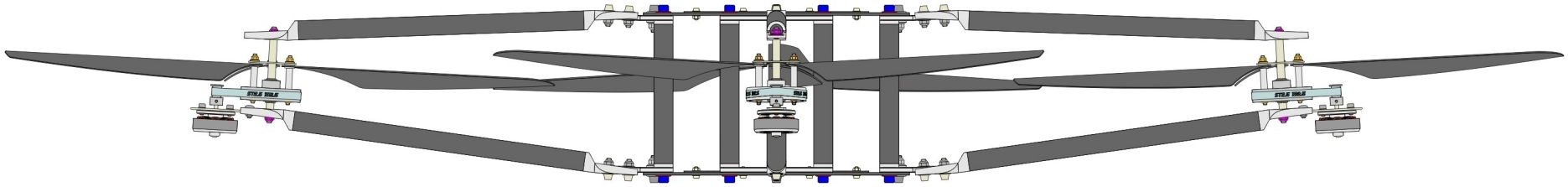
Computational Systems Group

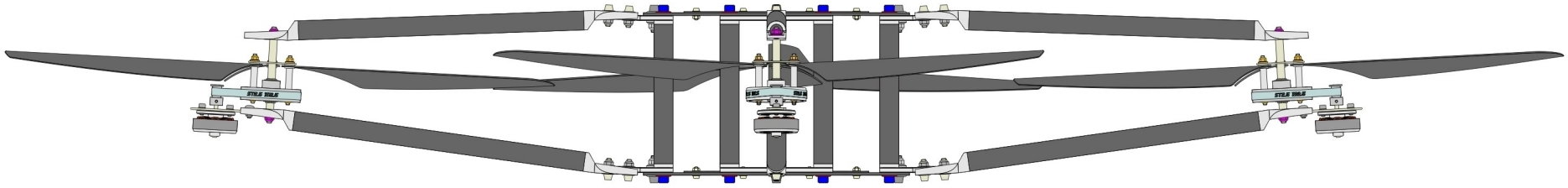
Introduction

- The JAviator Quadrotor
- Quadrotor Dynamics
- Thrust Dynamics
- Altitude Control
- Improvements
- Videos

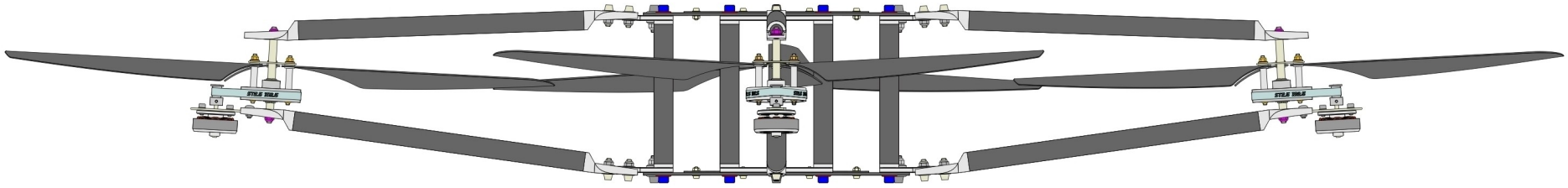
The JAviator Quadrotor



The JAviator Quadrotor

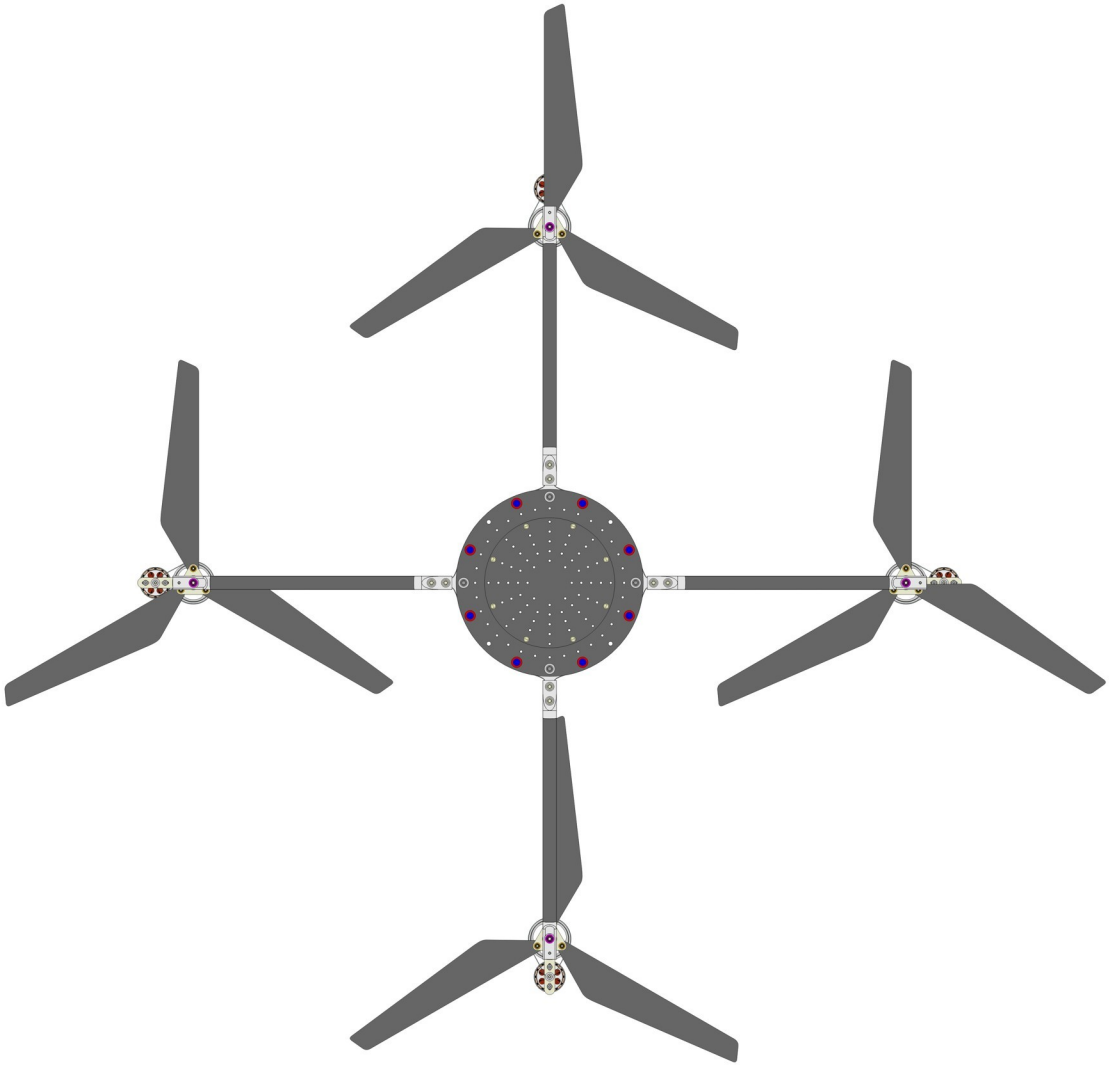


The JAviator Quadrotor



- Total diameter (over spinning rotors): 1.3 m
- Empty weight (including electronics): 2.2 kg
- Max lift capacity (flyable with 4.4kg): 5.6 kg

Quadrotor Dynamics: Basics



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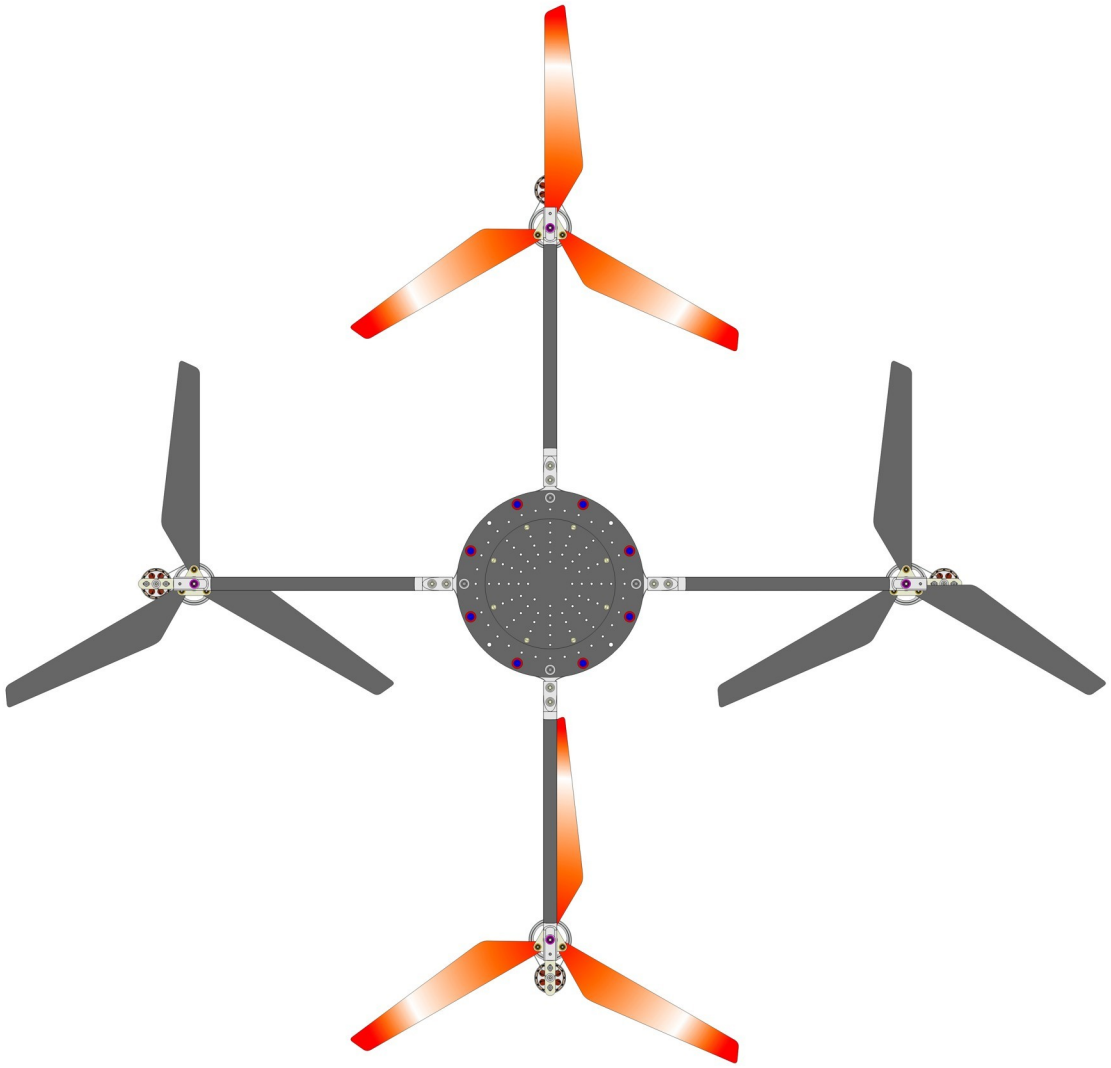

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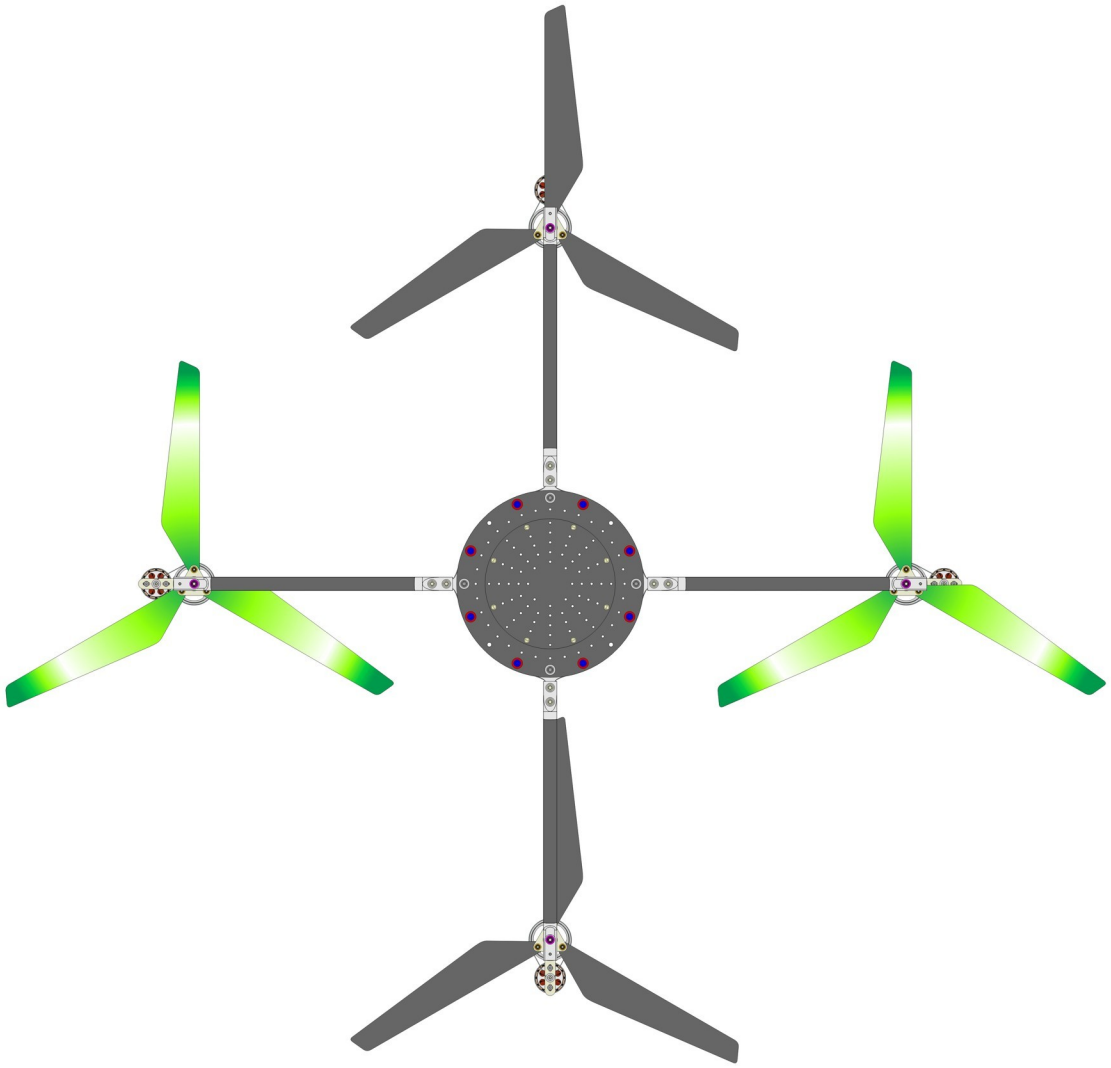
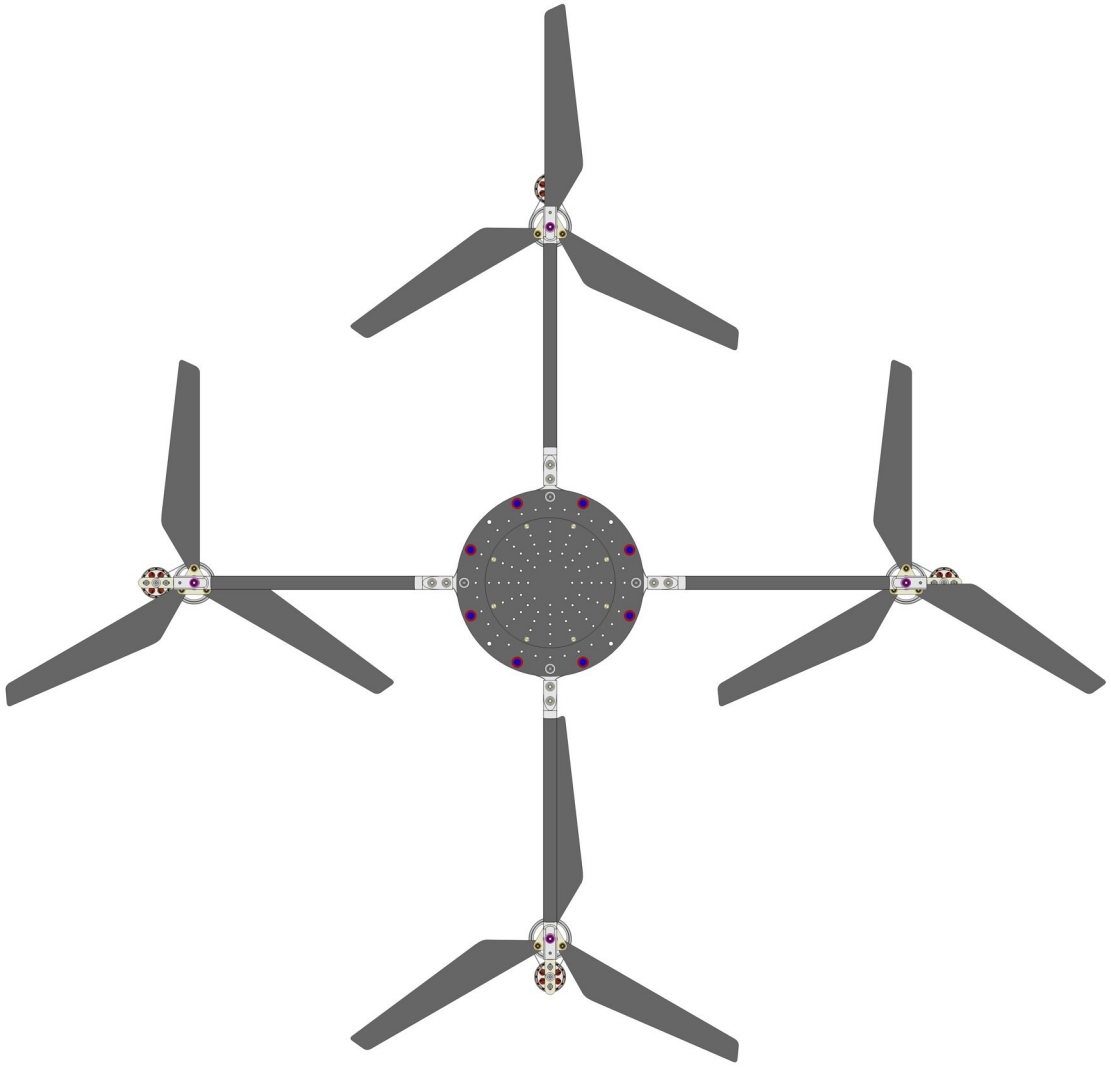
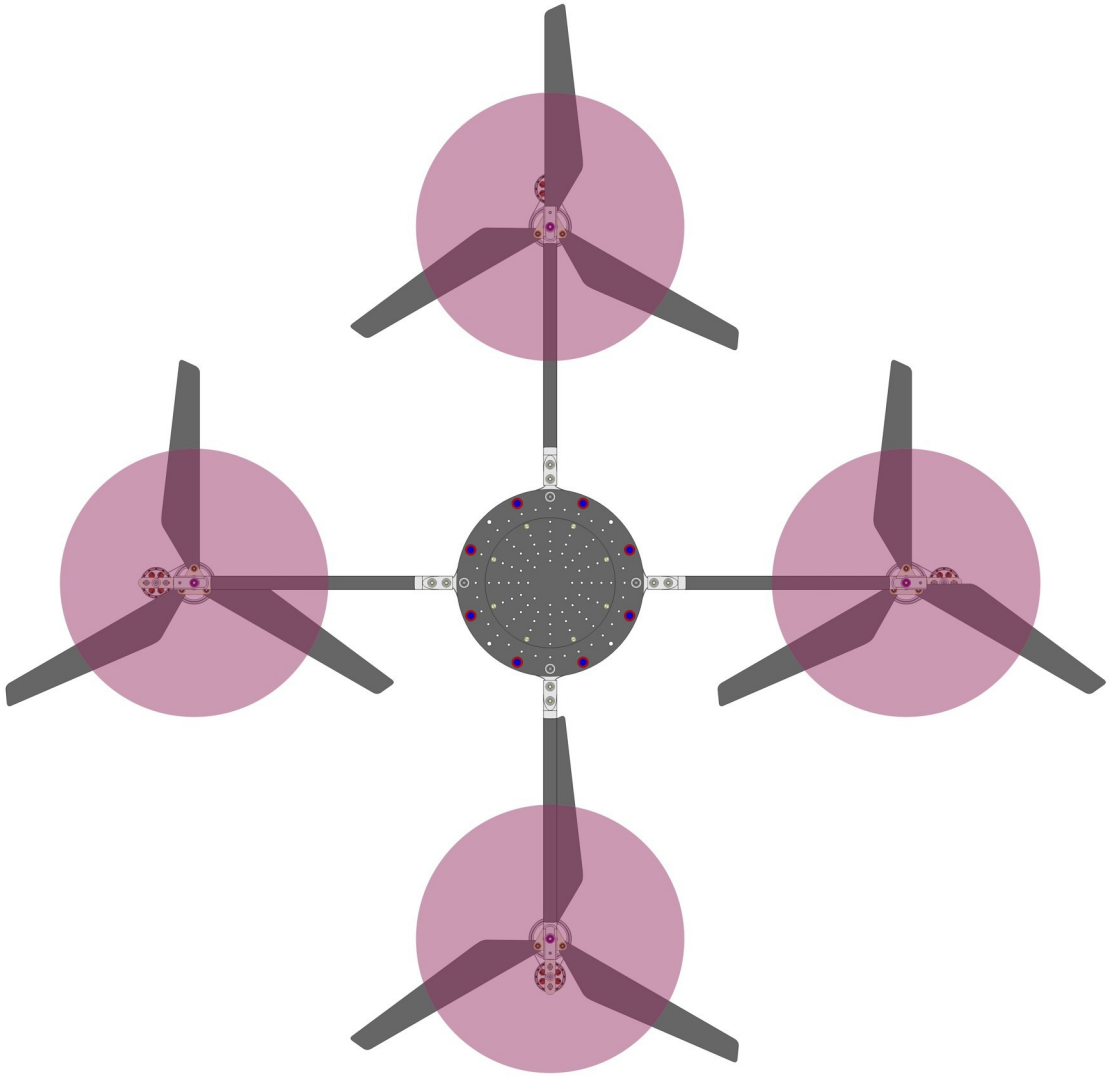


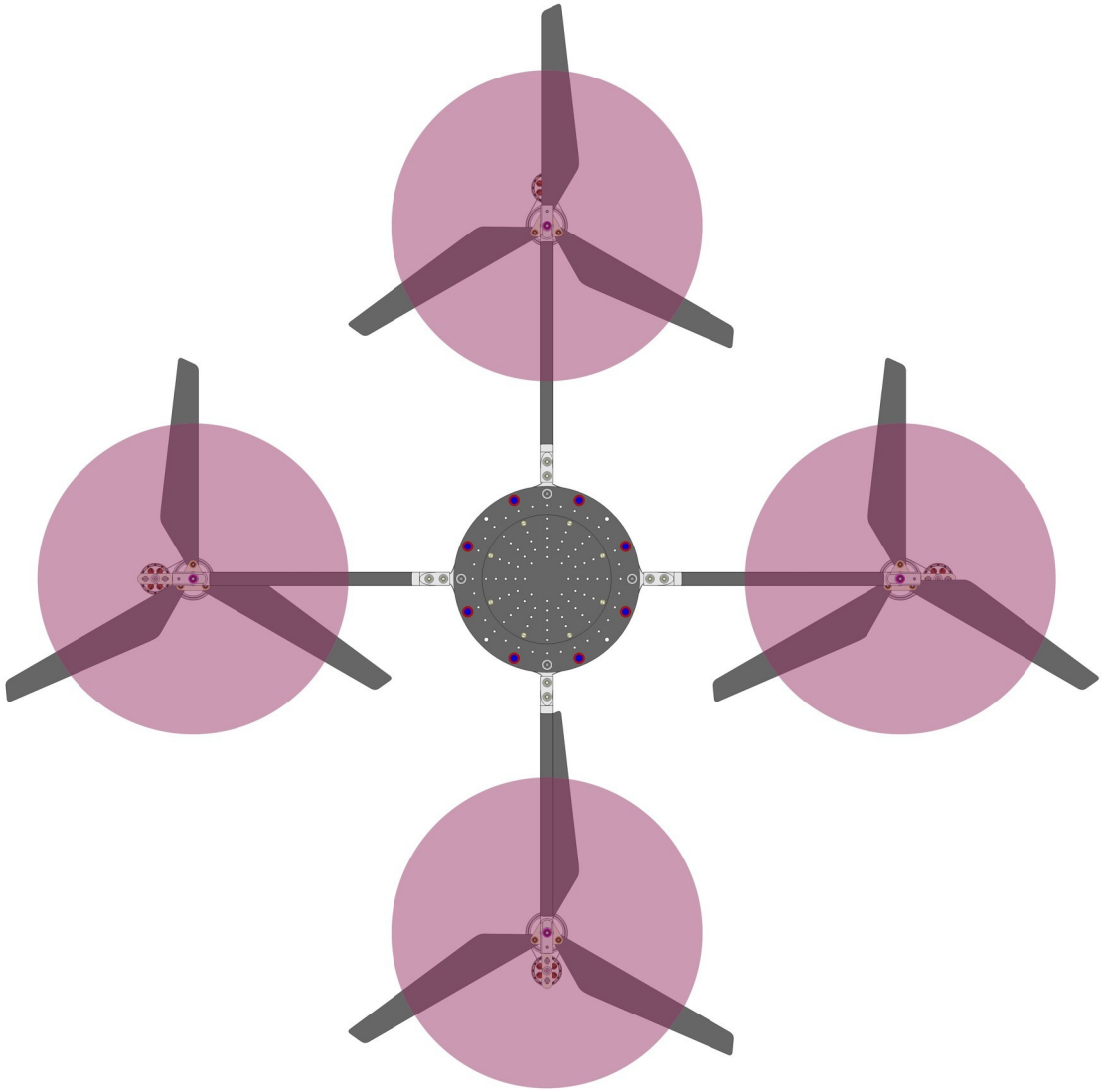
Quadrotor Dynamics: Altitude



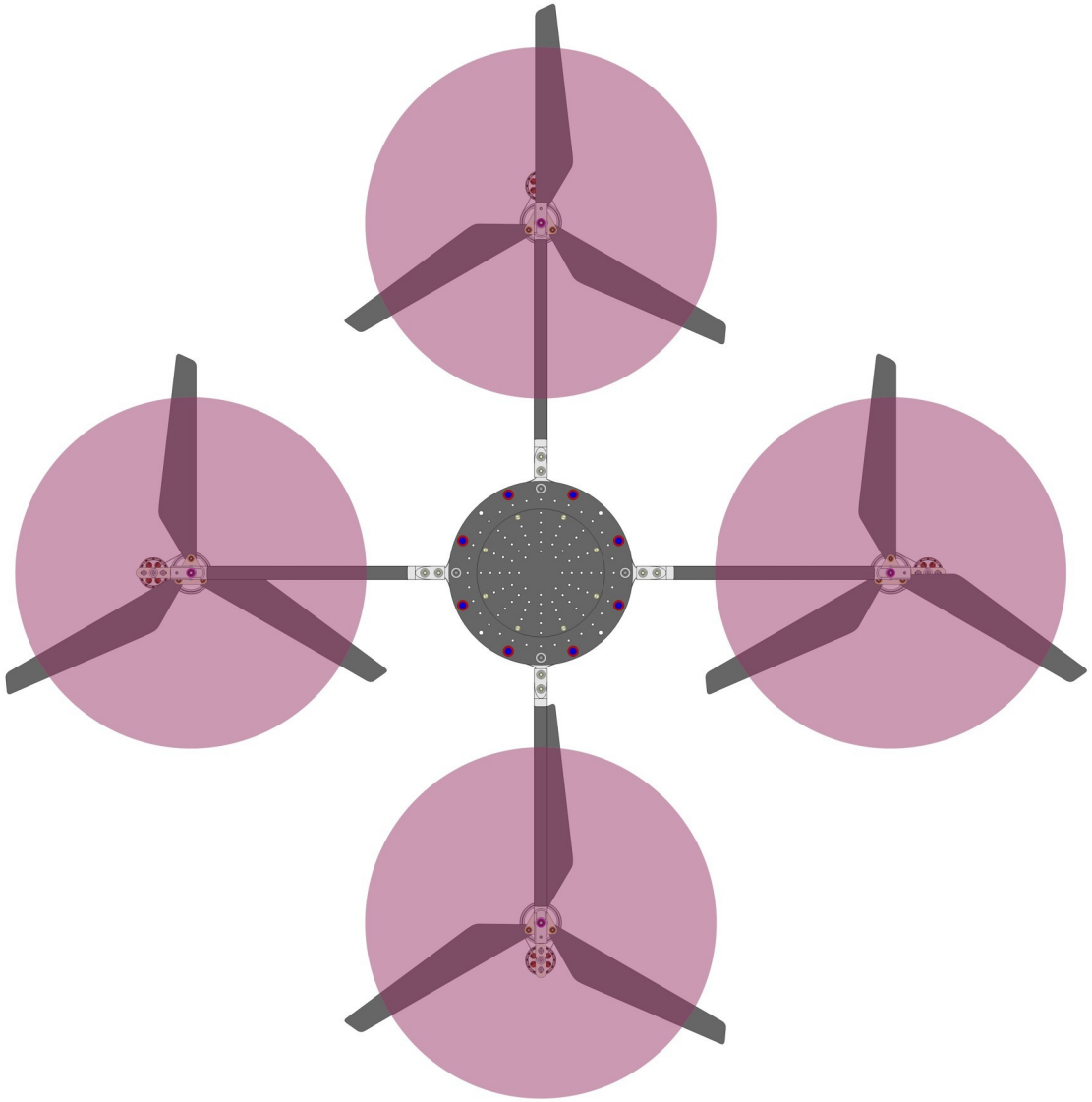
Quadrotor Dynamics: Altitude



Quadrotor Dynamics: Altitude



Quadrotor Dynamics: Altitude



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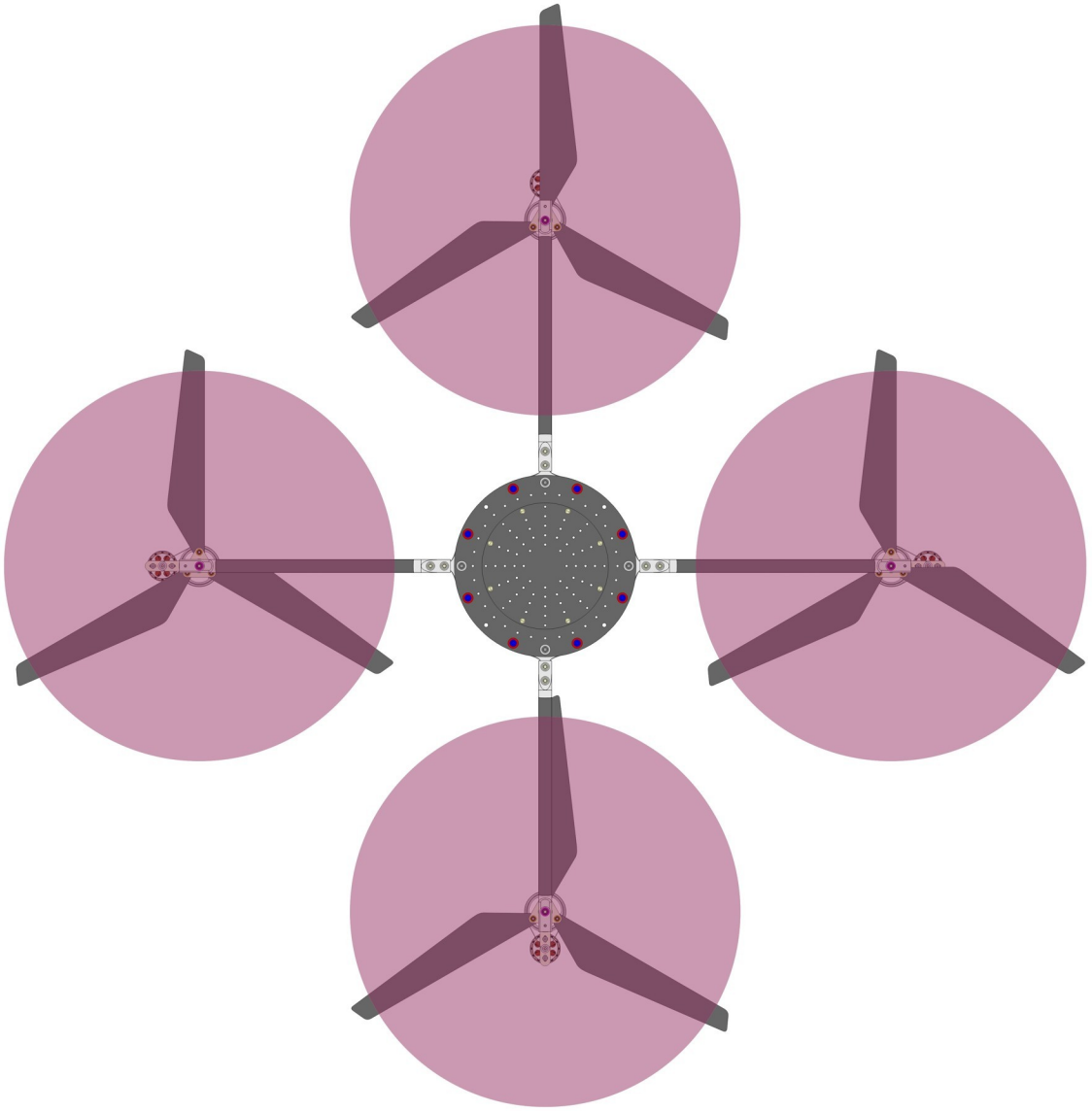

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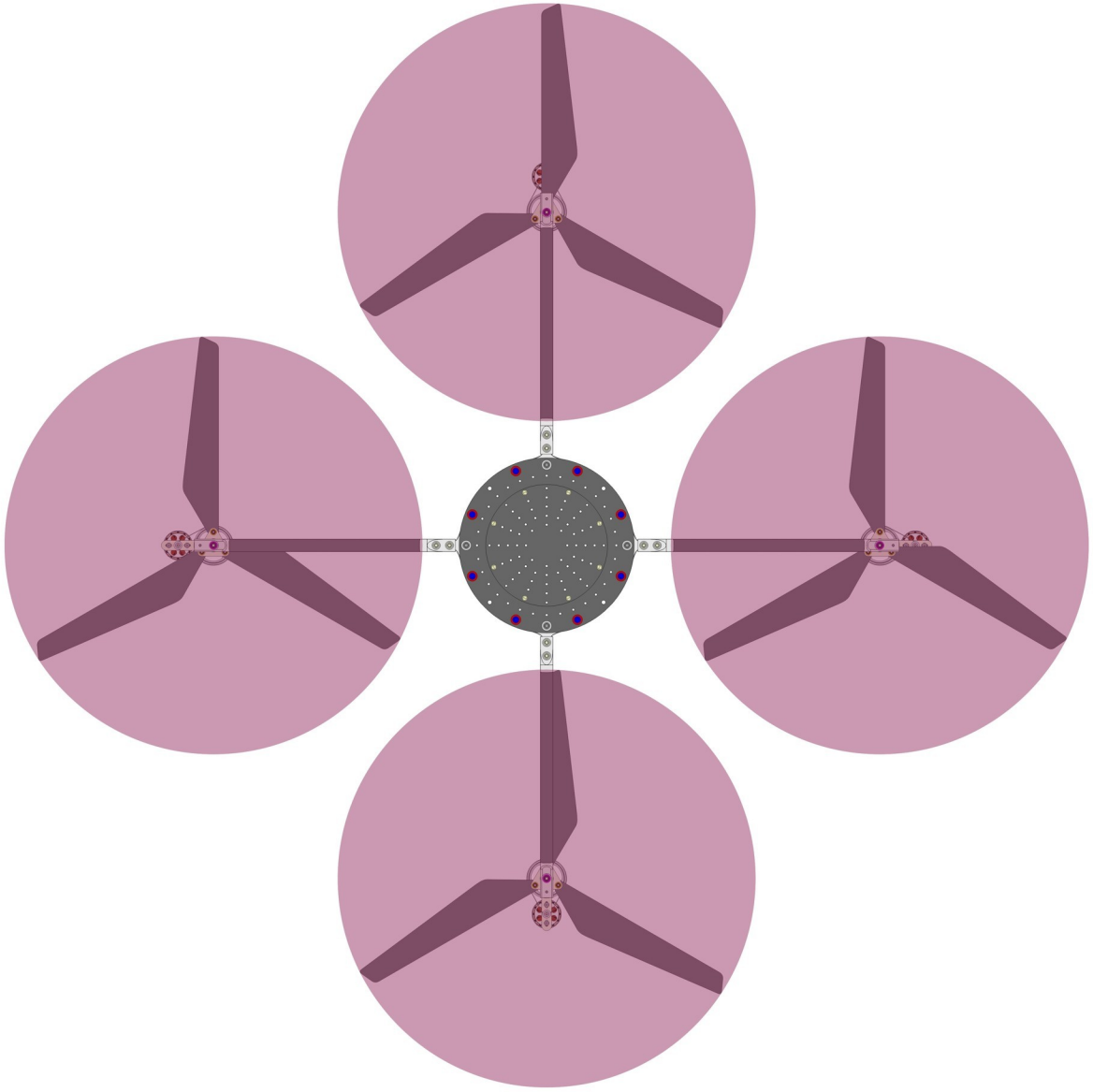
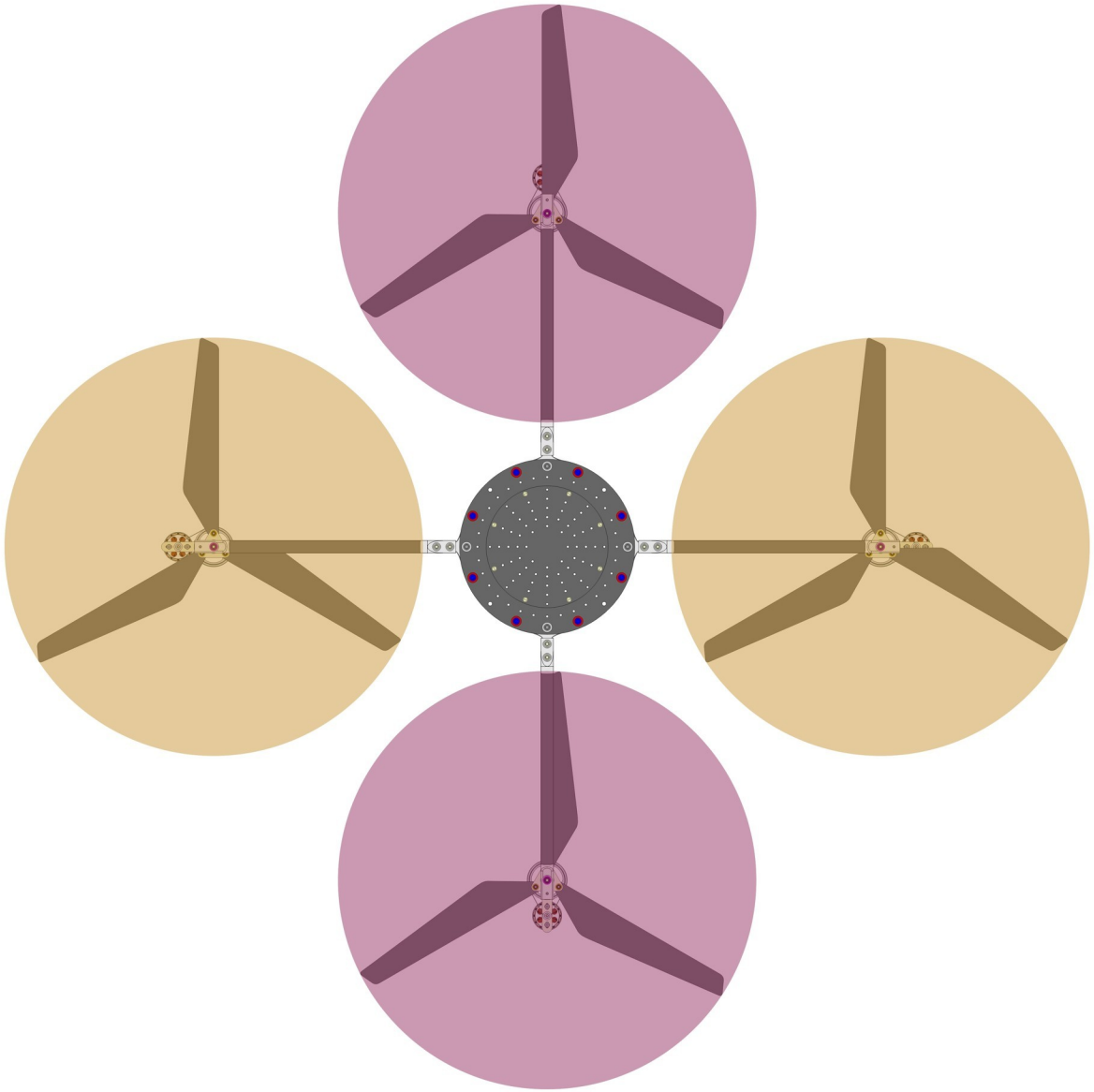


Quadrotor Dynamics: Roll



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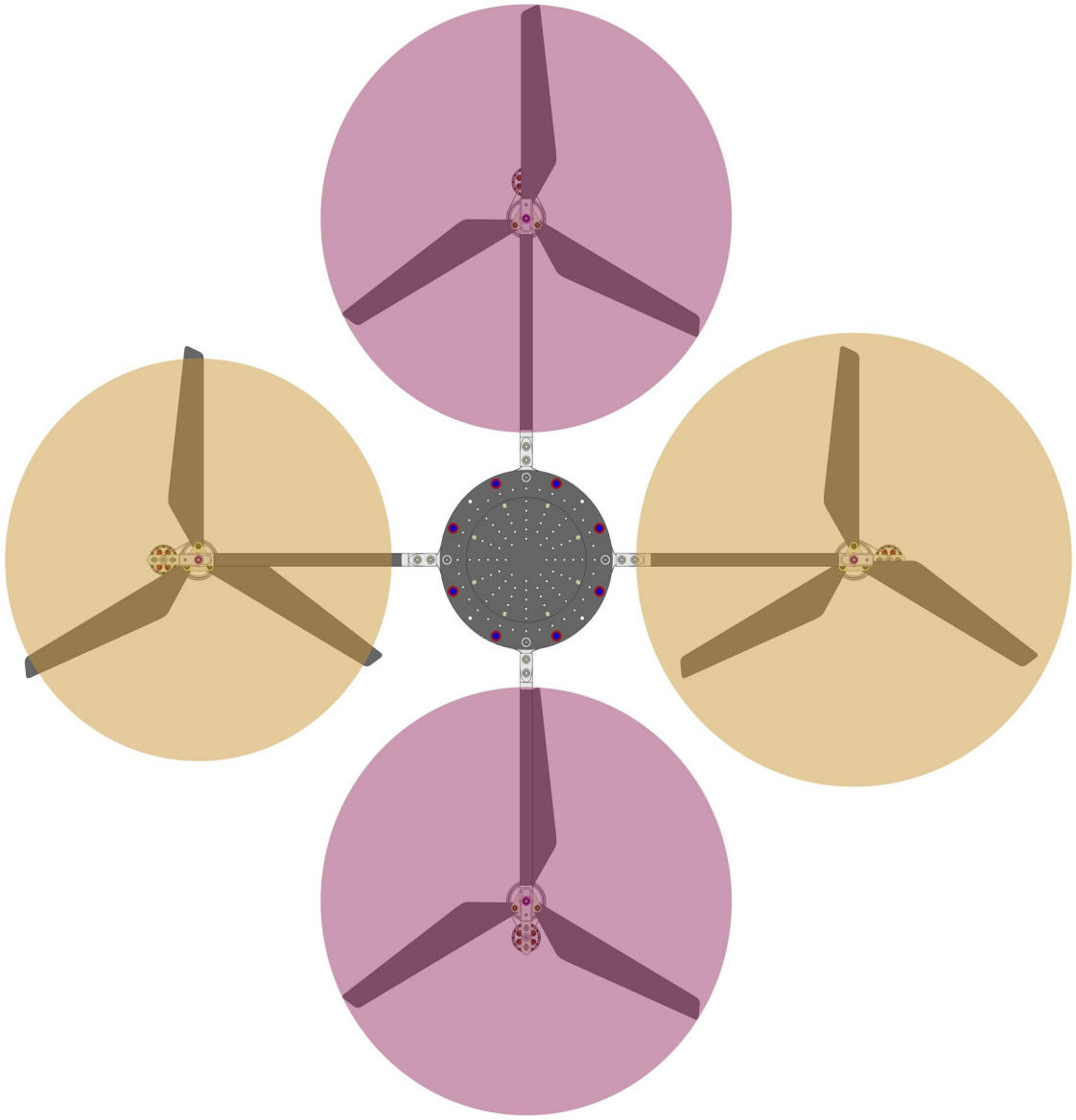

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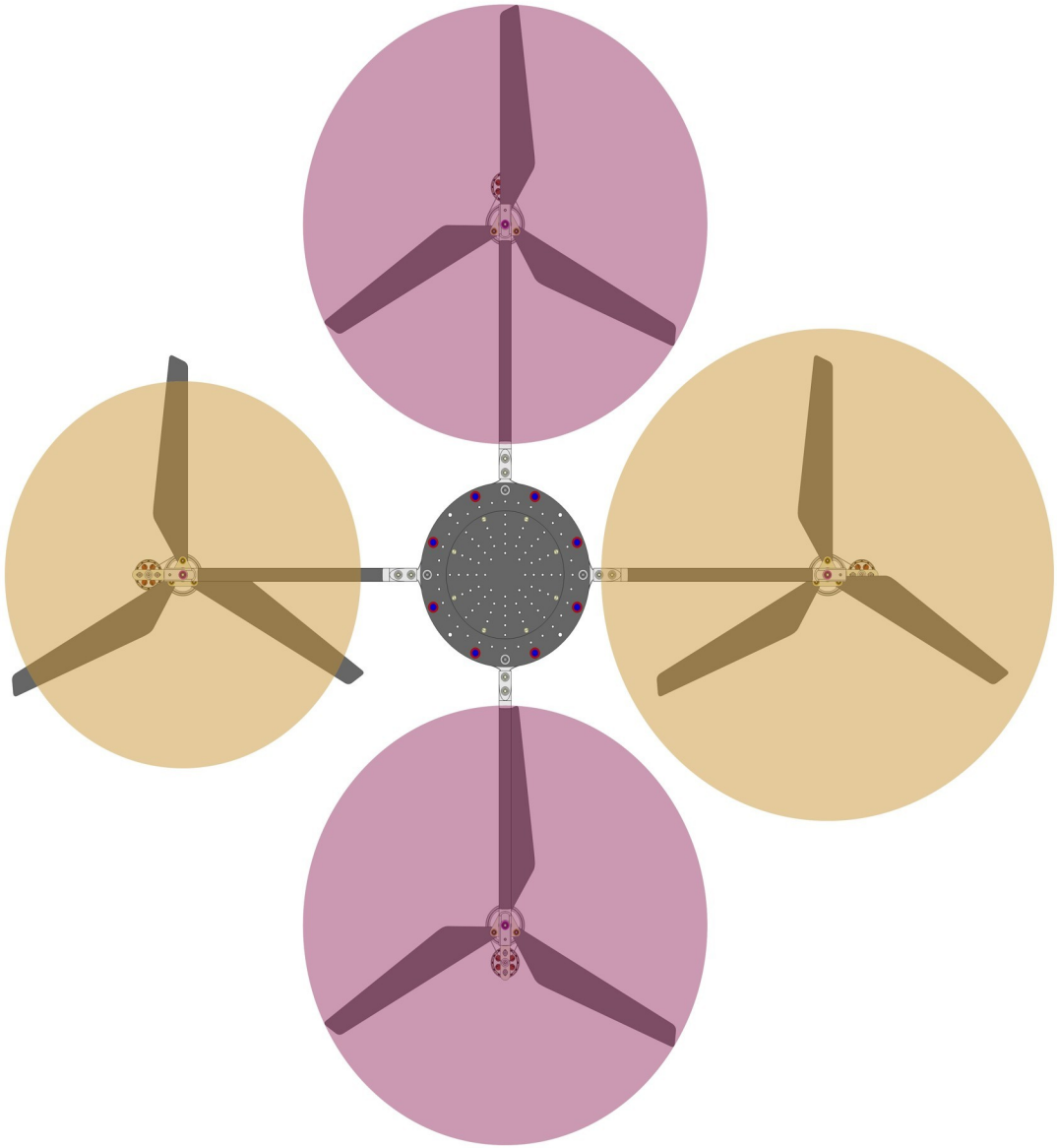

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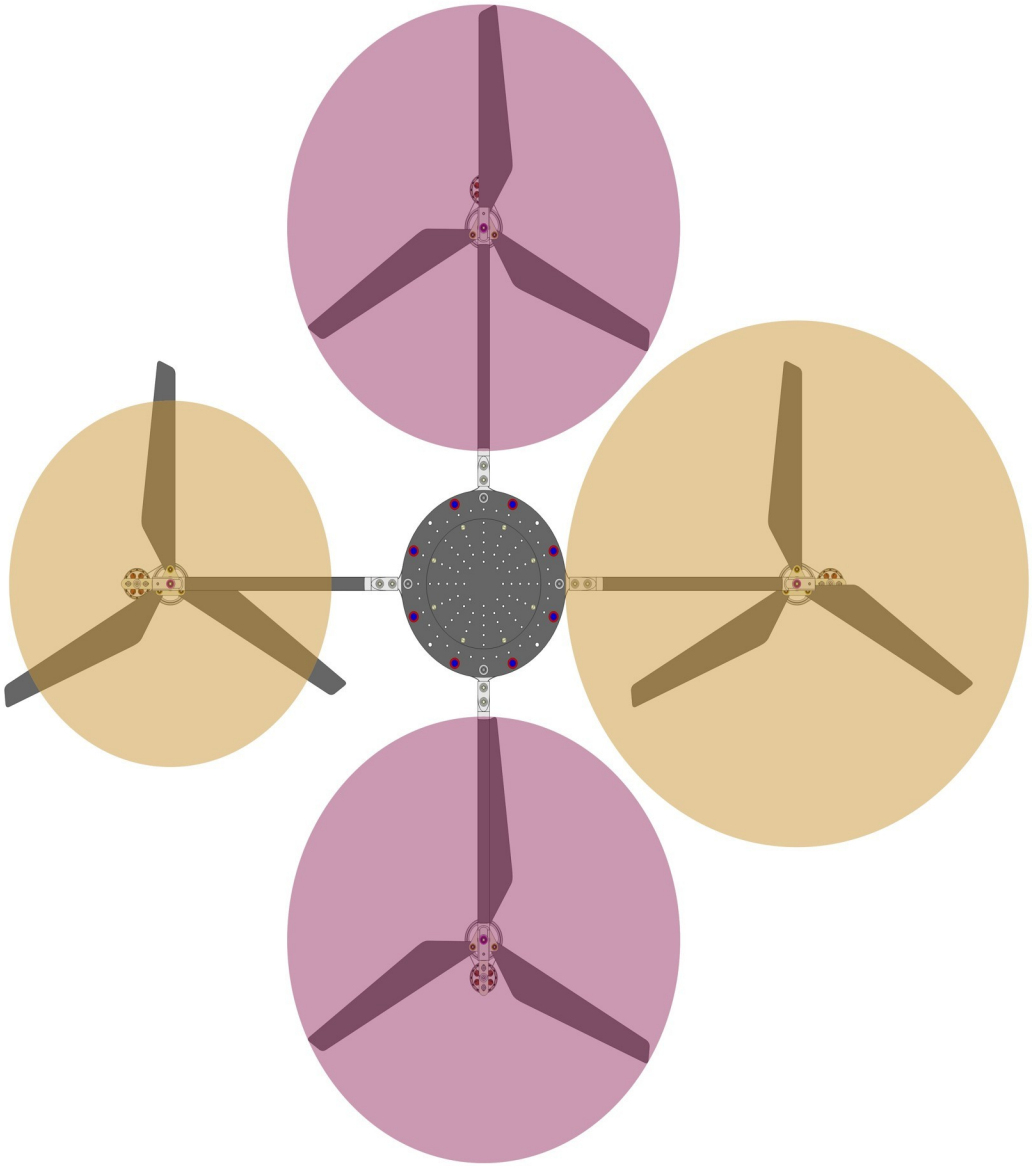

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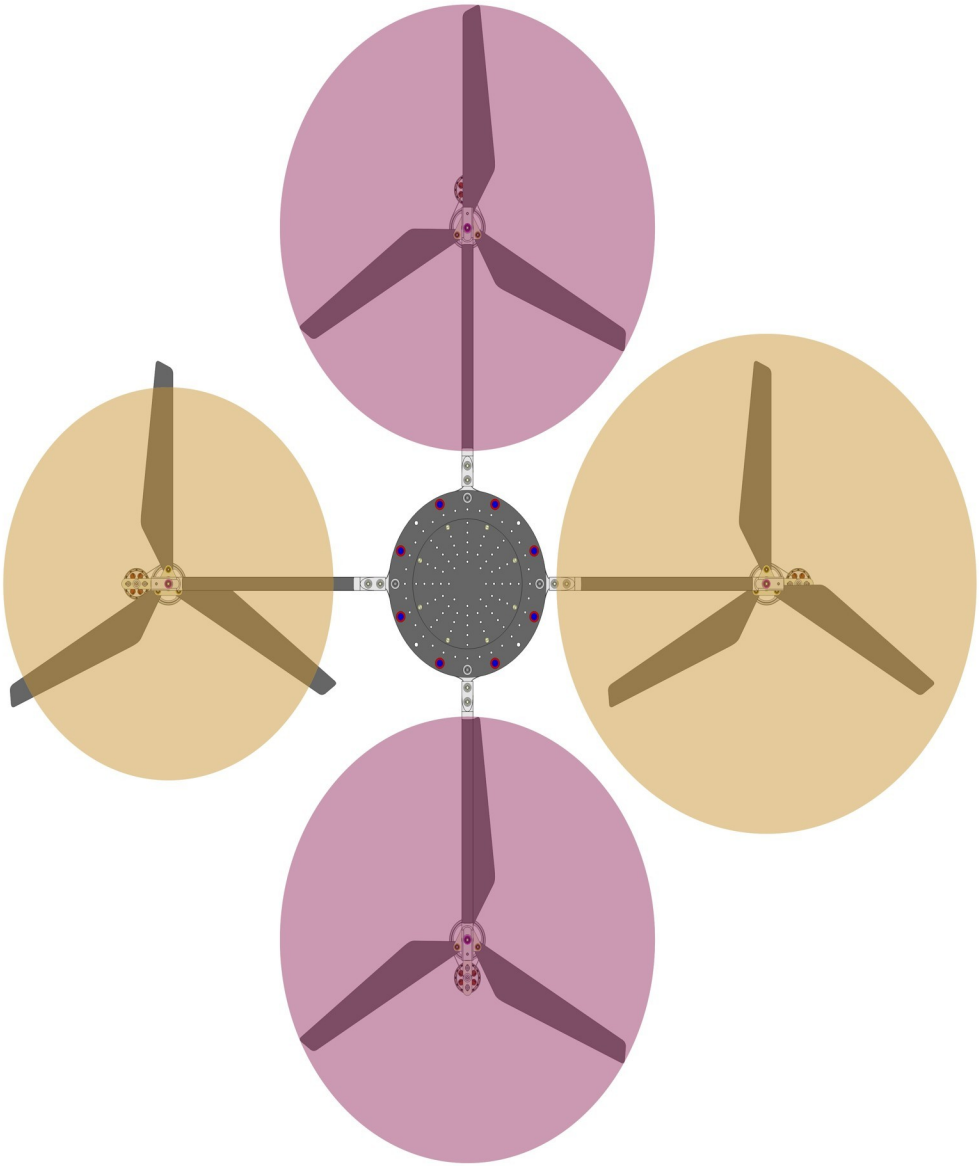

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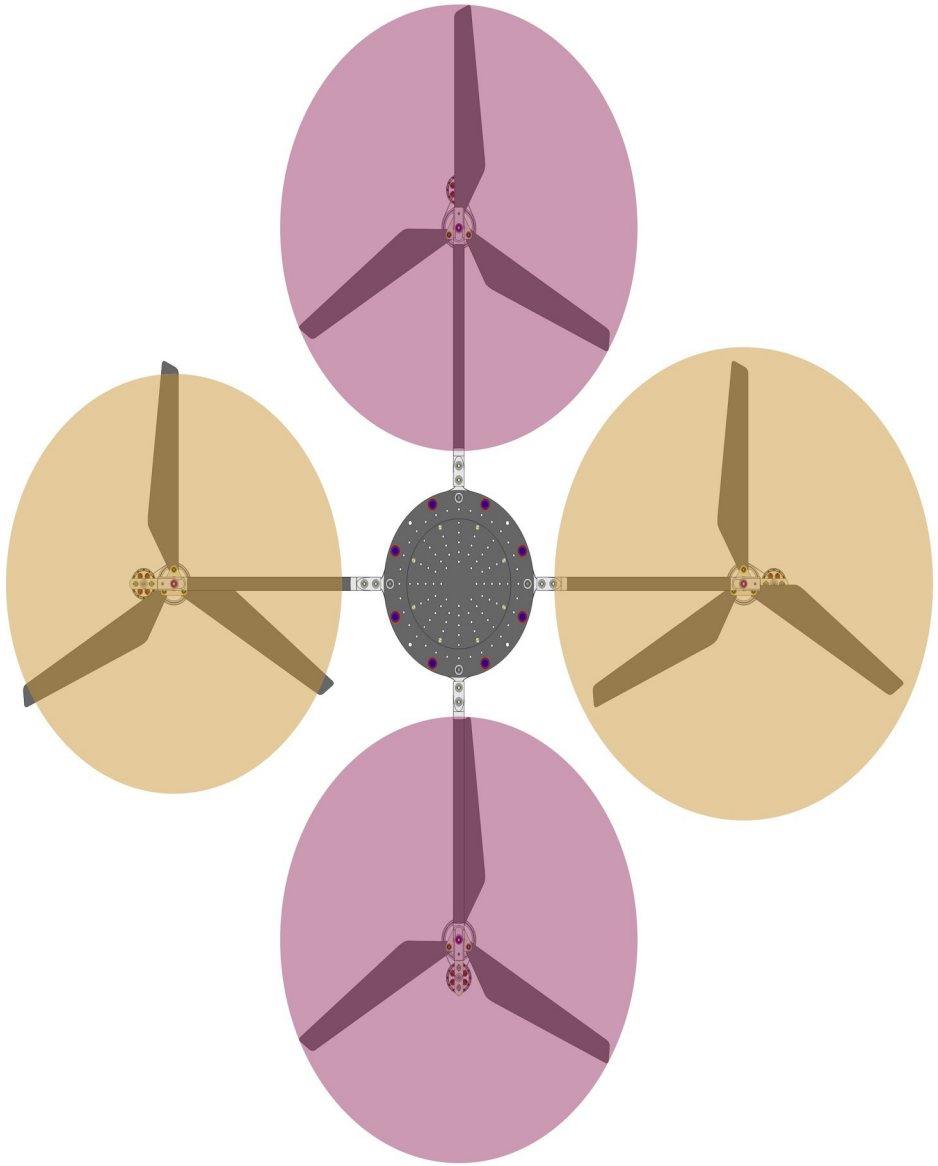

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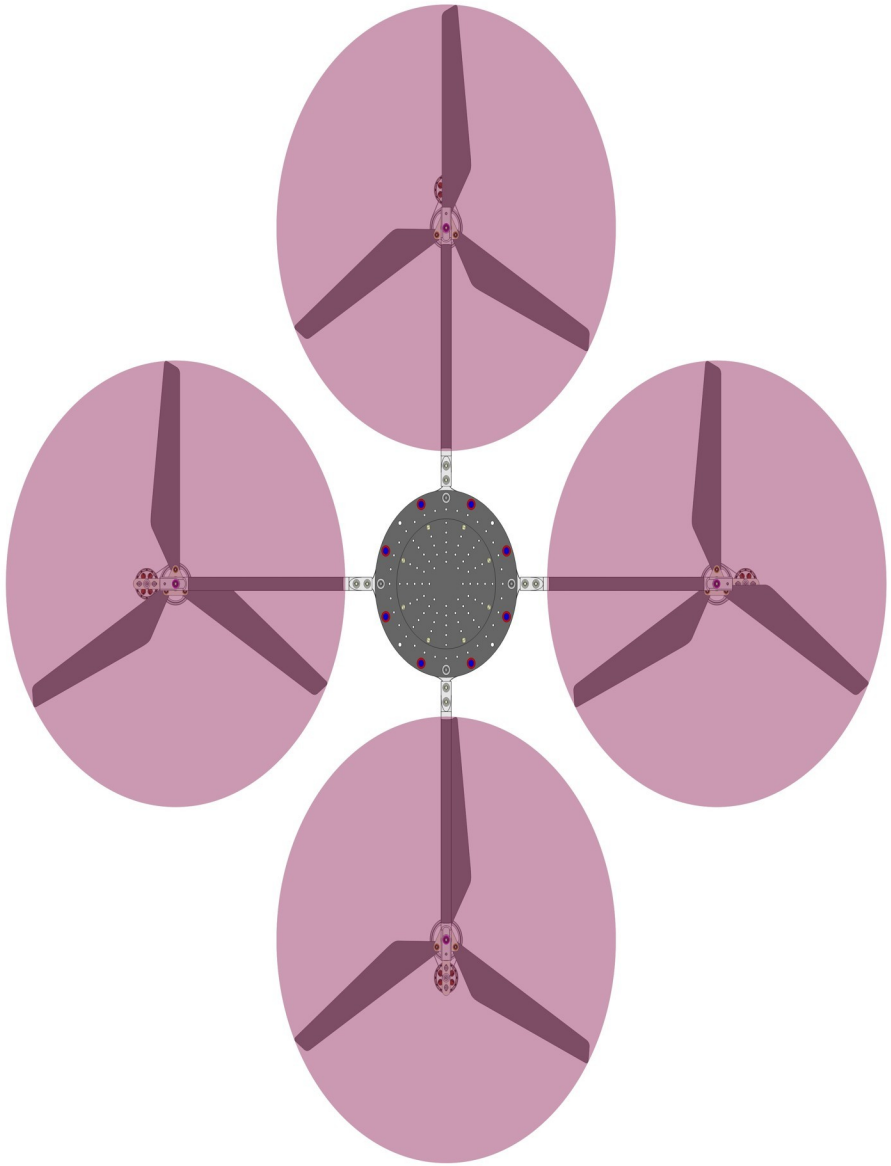

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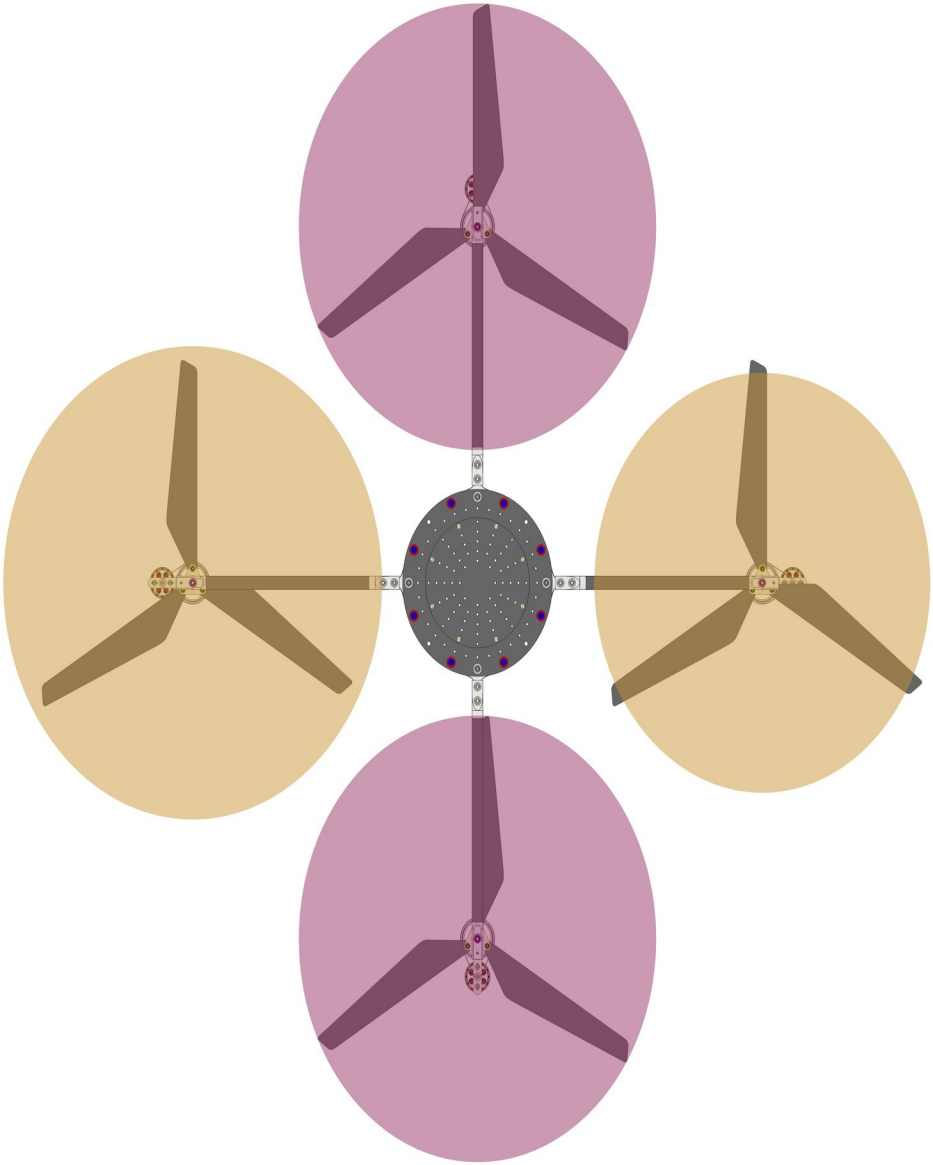
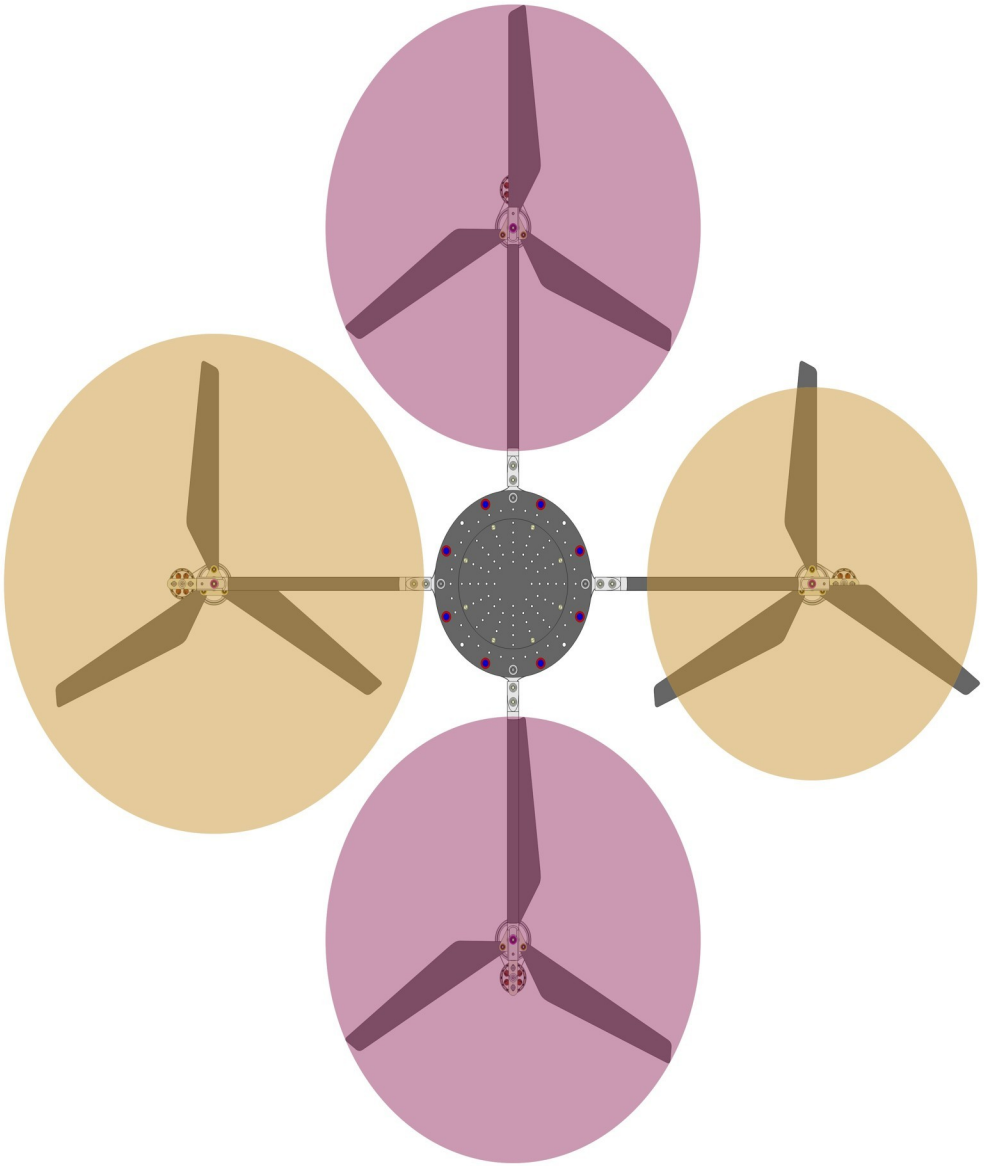


Quadrotor Dynamics: Roll



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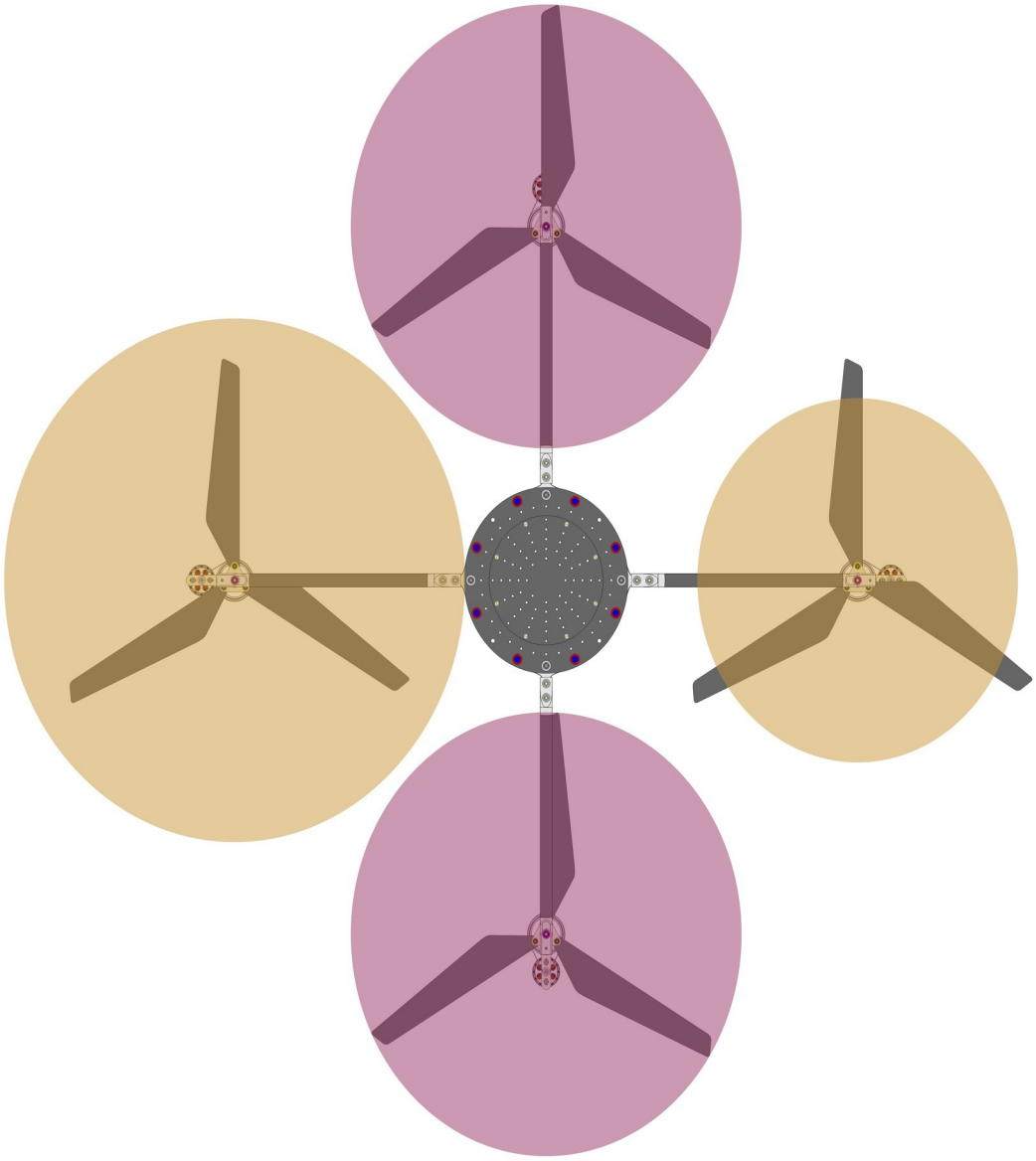

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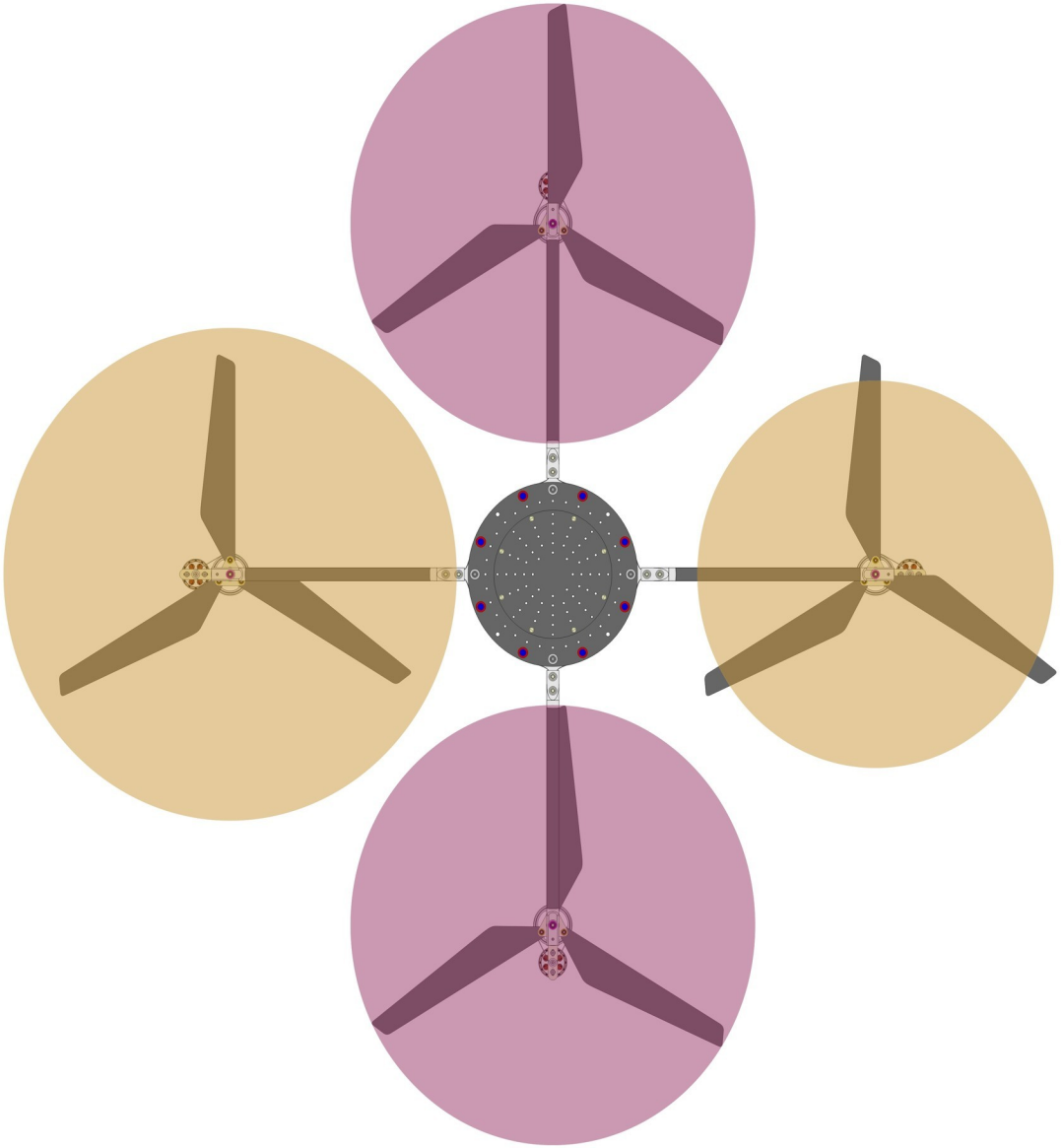

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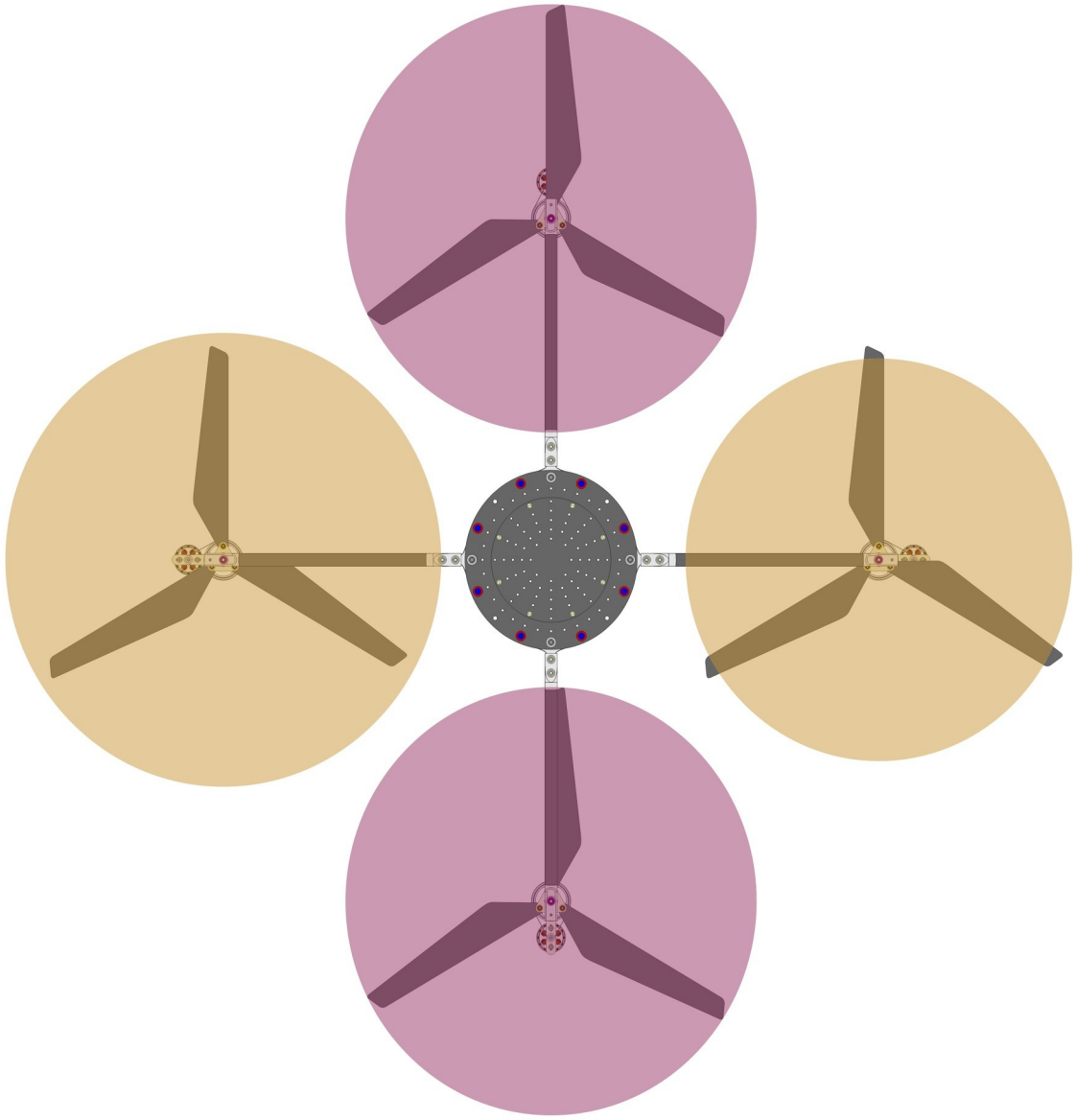

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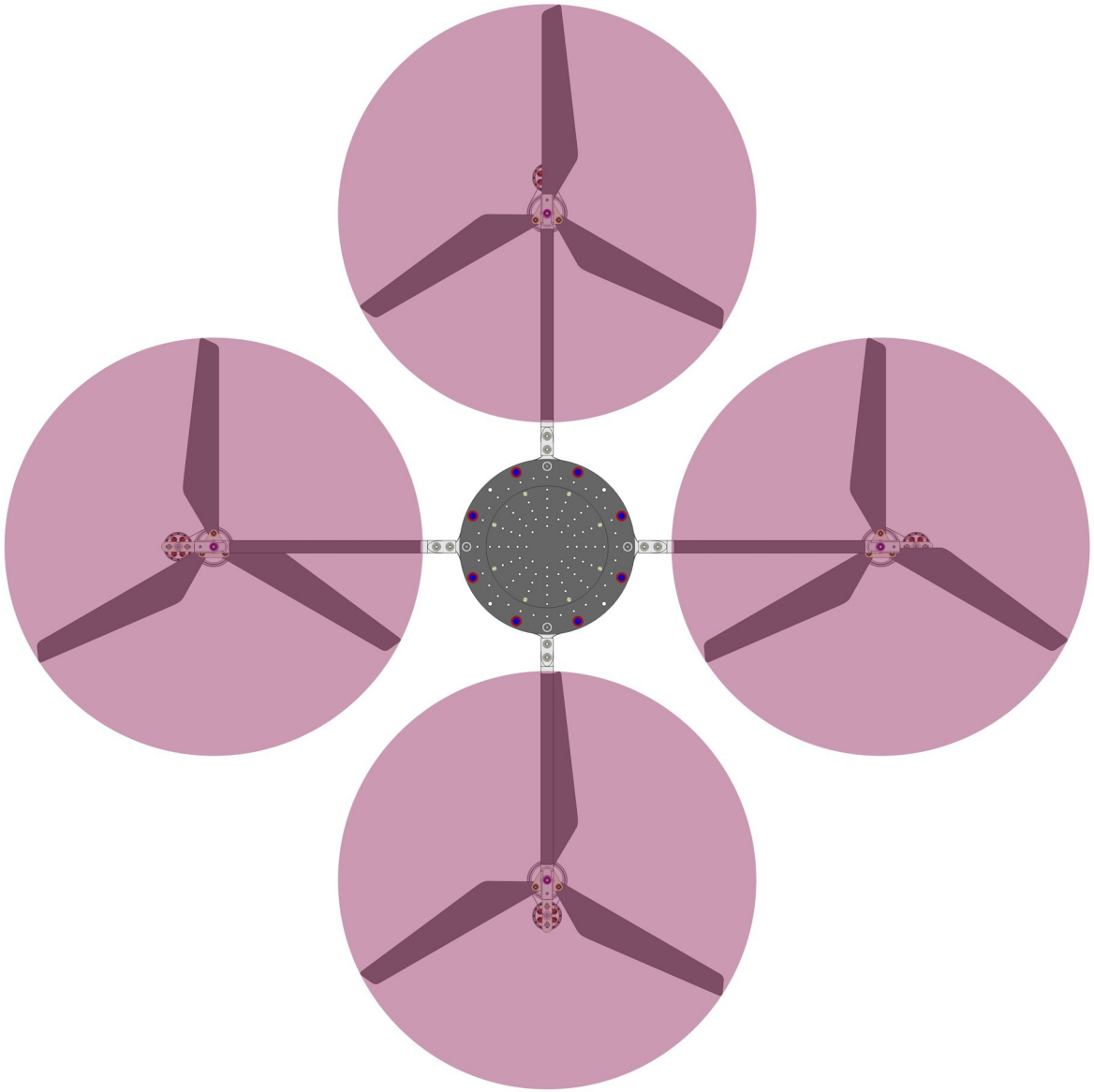
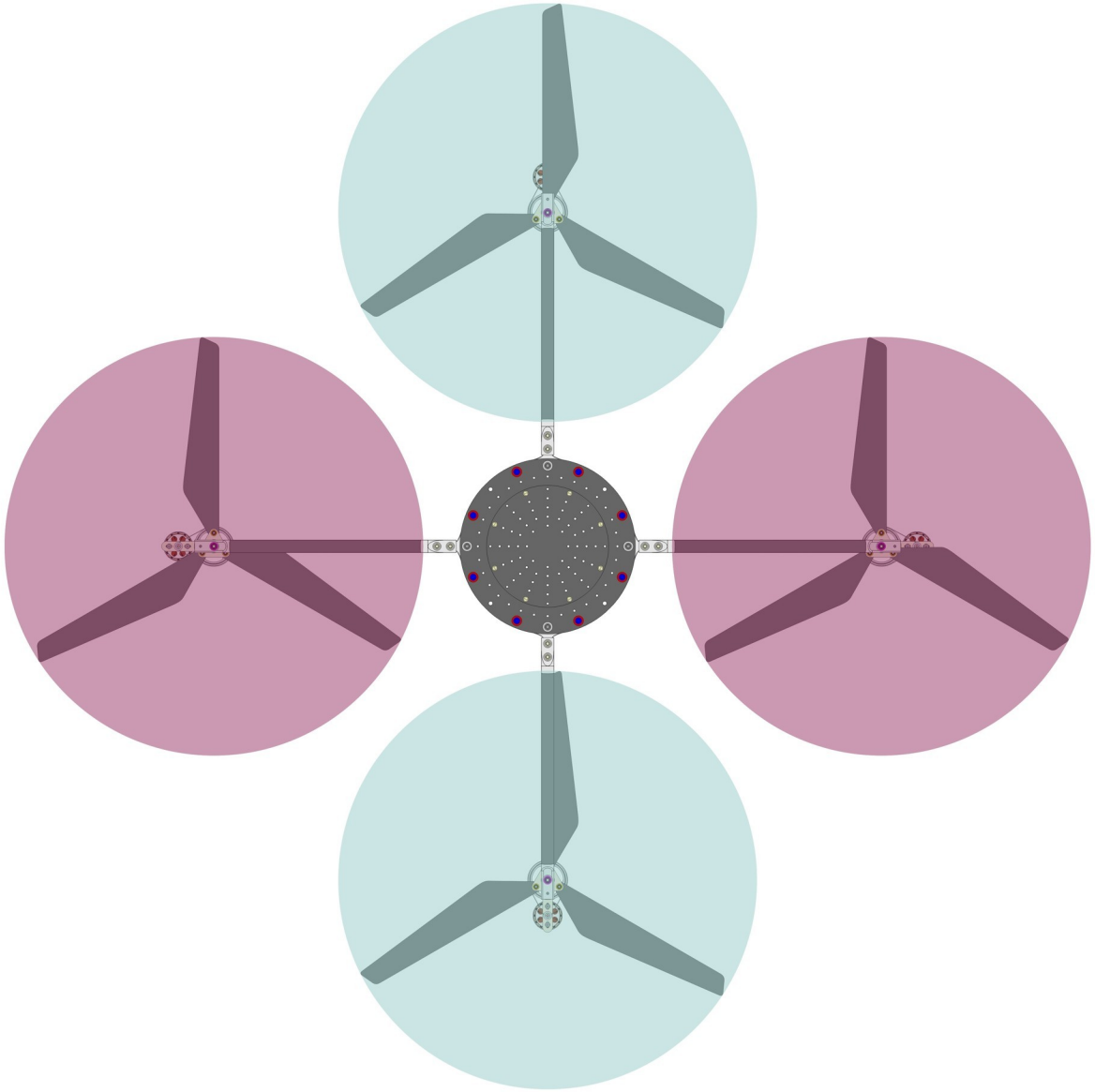


Quadrotor Dynamics: Pitch



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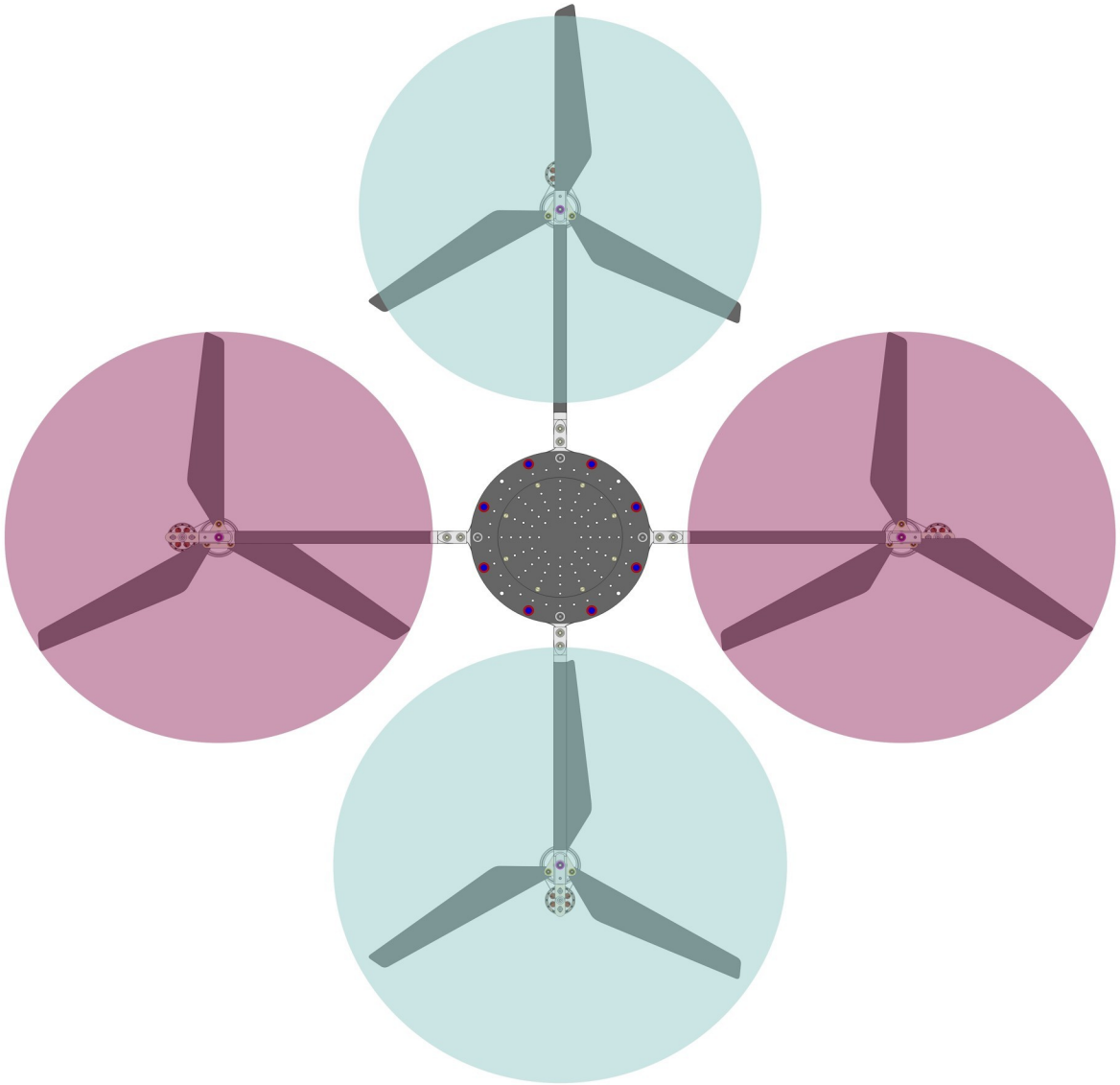

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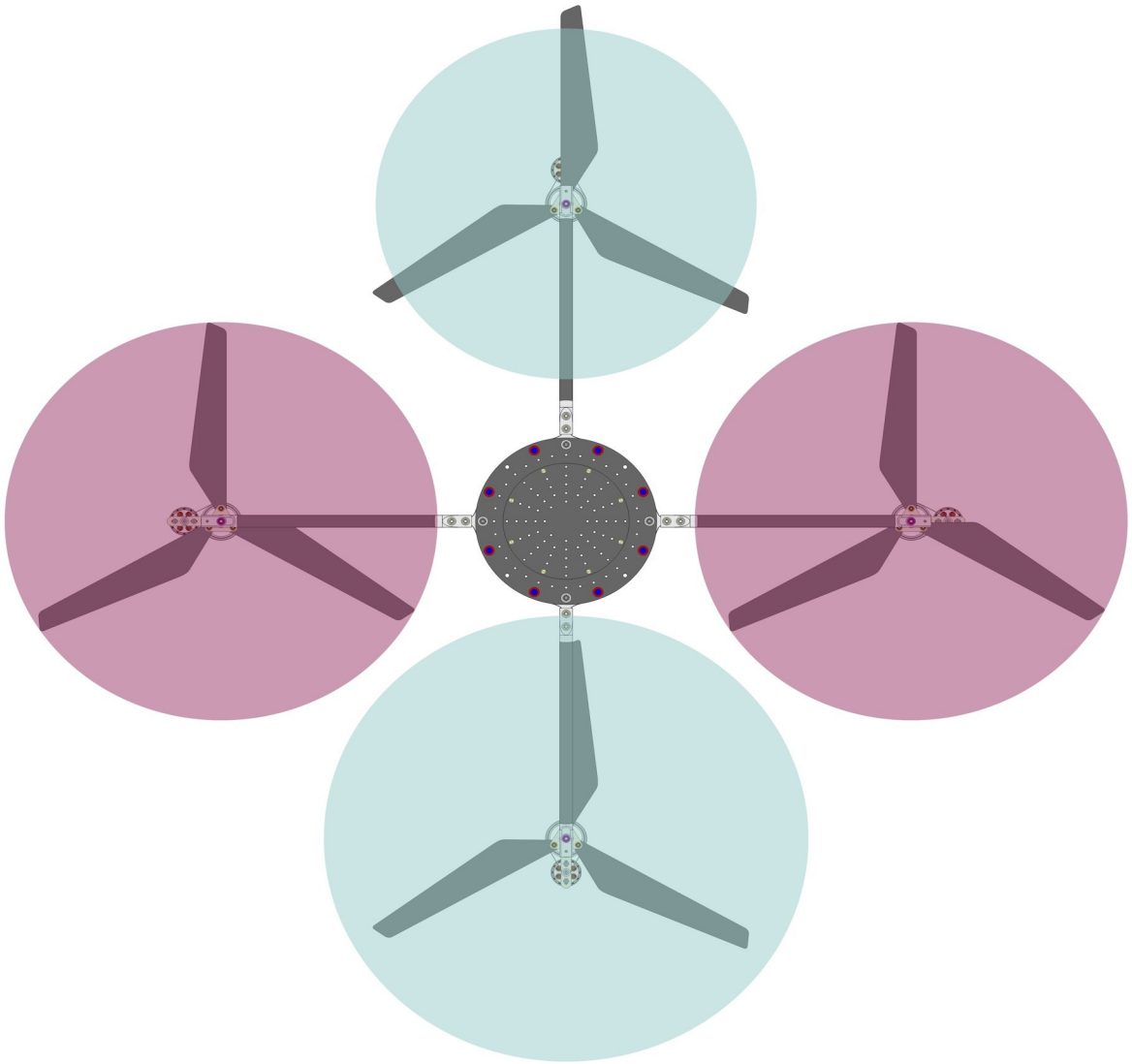

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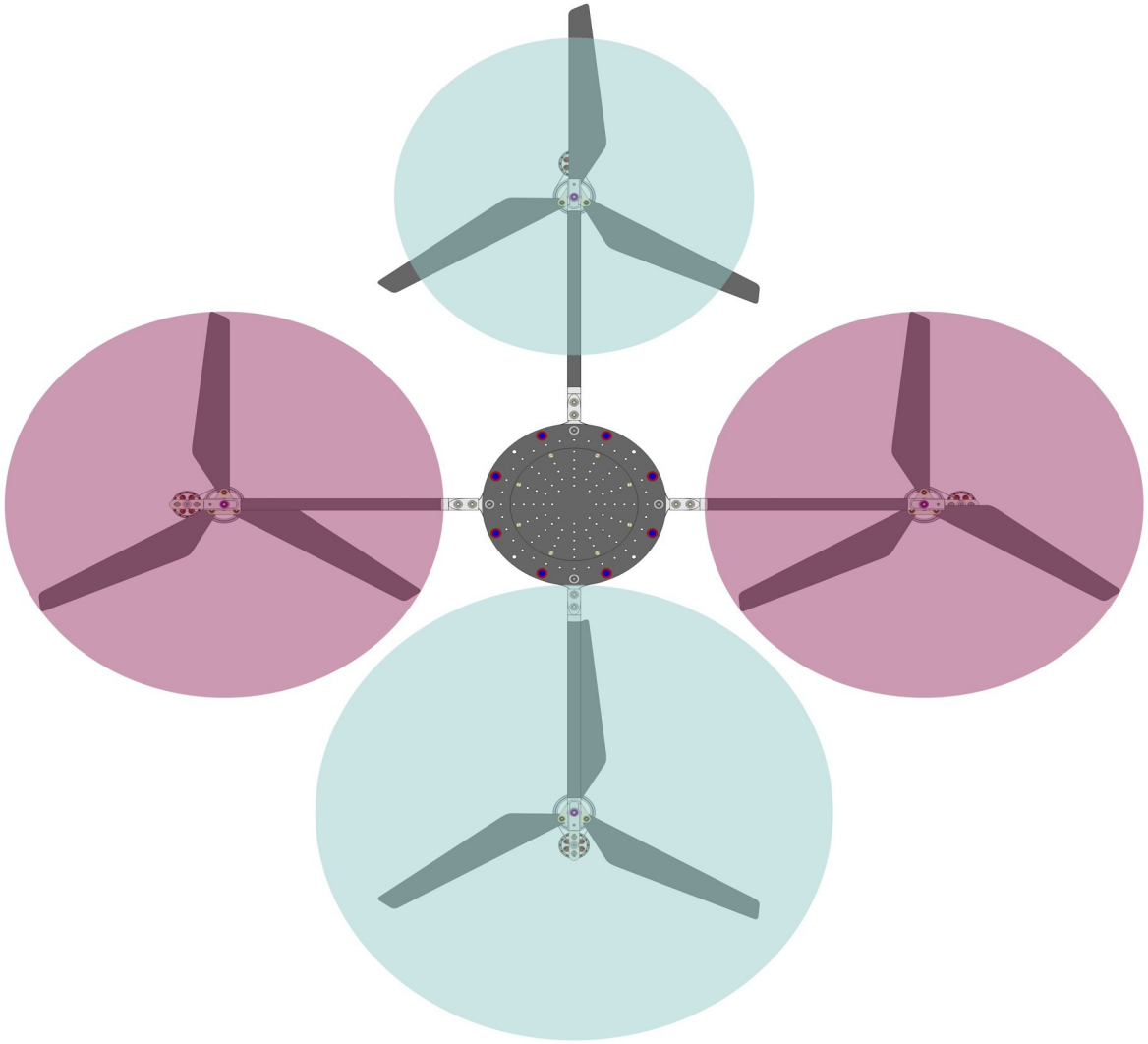

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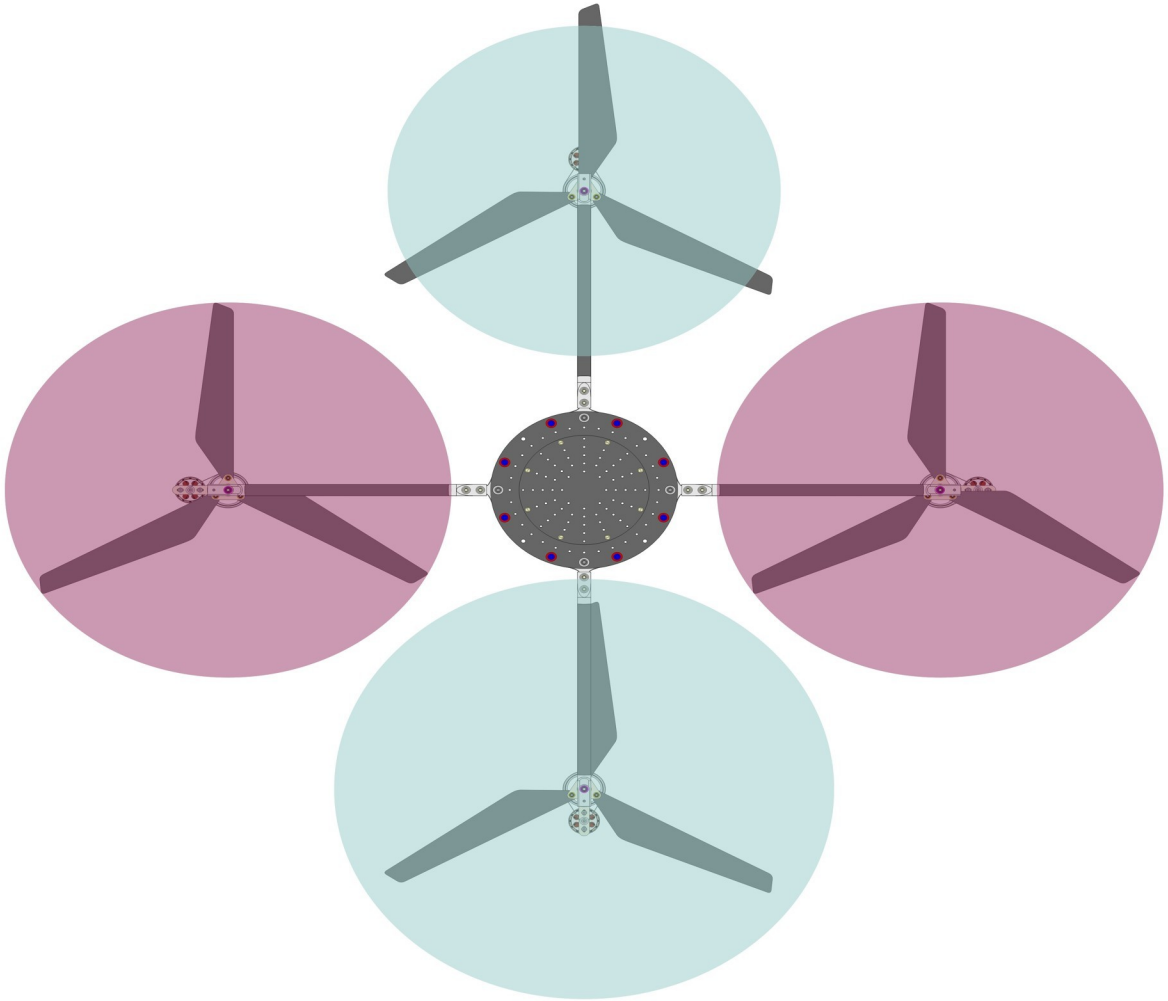

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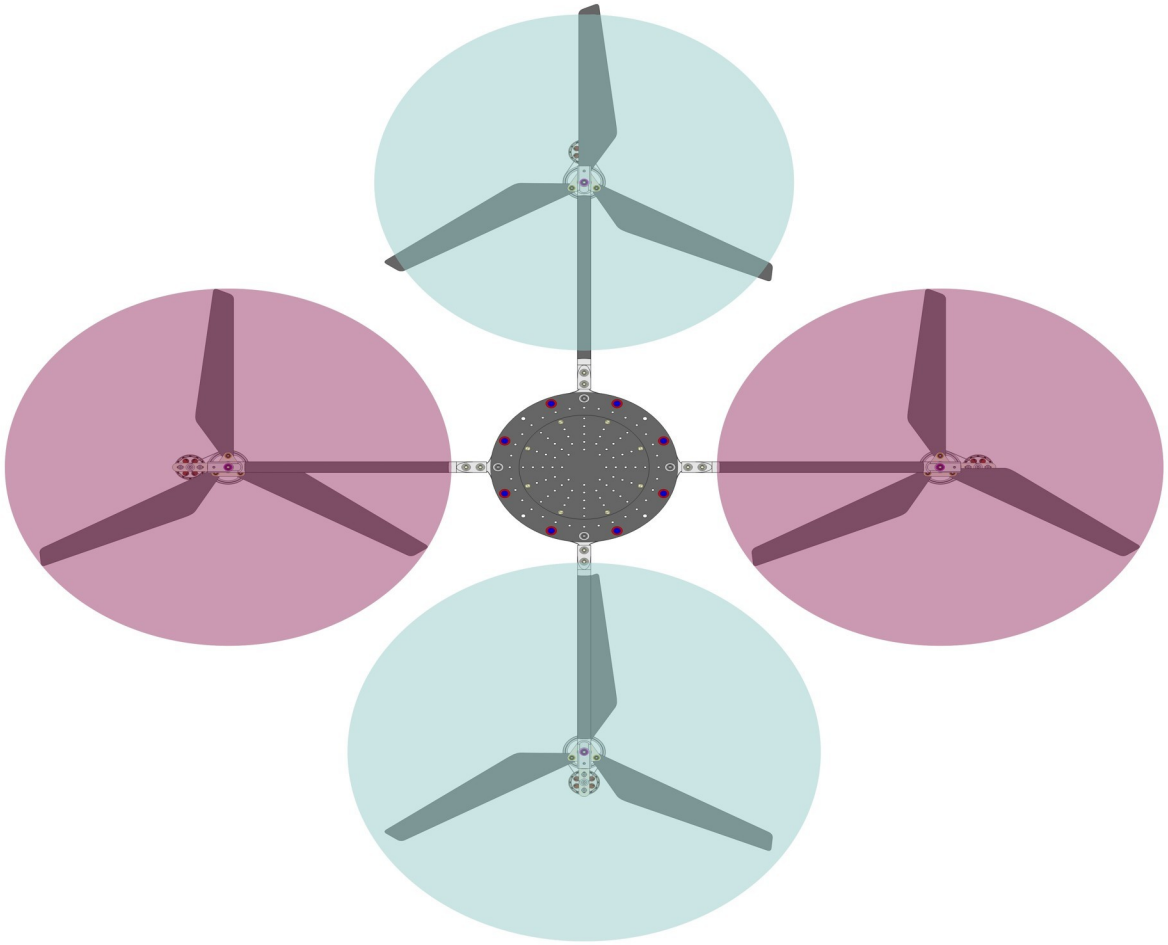

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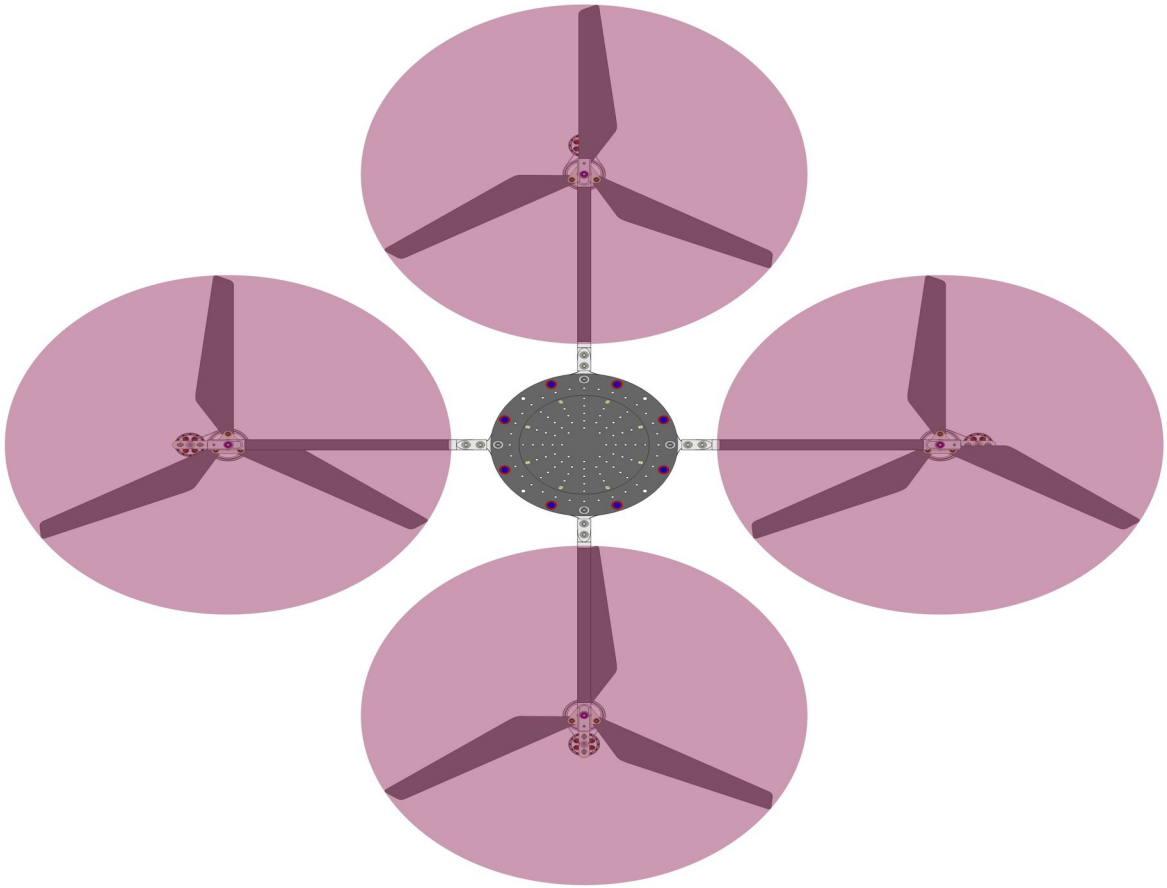

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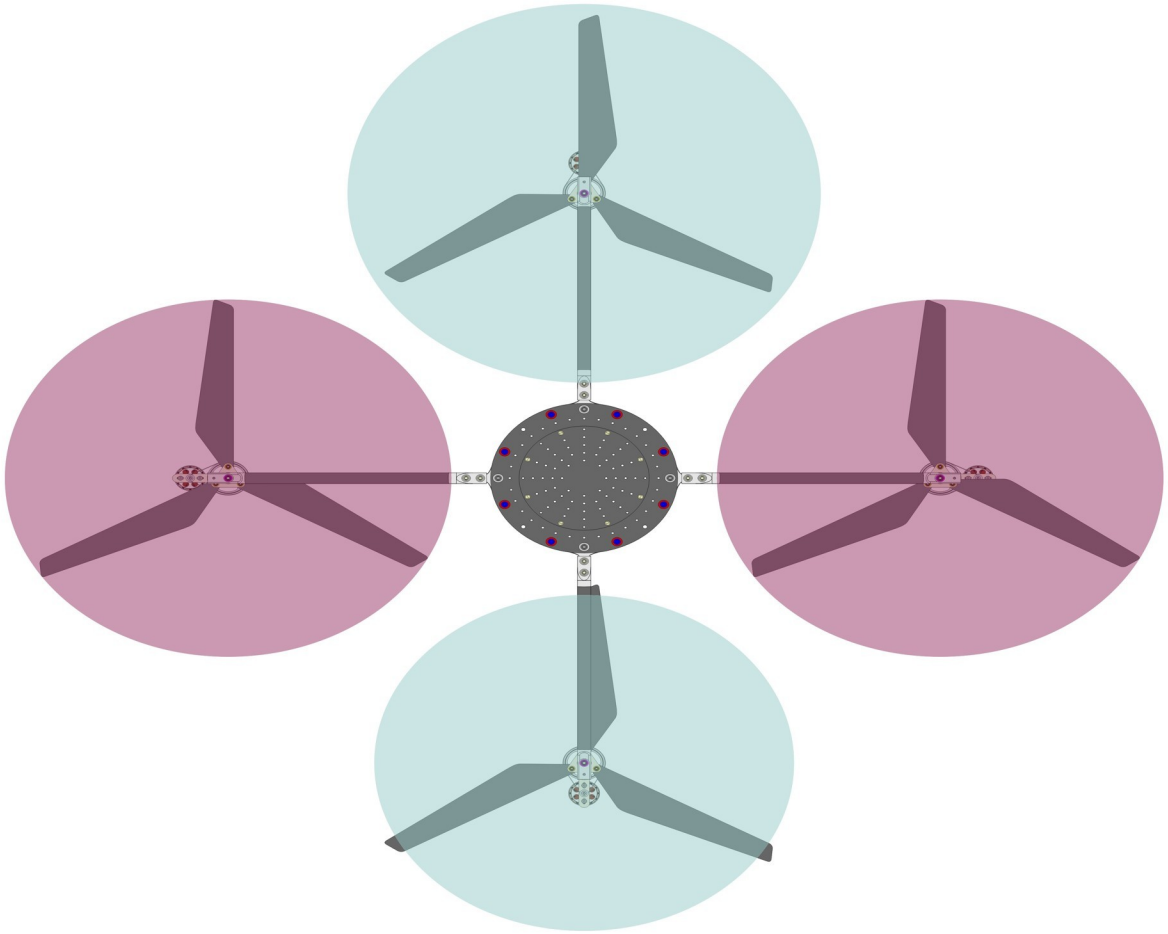

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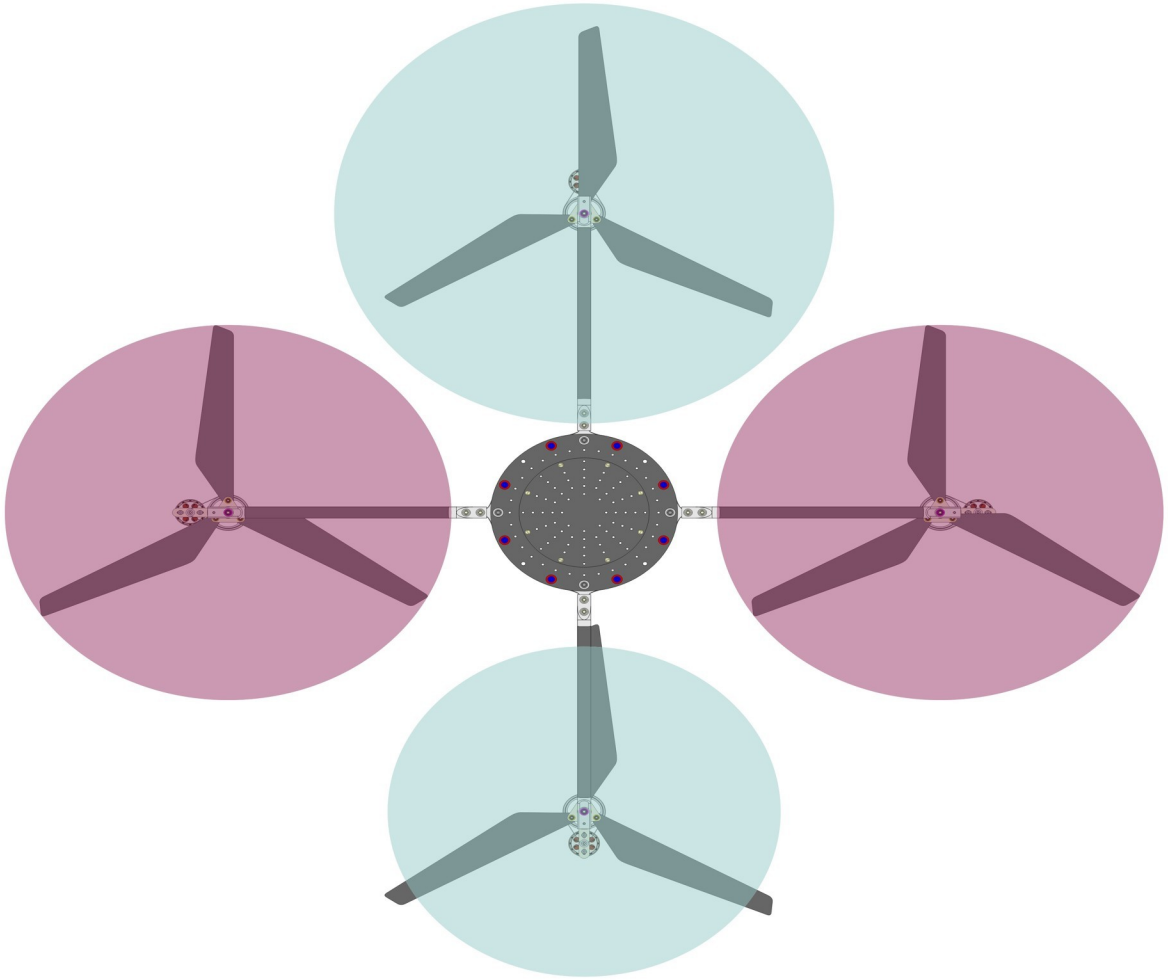

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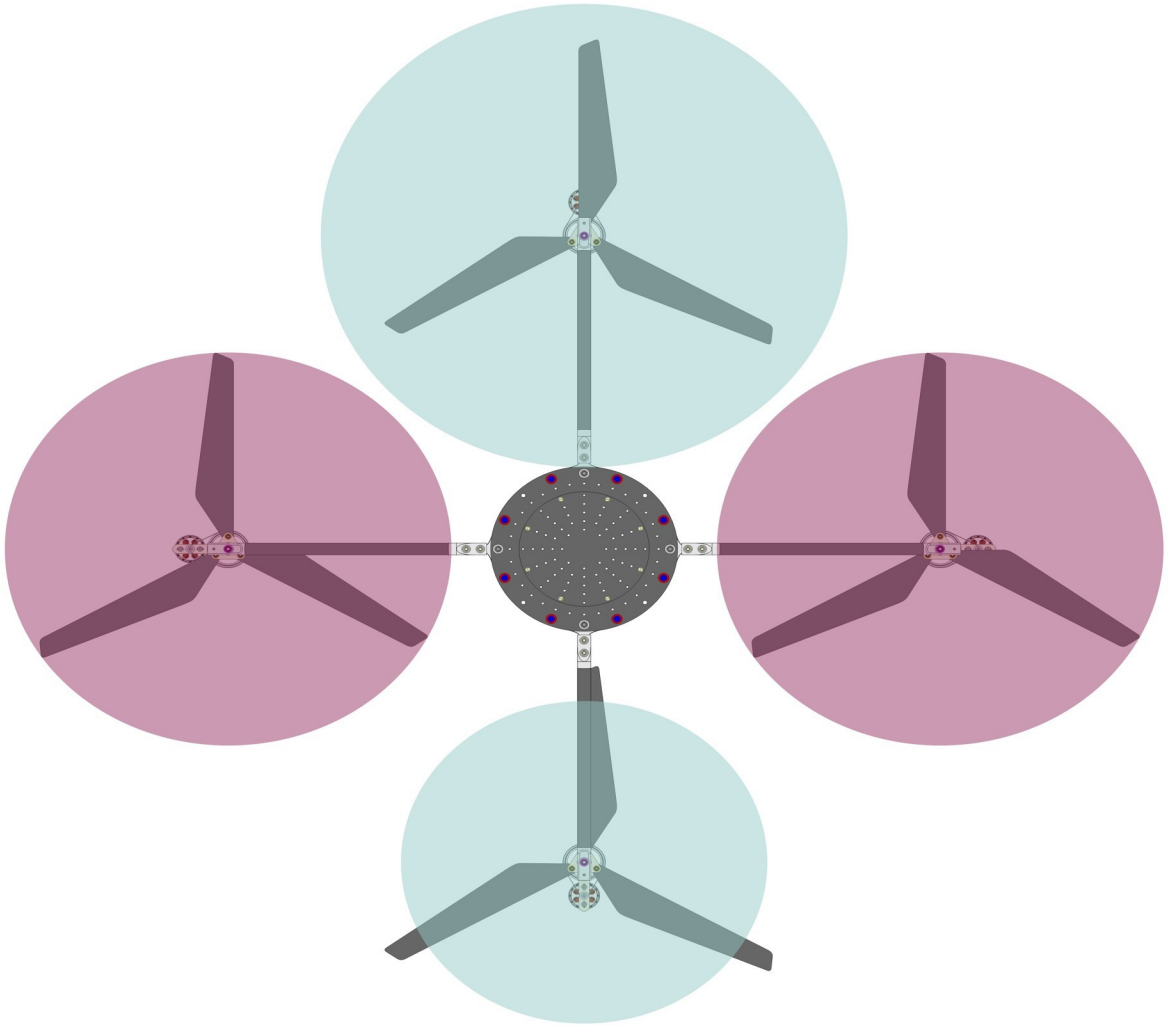

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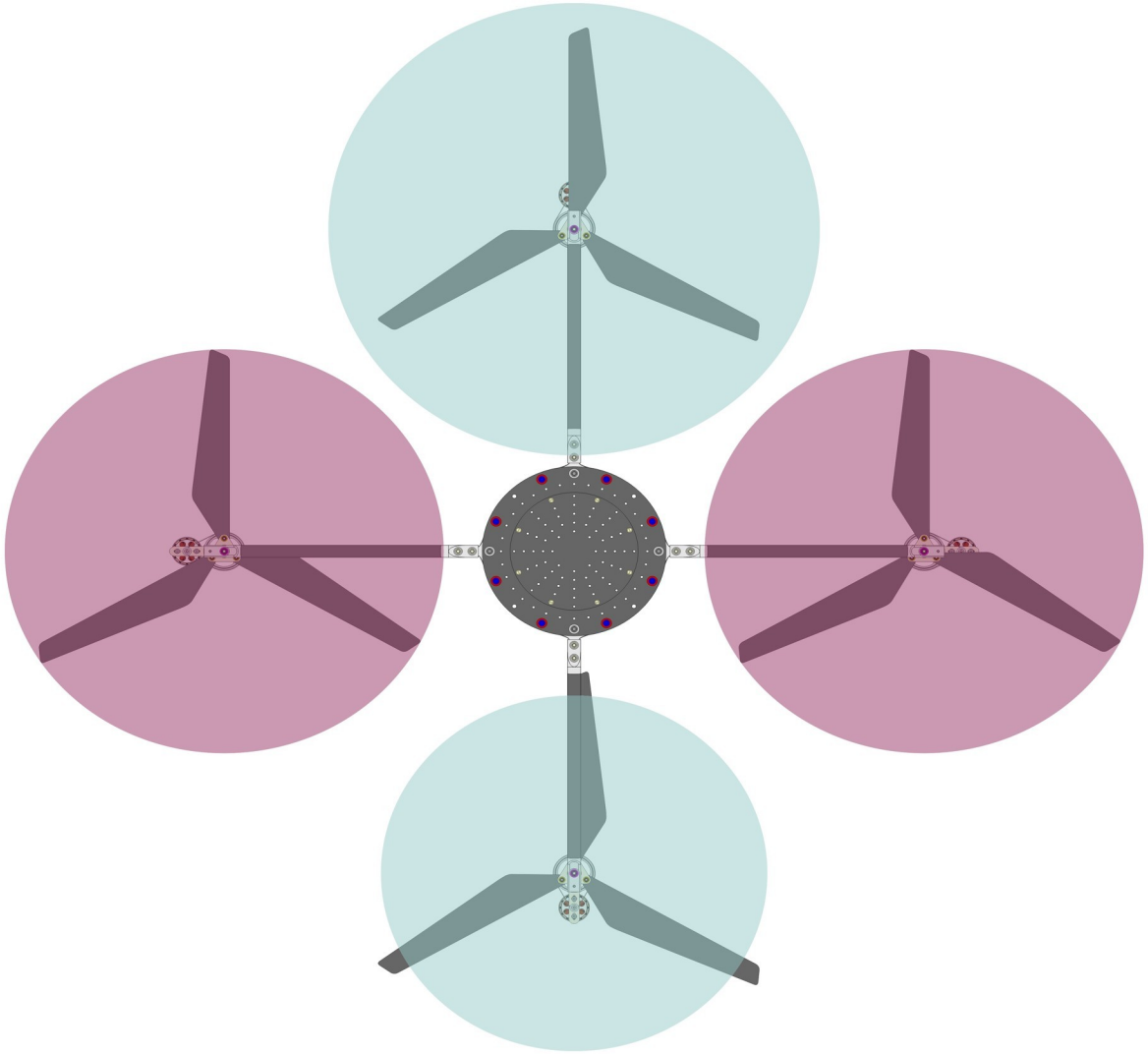
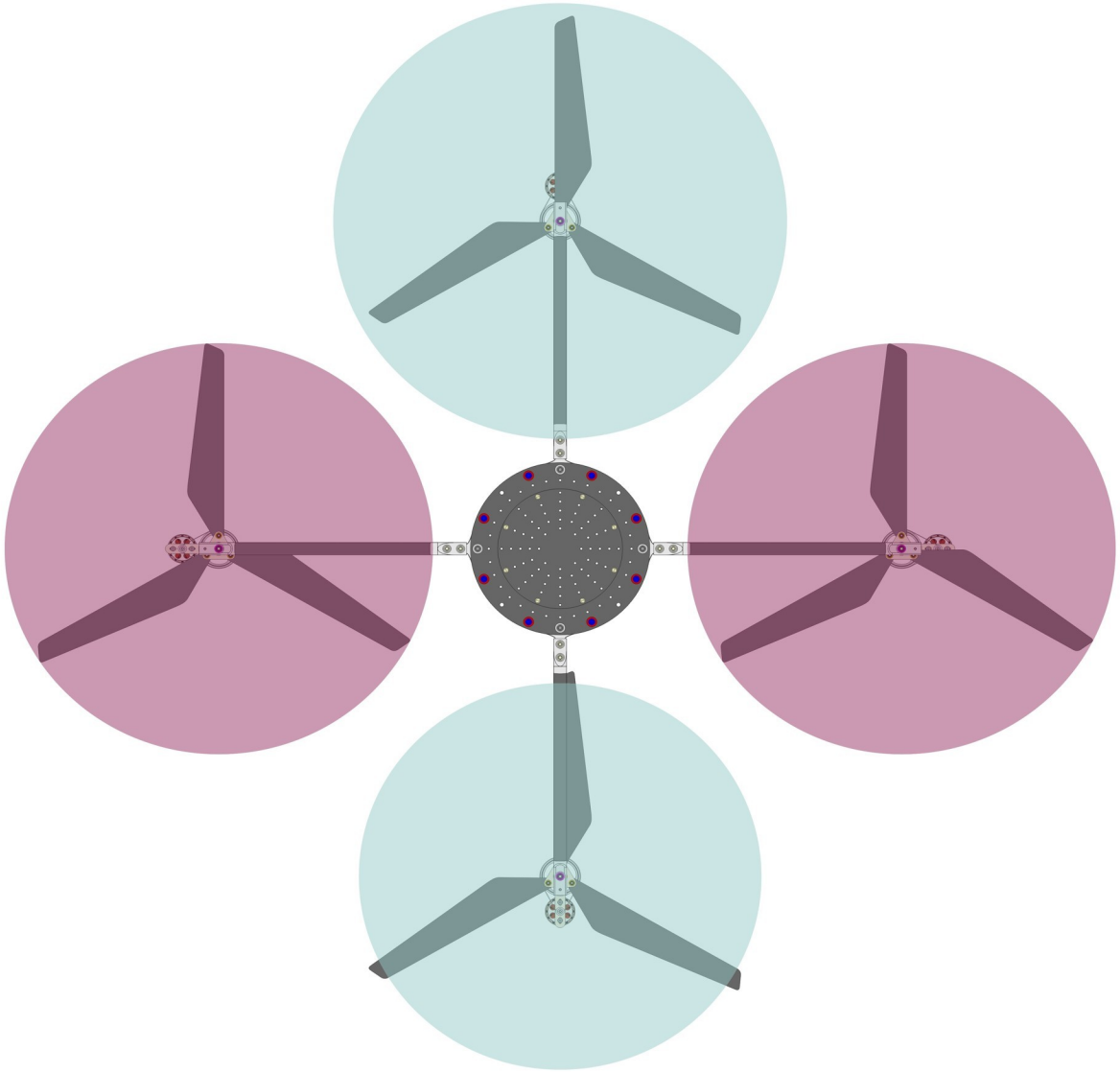


Quadrotor Dynamics: Pitch



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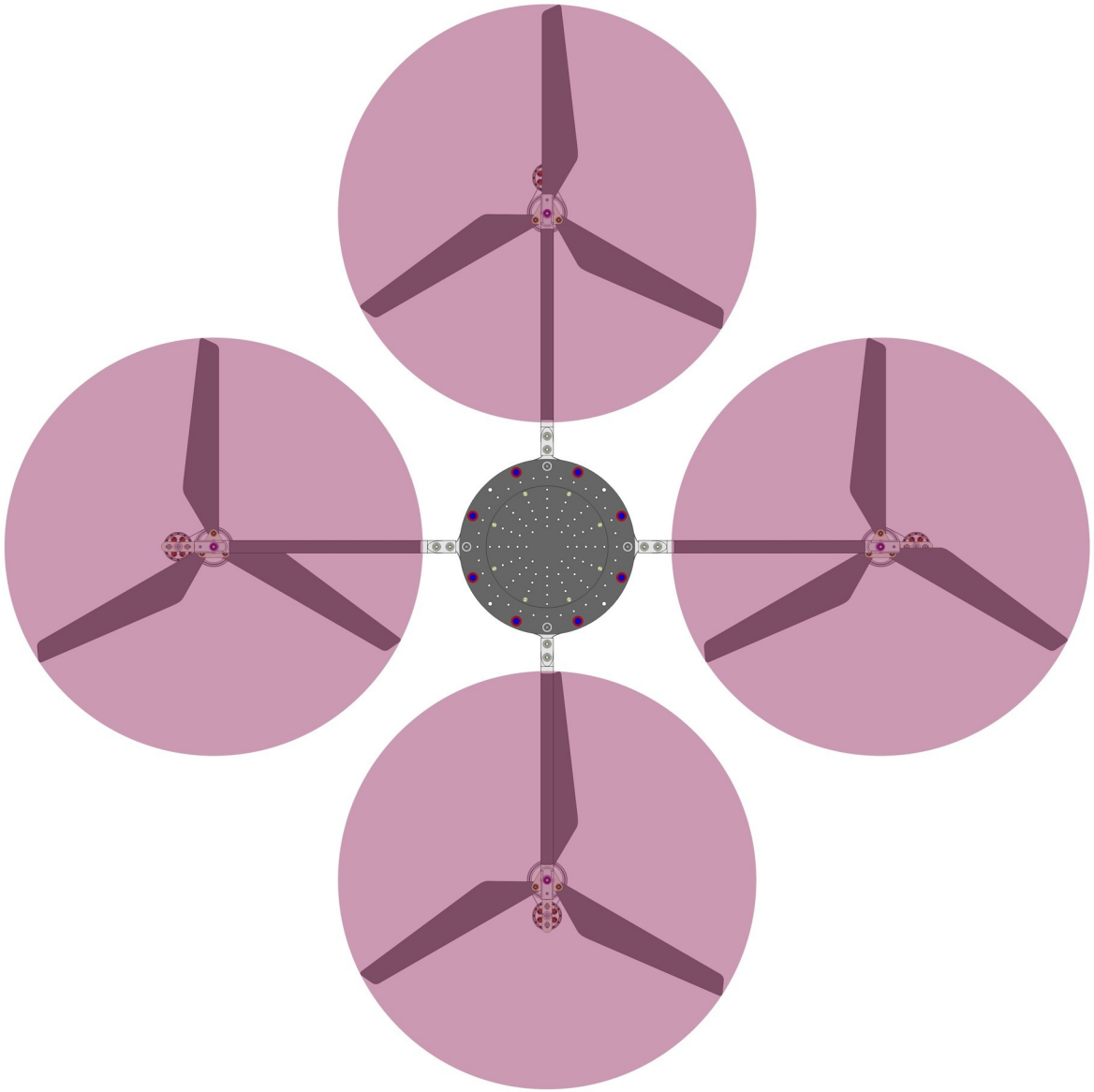
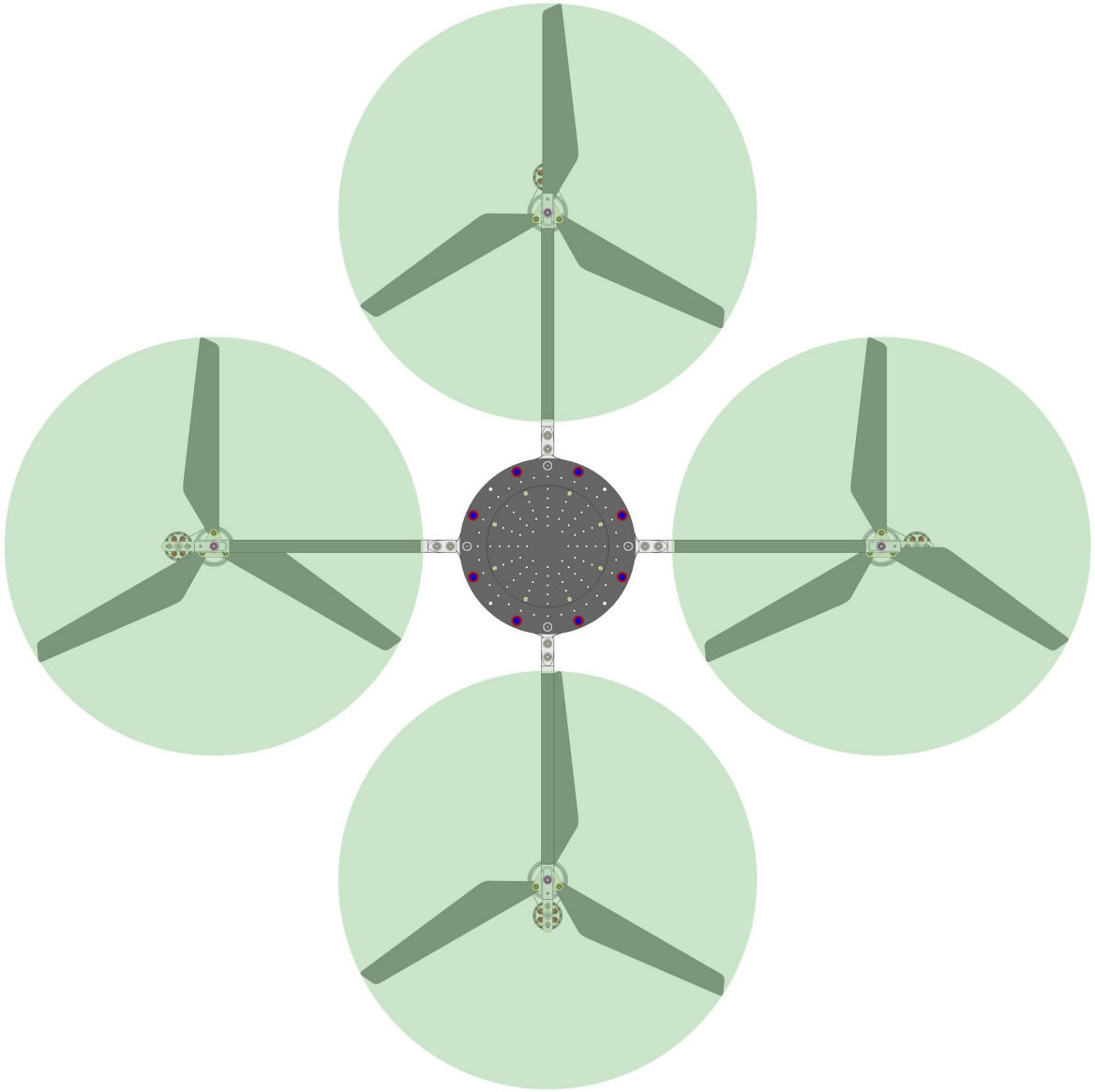


Quadrotor Dynamics: Yaw



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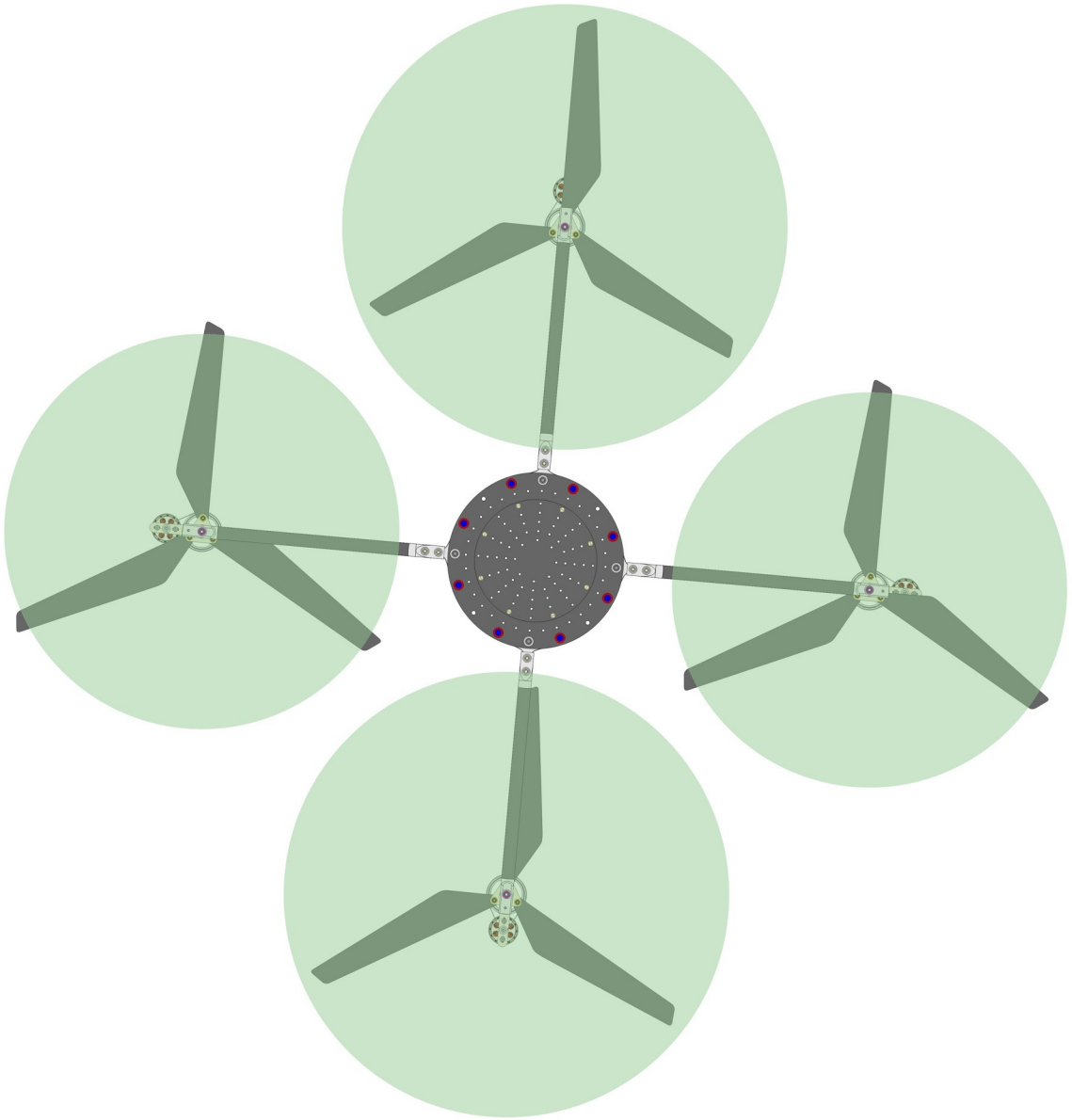

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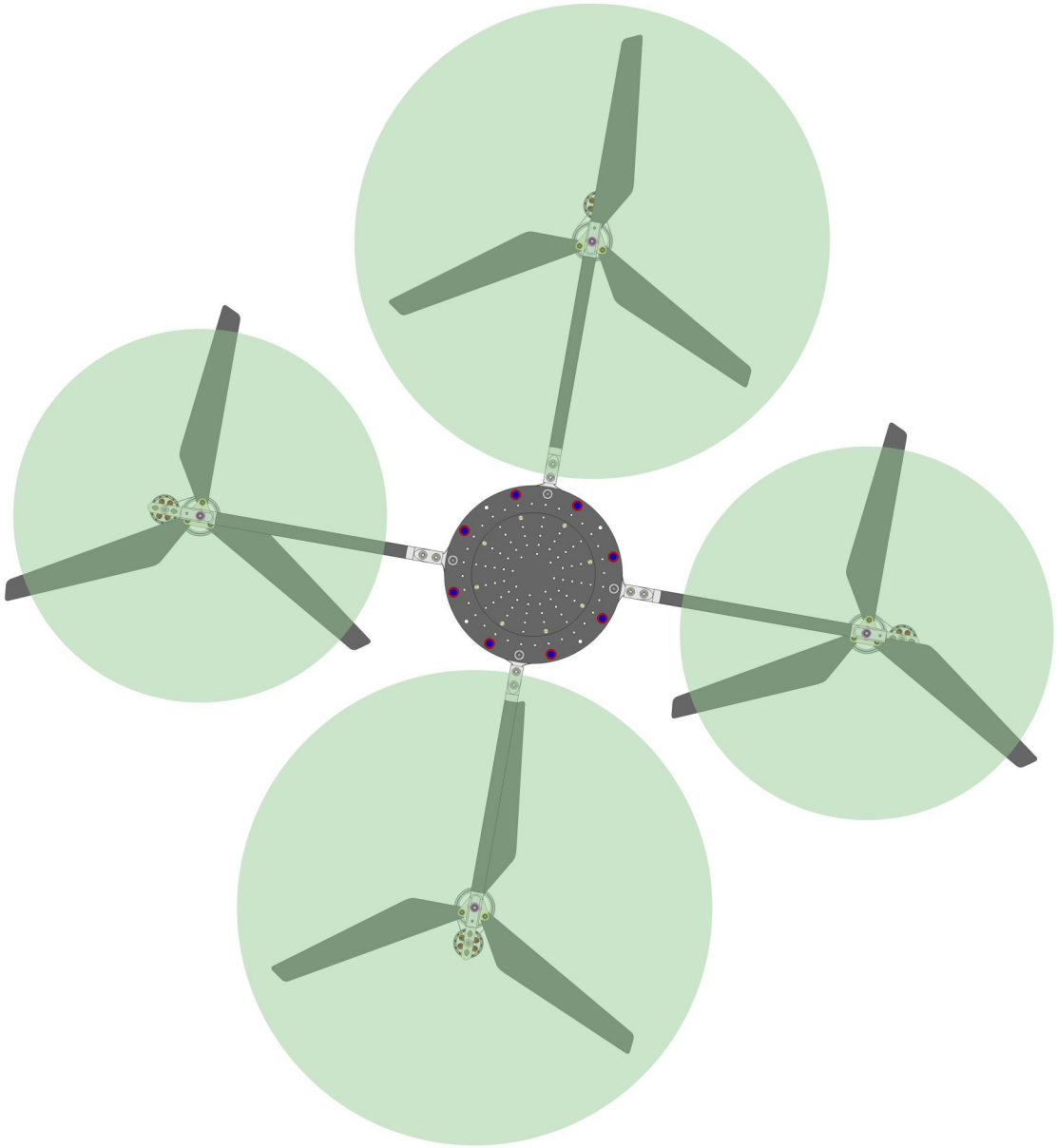

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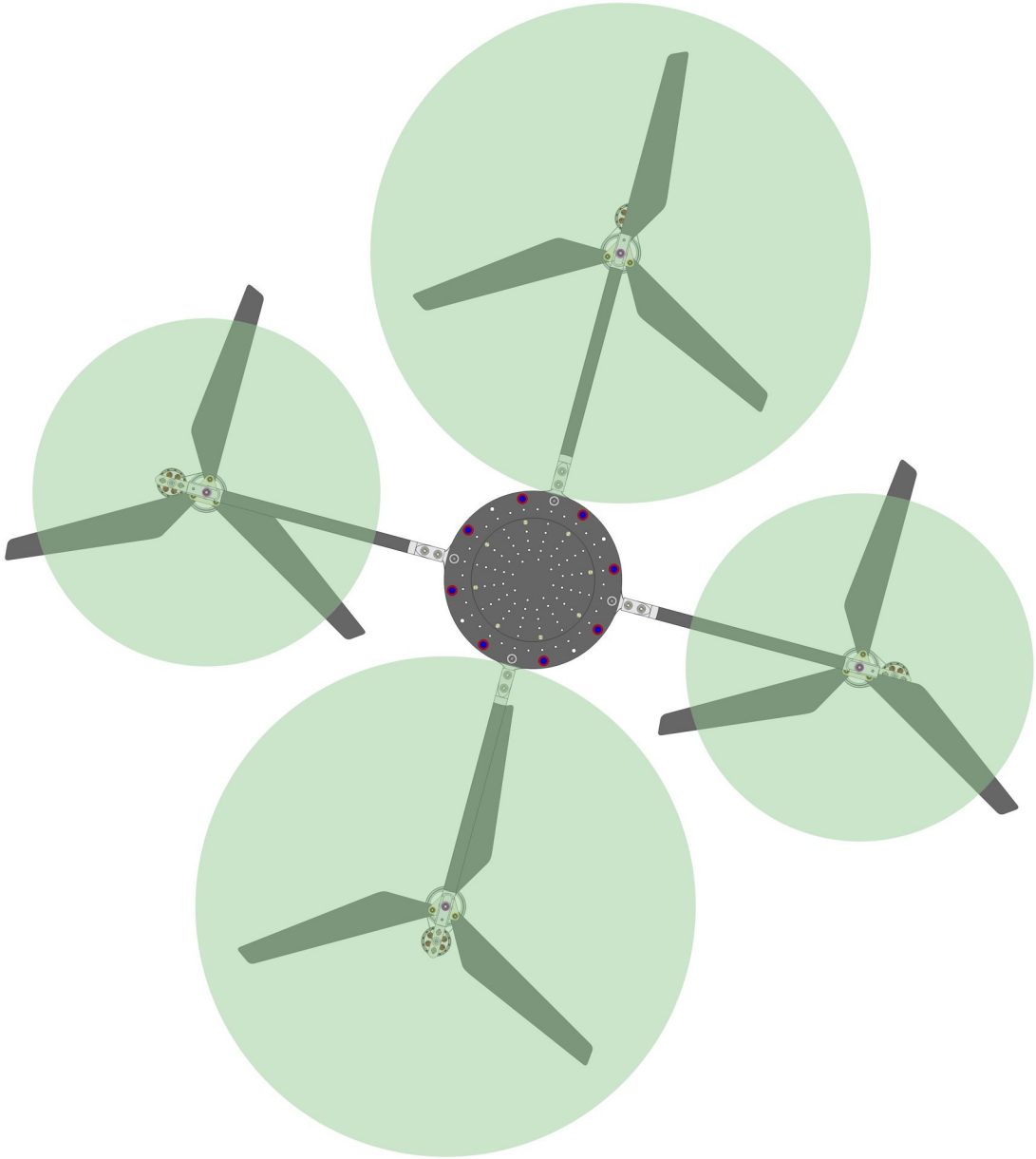

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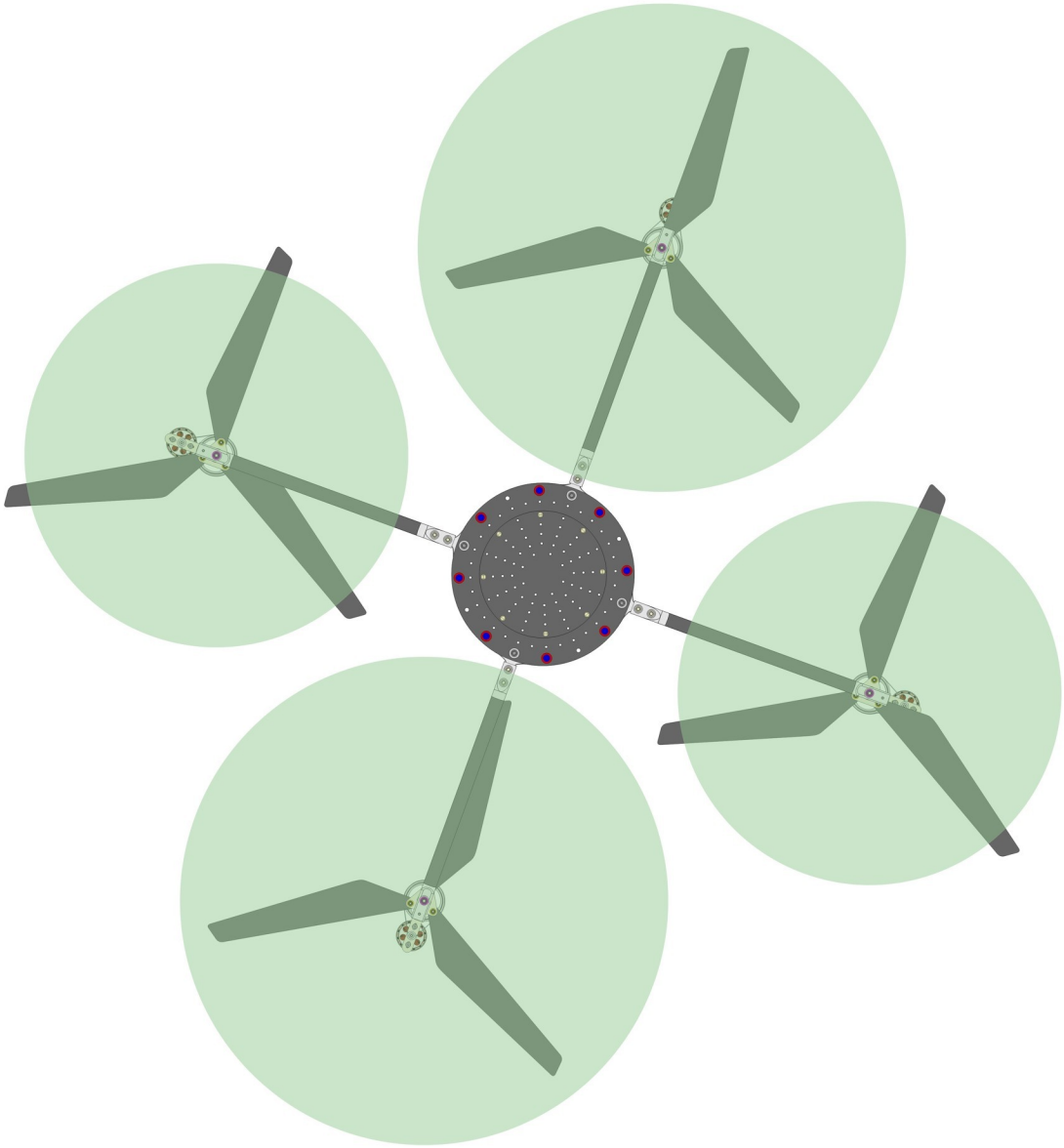

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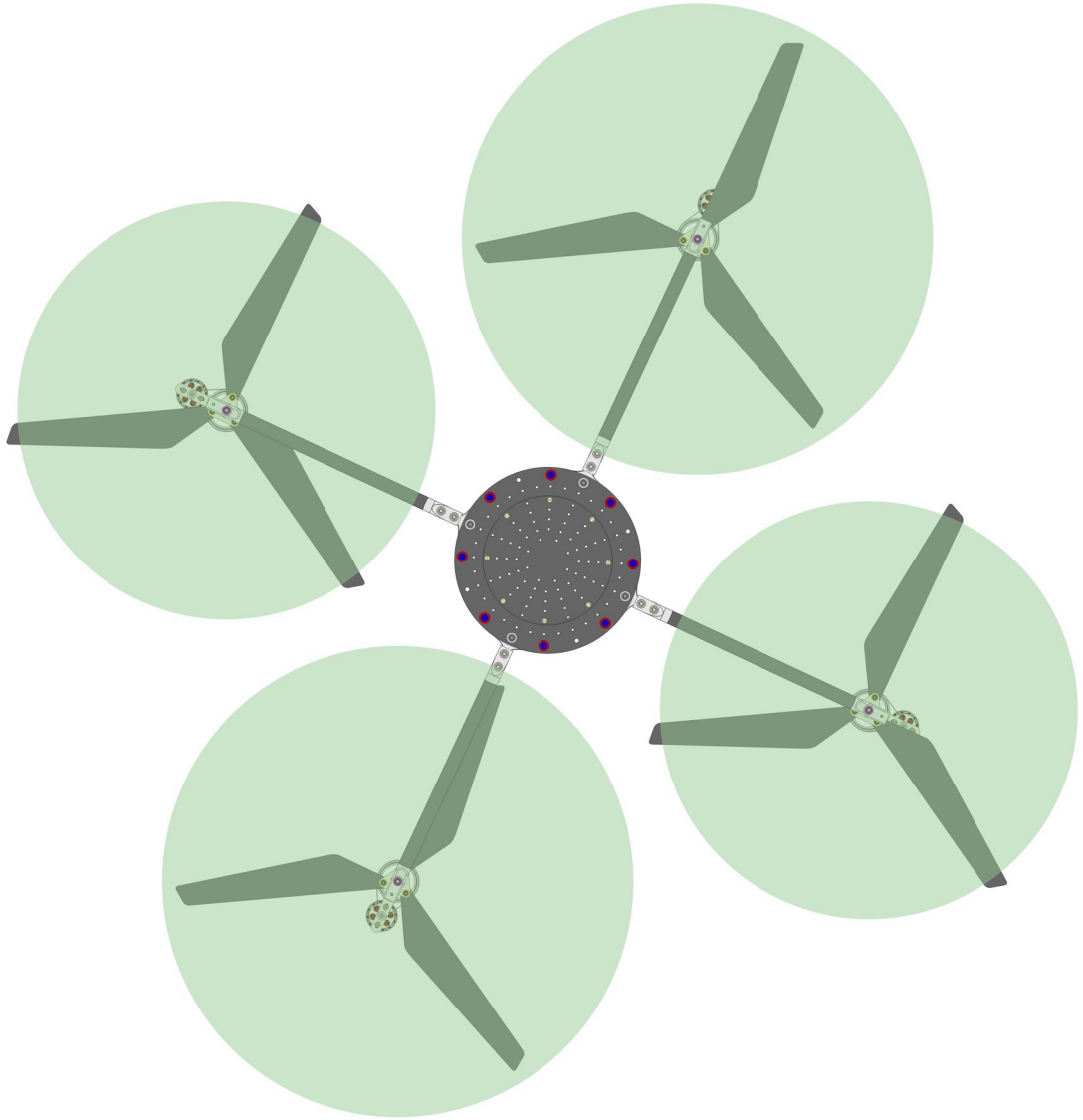

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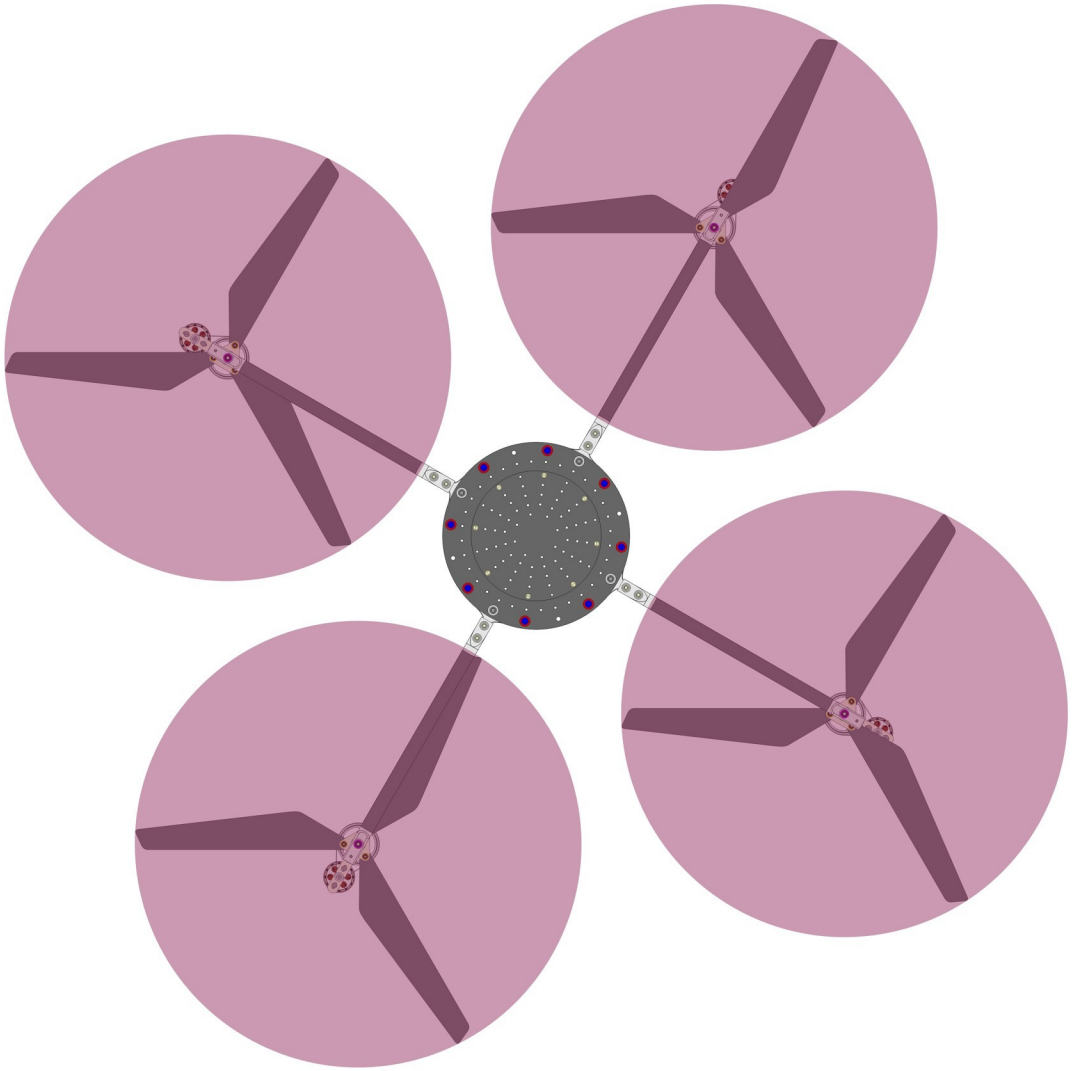

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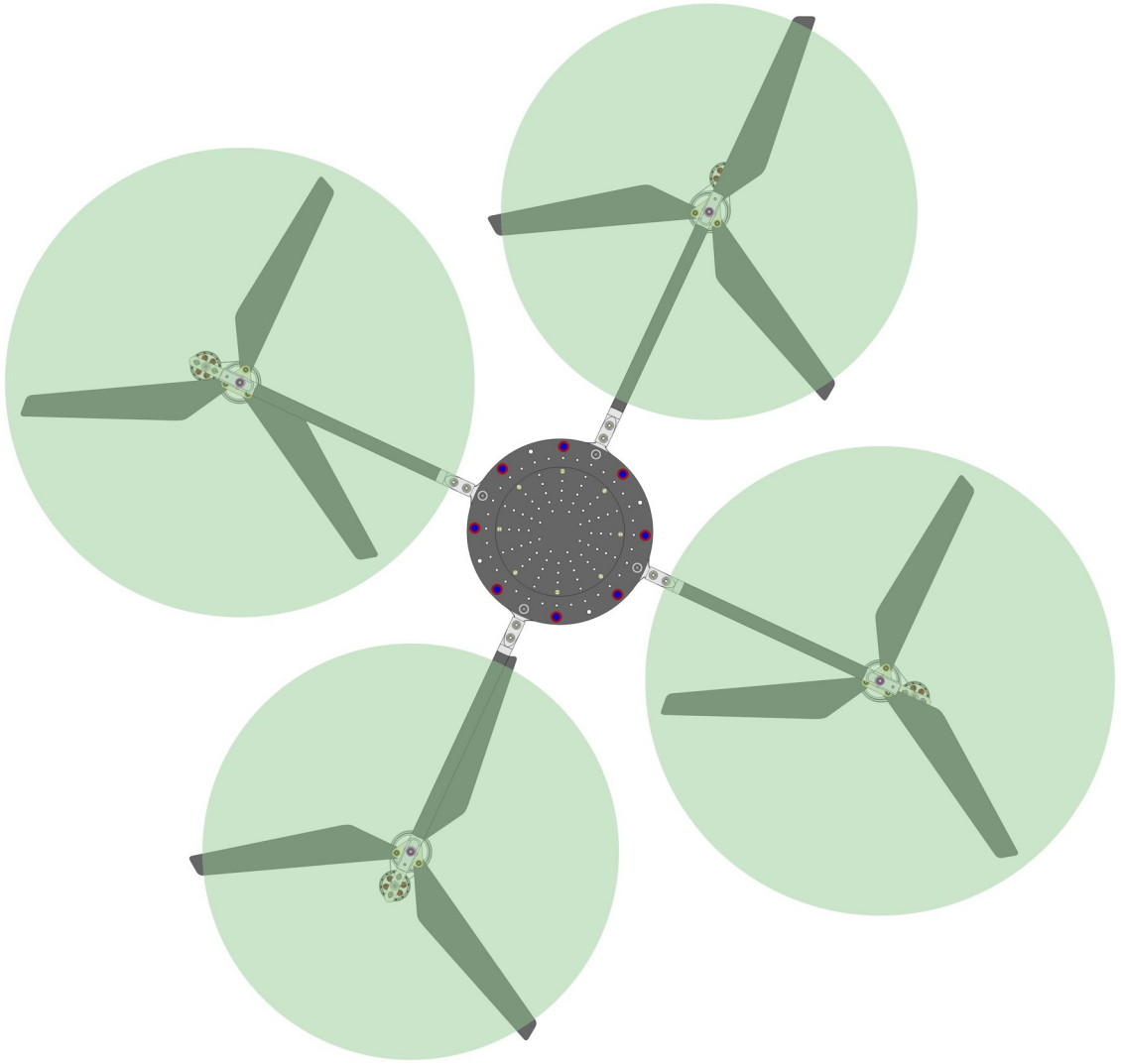

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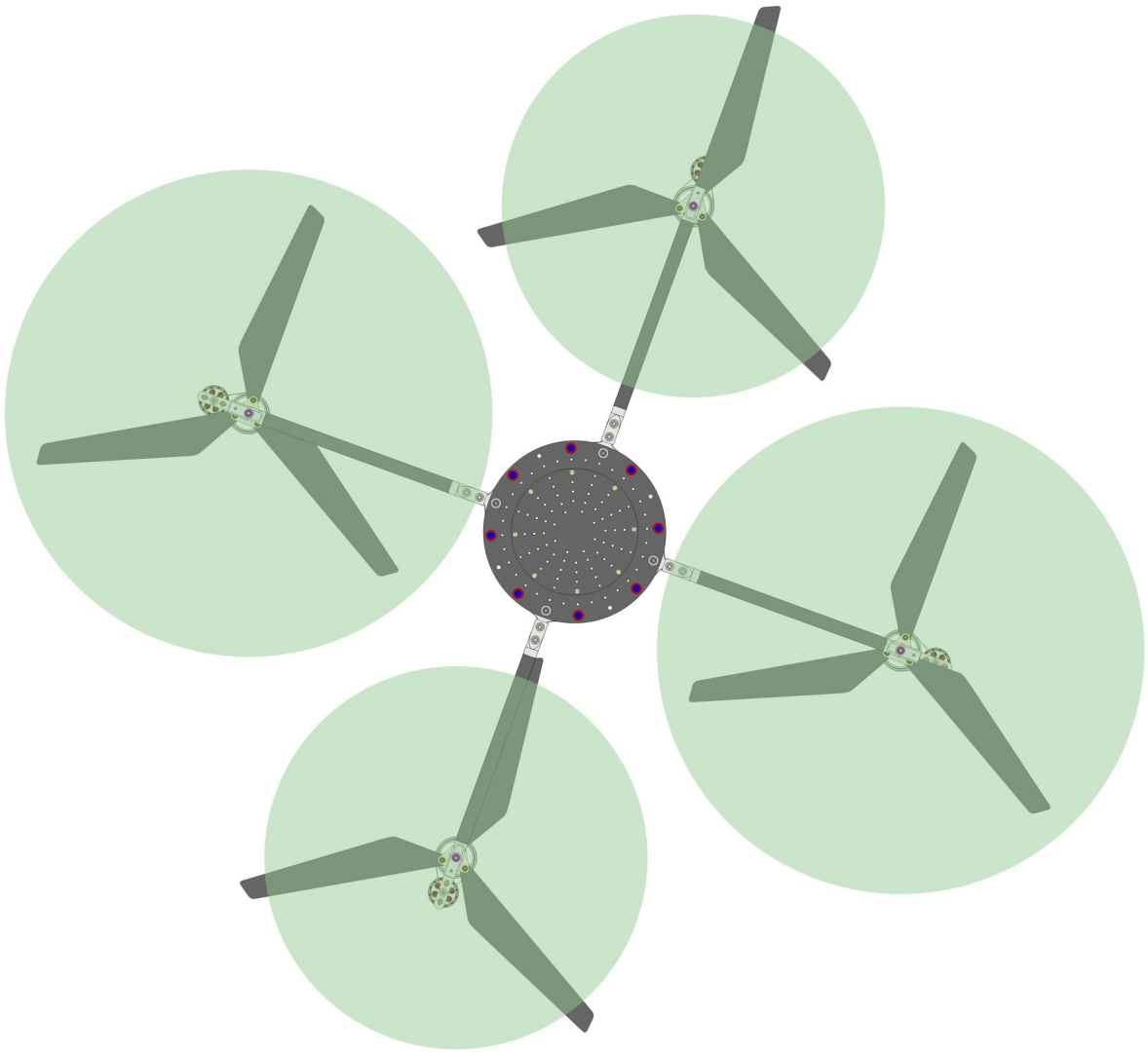

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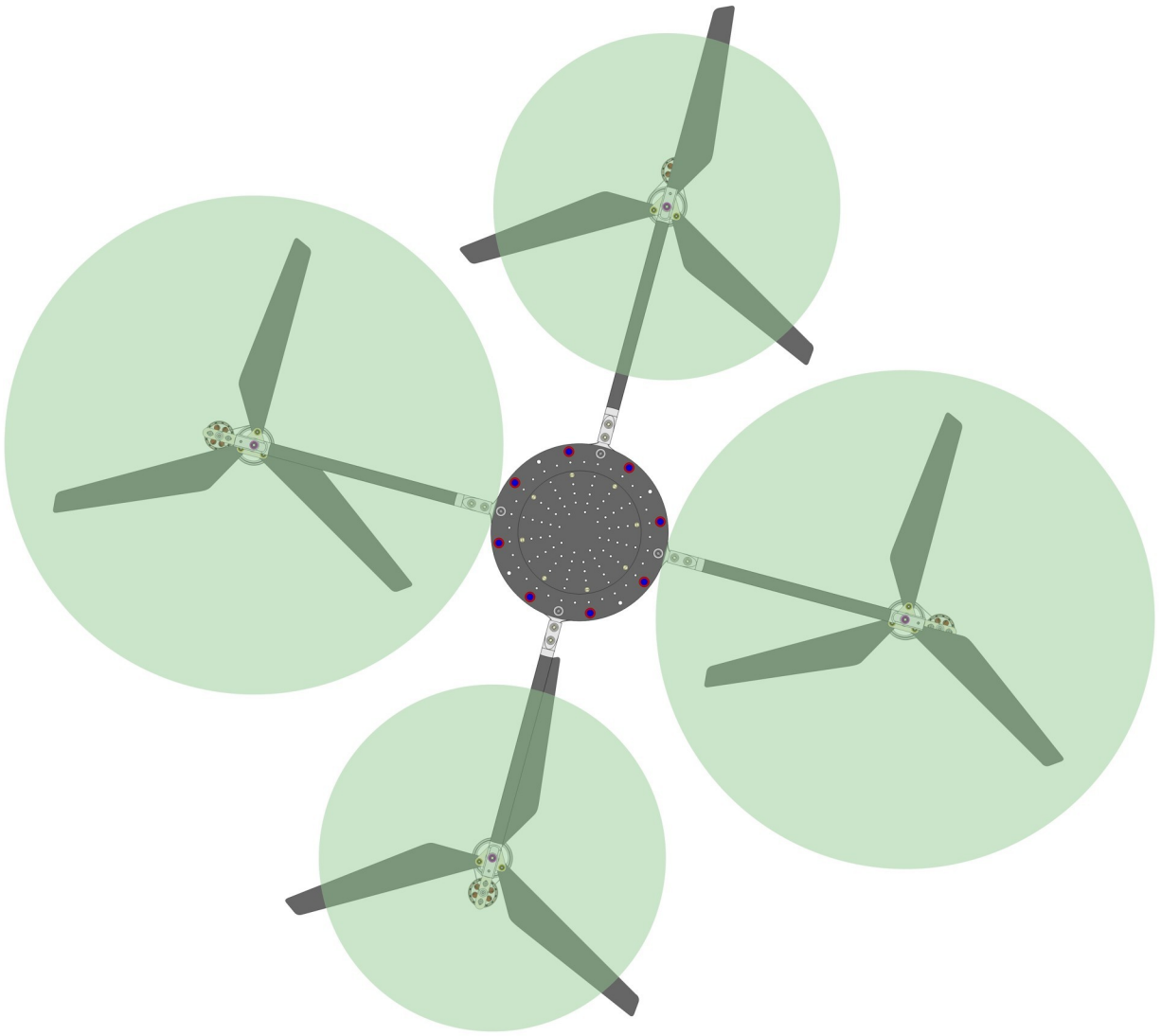

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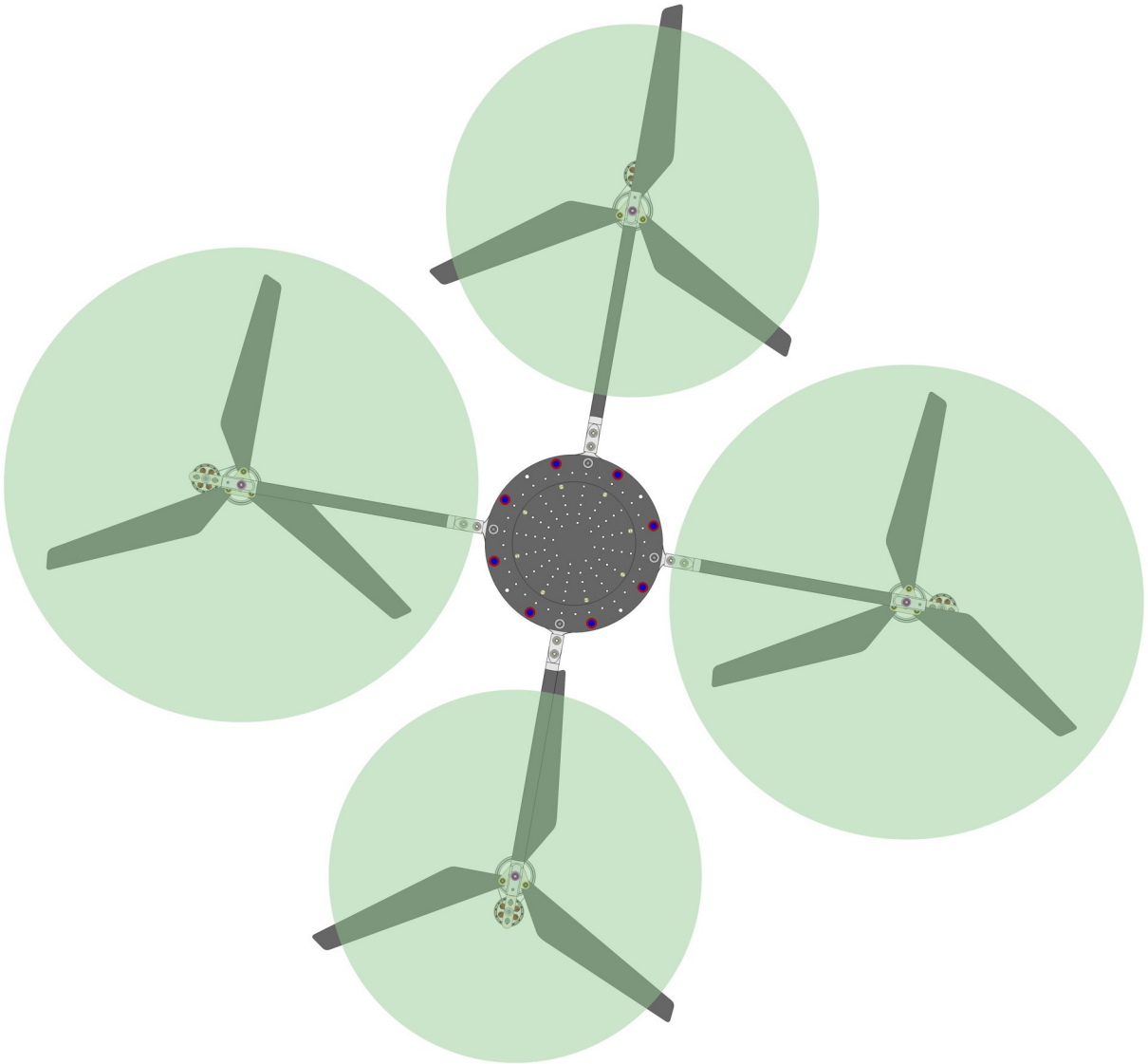

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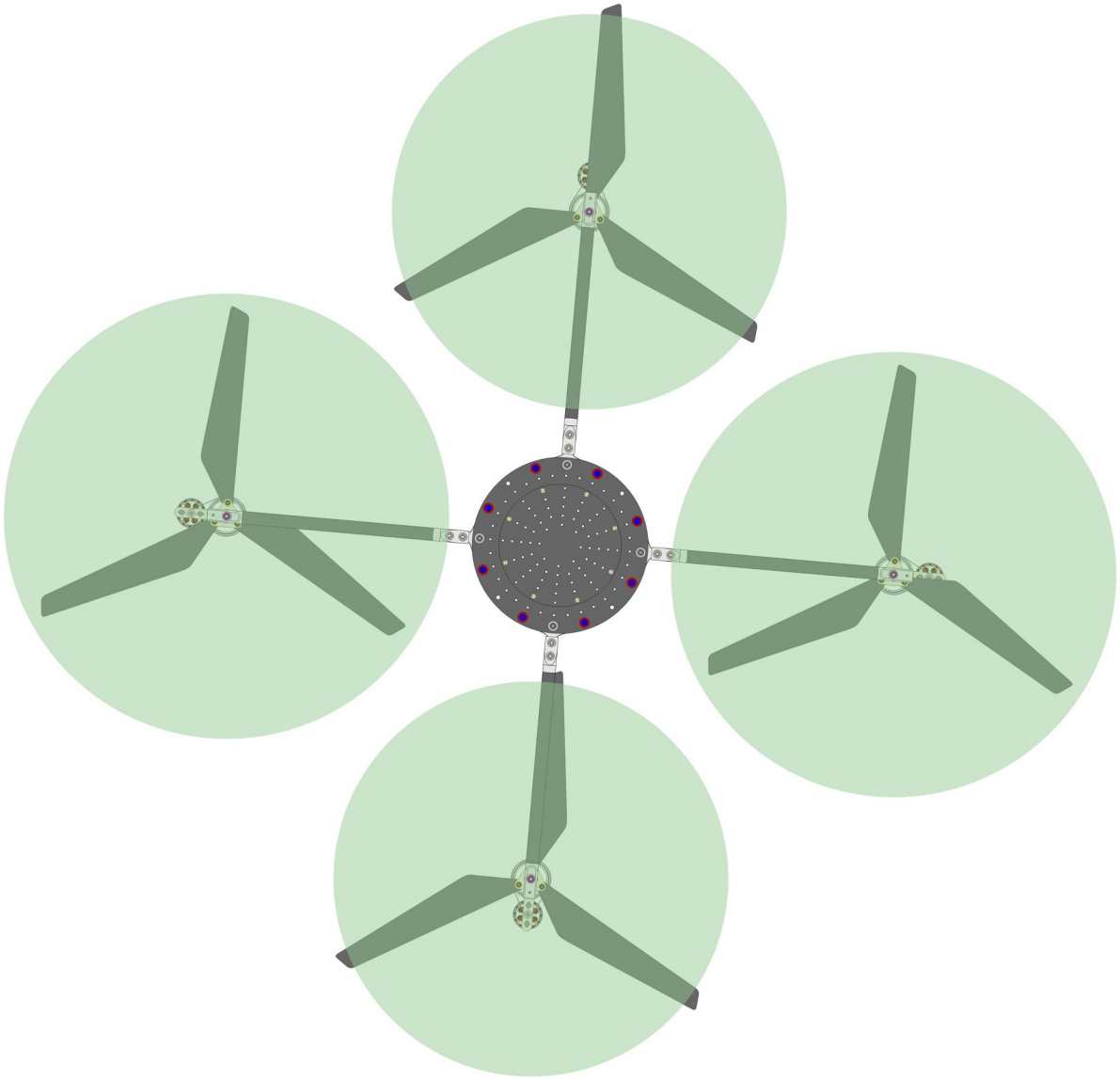

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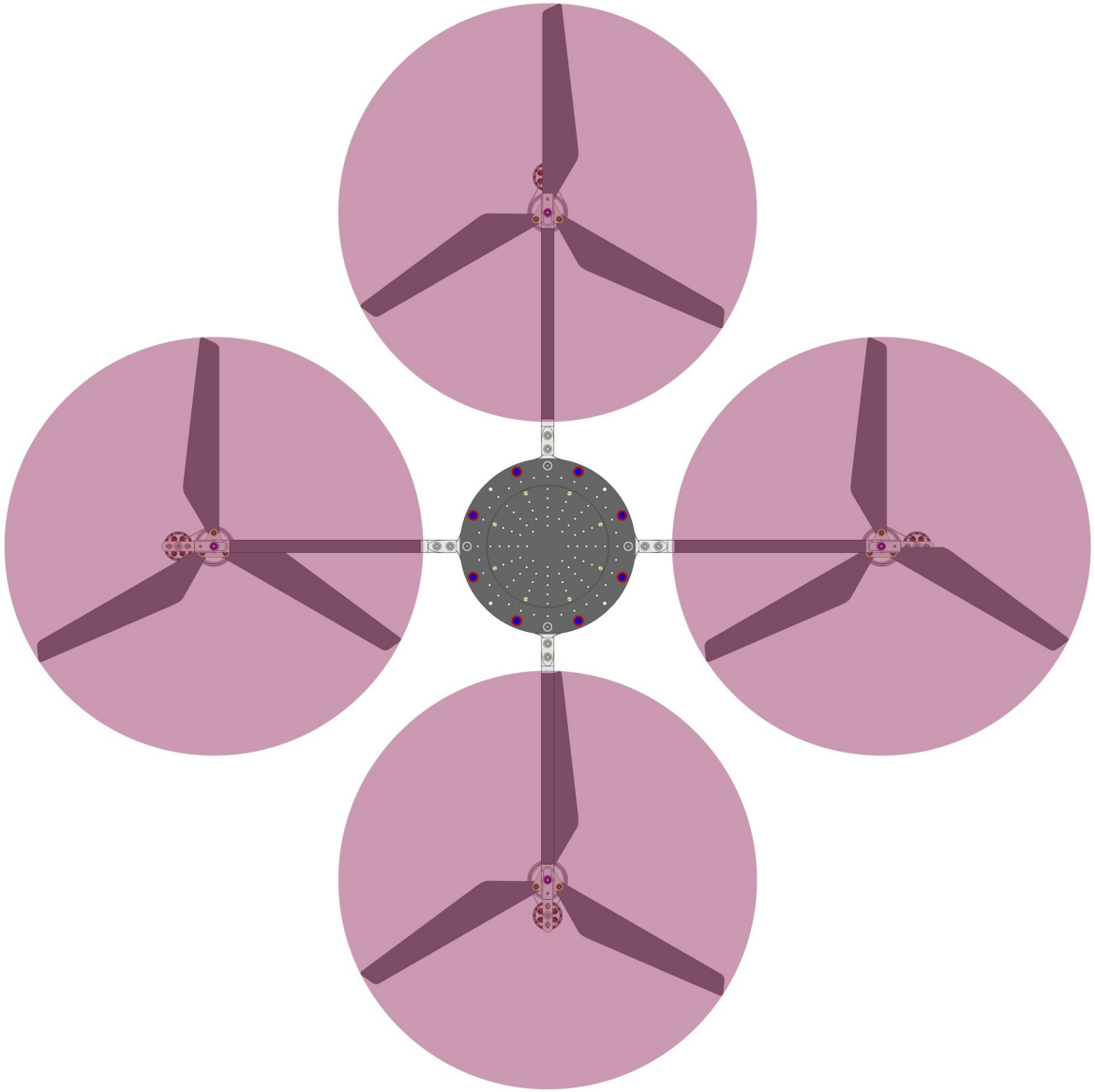
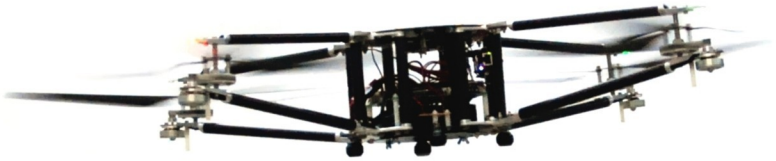


Thrust Dynamics

Thrust Dynamics



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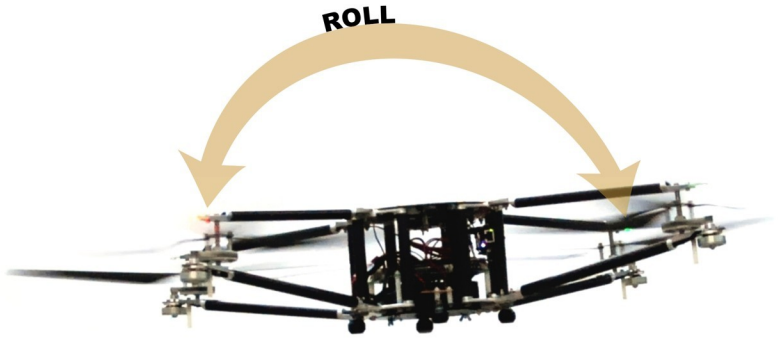

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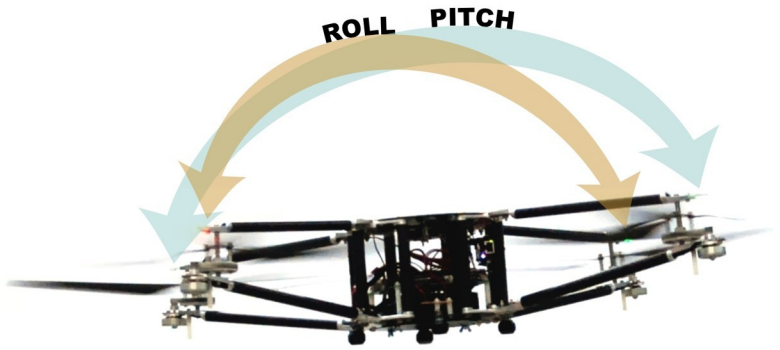

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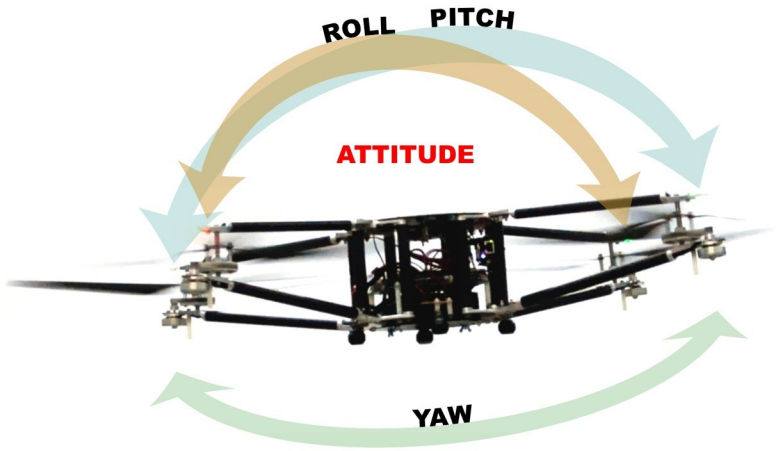

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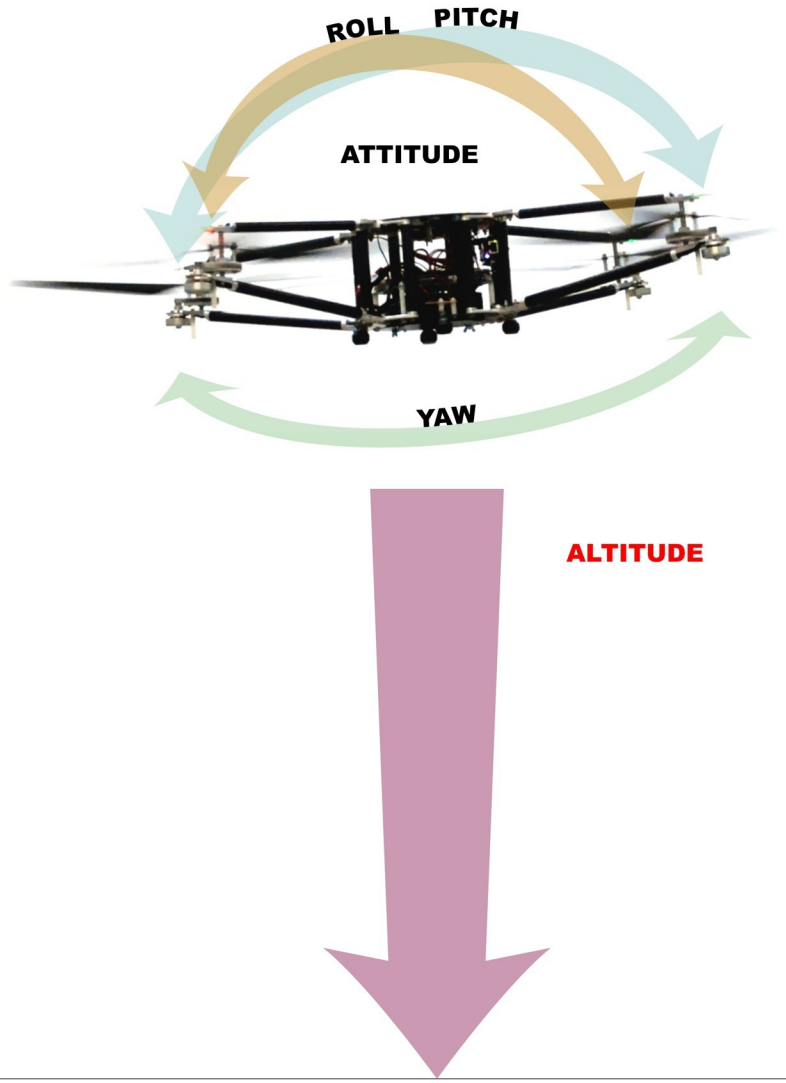
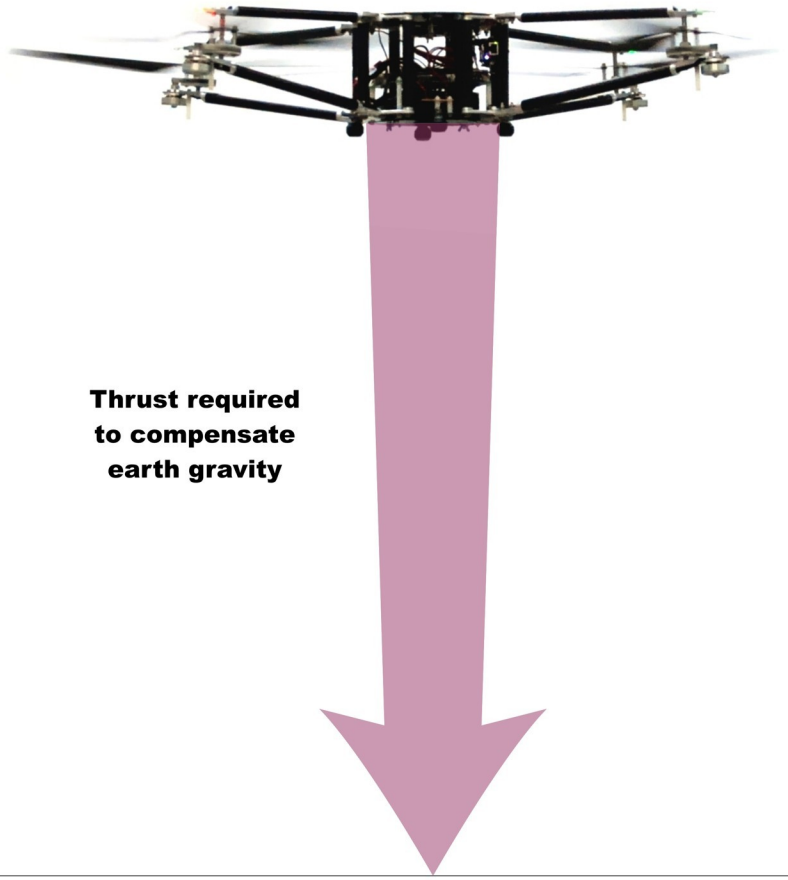


Thrust Dynamics

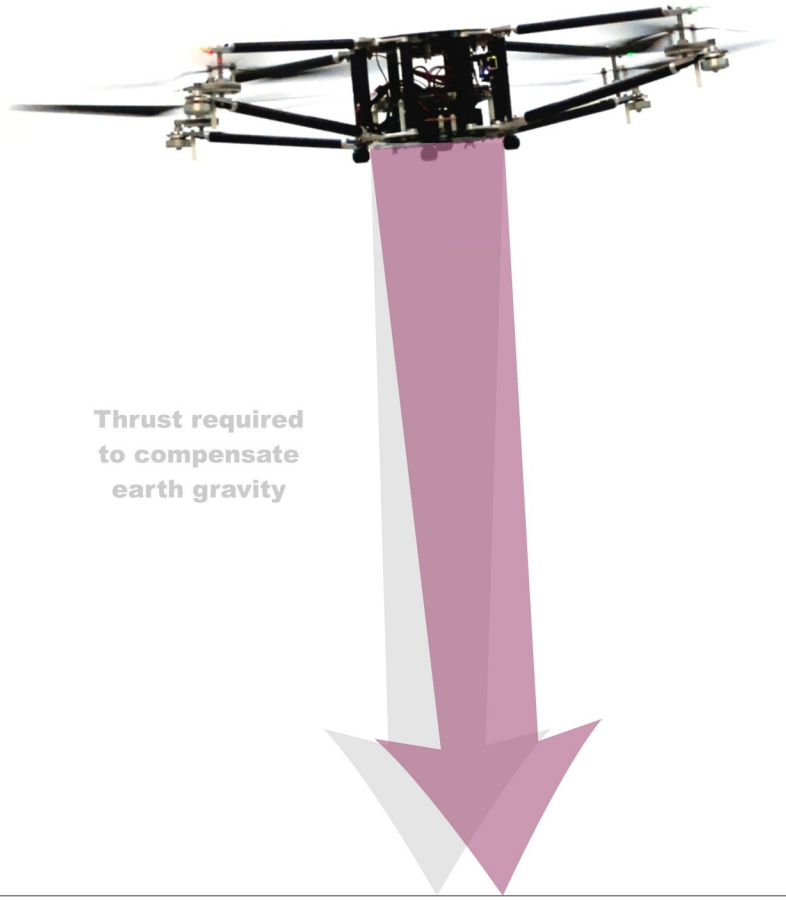
Roll/Pitch: 0°



Thrust required to compensate earth gravity

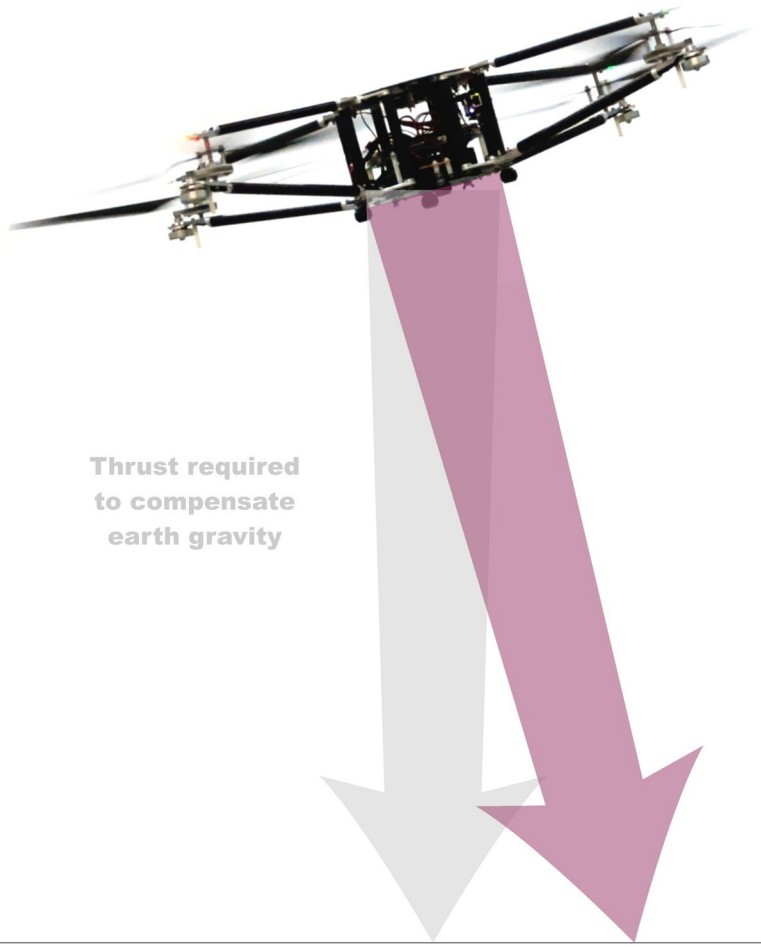
Thrust Dynamics

Pitch angle: 5°

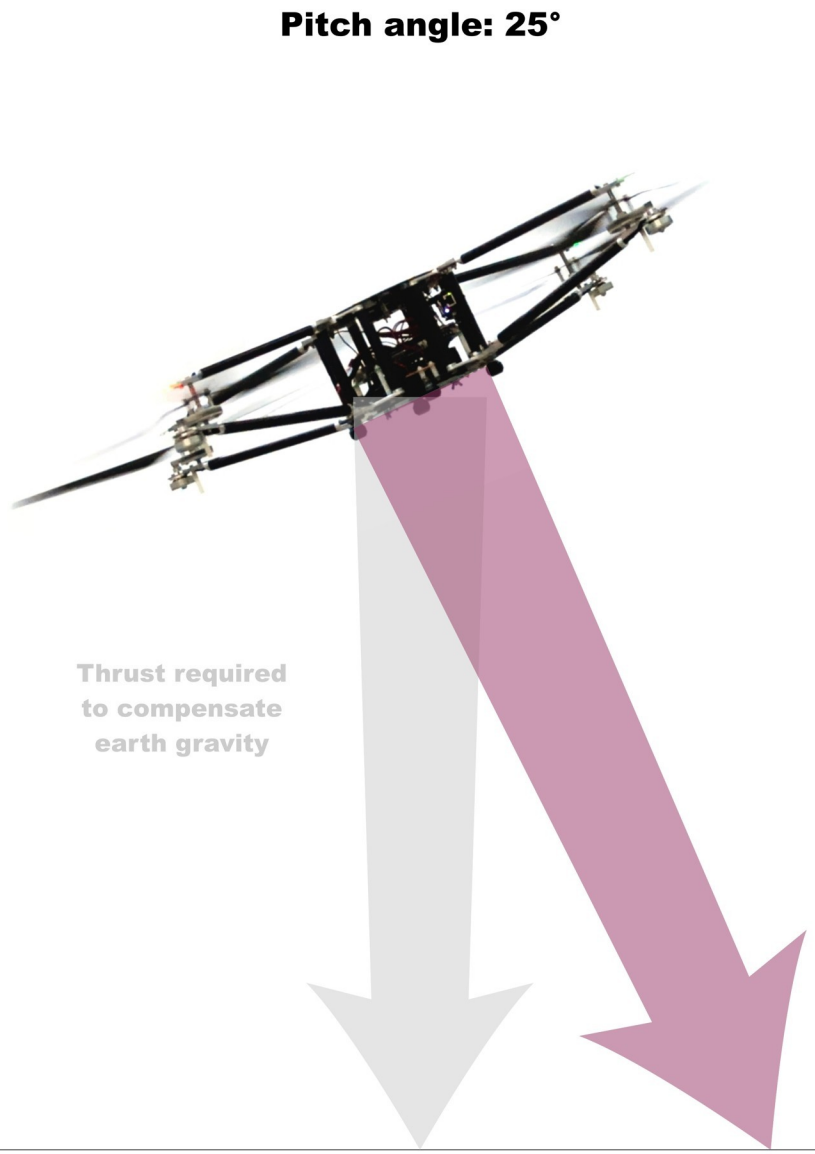


Thrust Dynamics

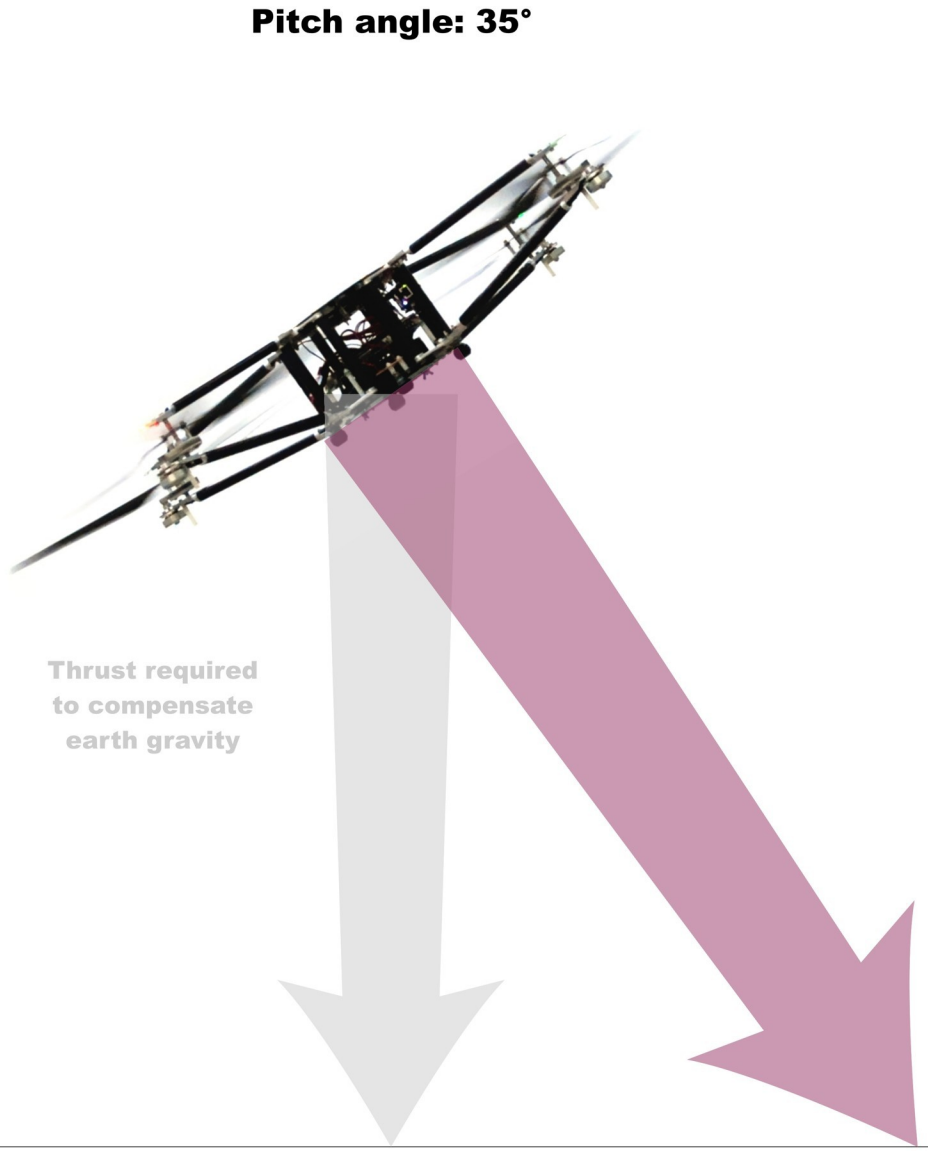
Pitch angle: 15°



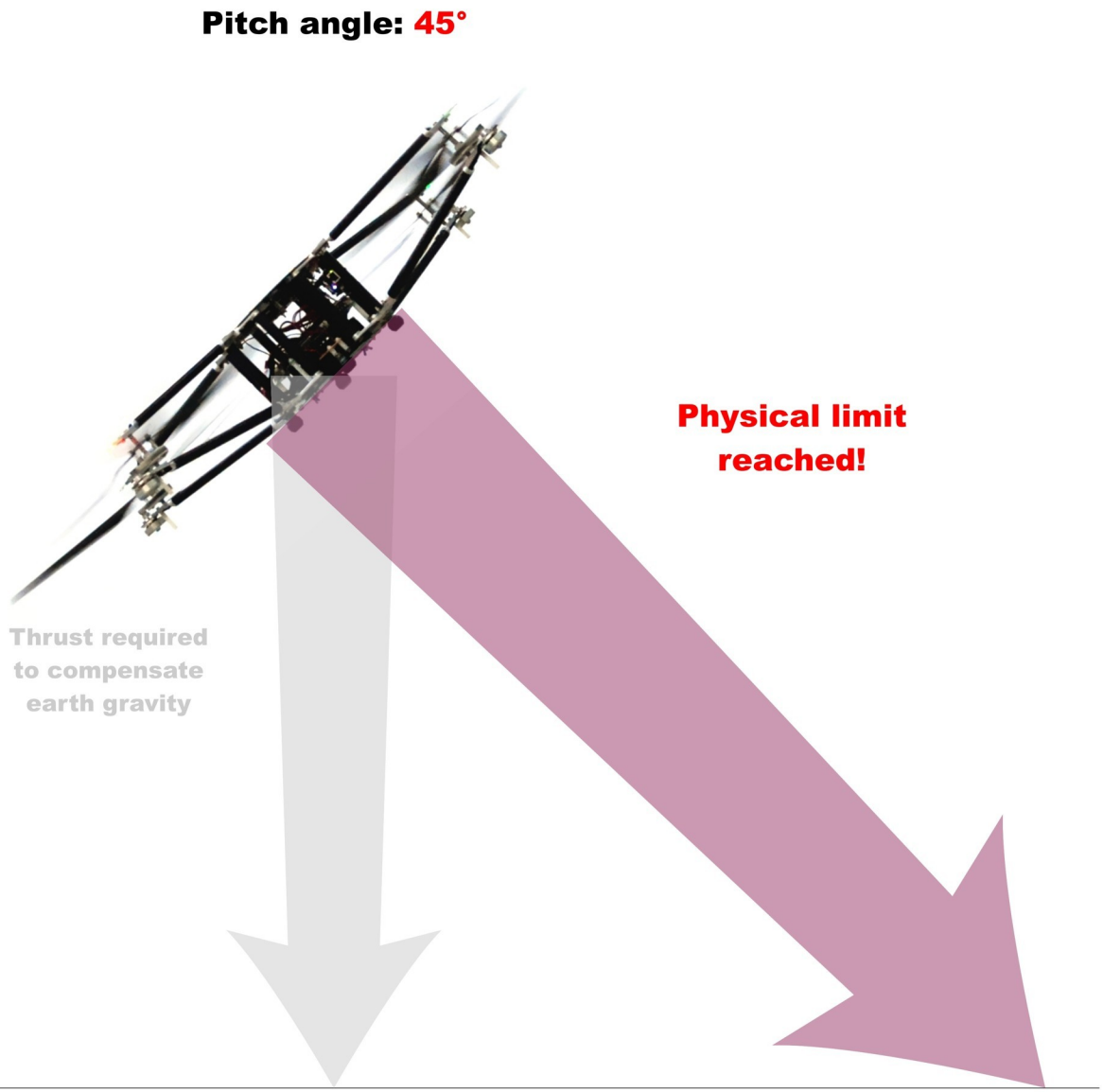
Thrust Dynamics



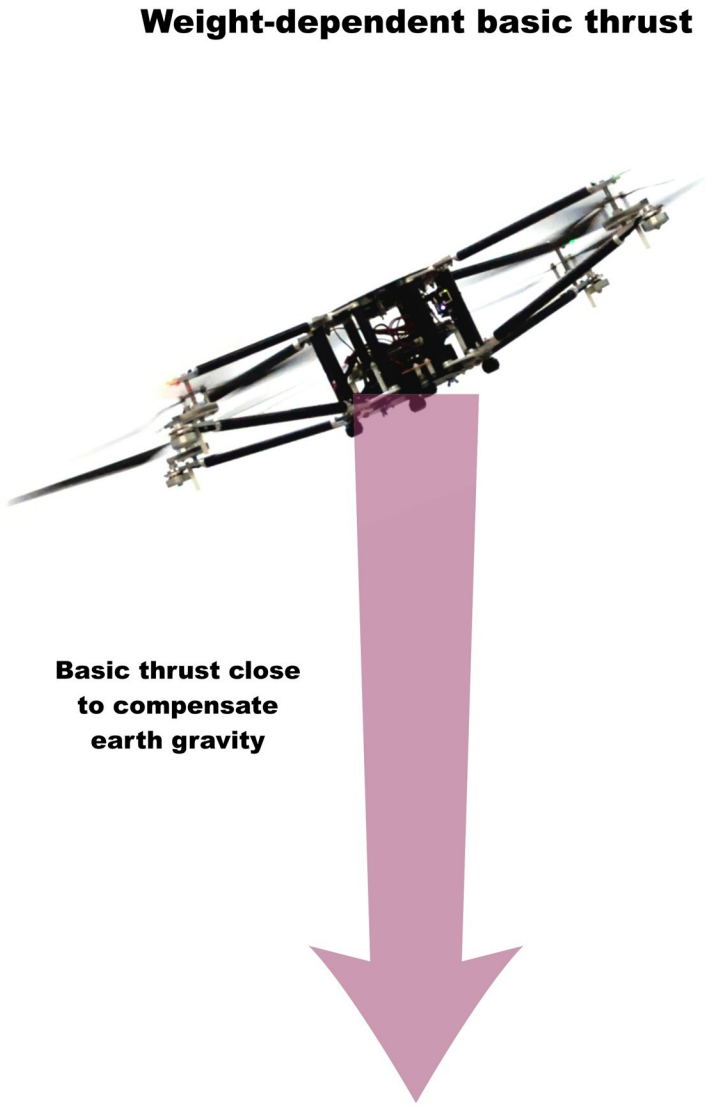
Thrust Dynamics



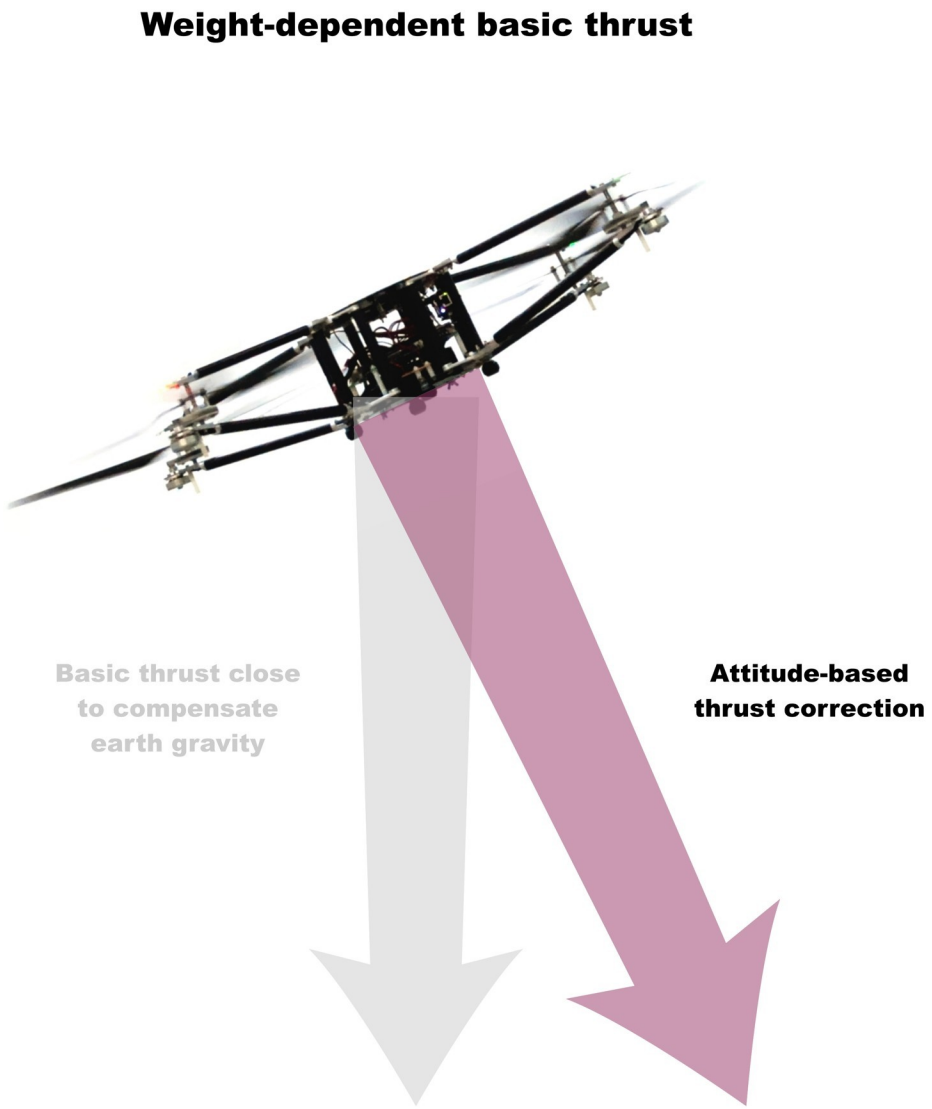
Thrust Dynamics



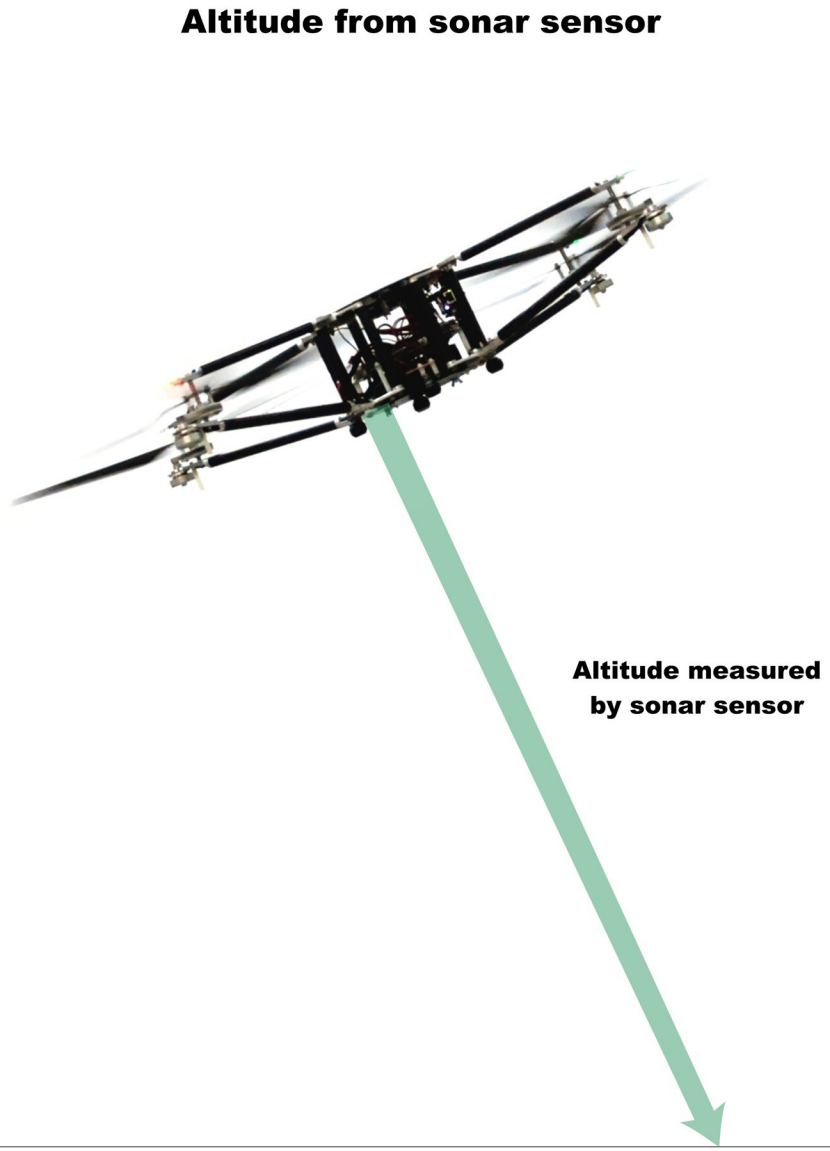
Altitude Control



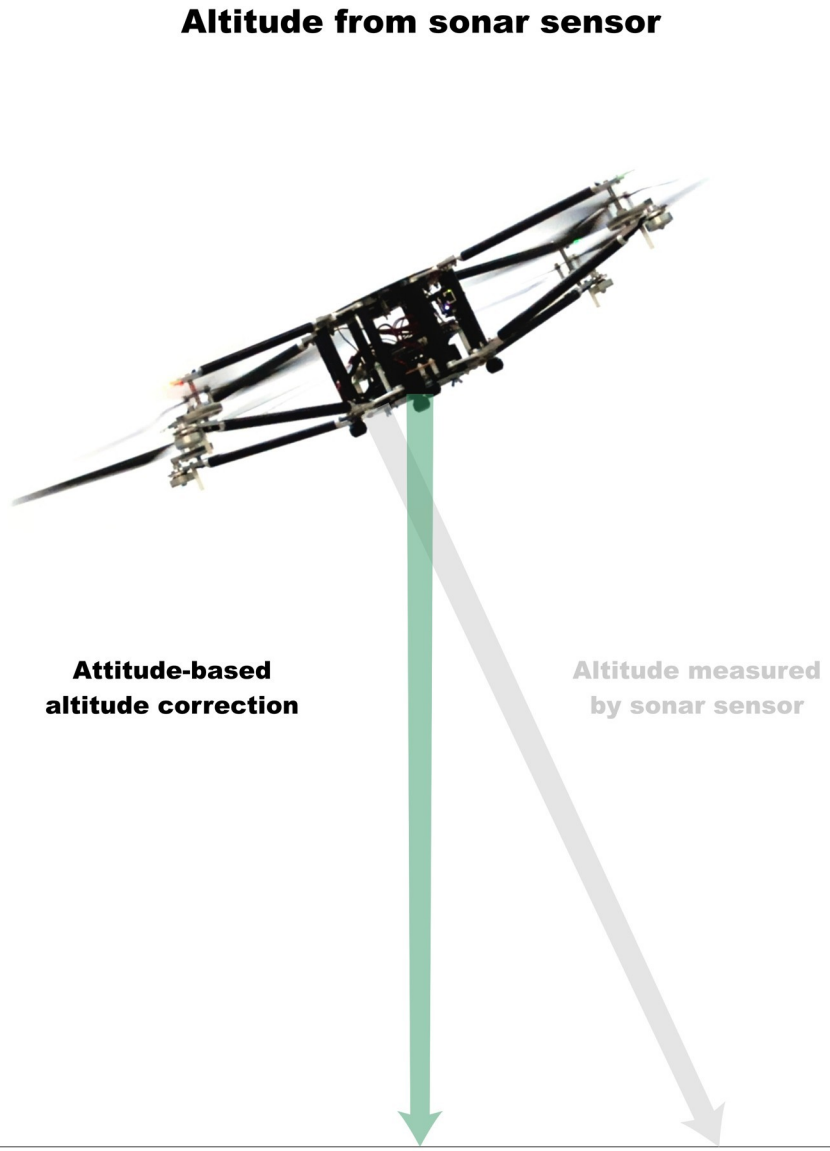
Altitude Control



Altitude Control



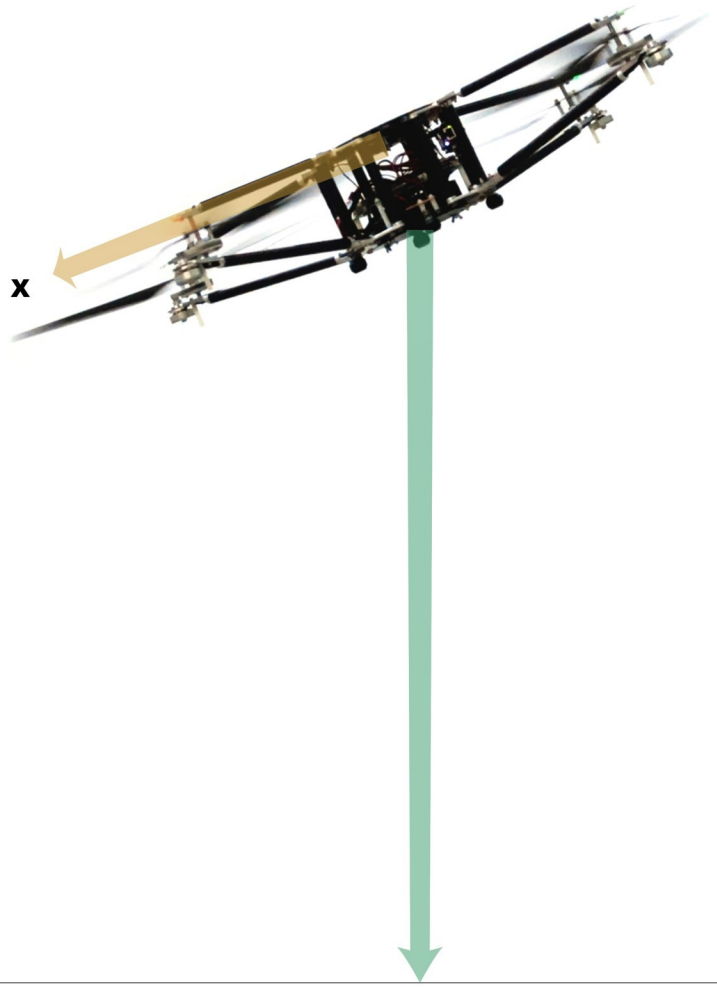
Altitude Control



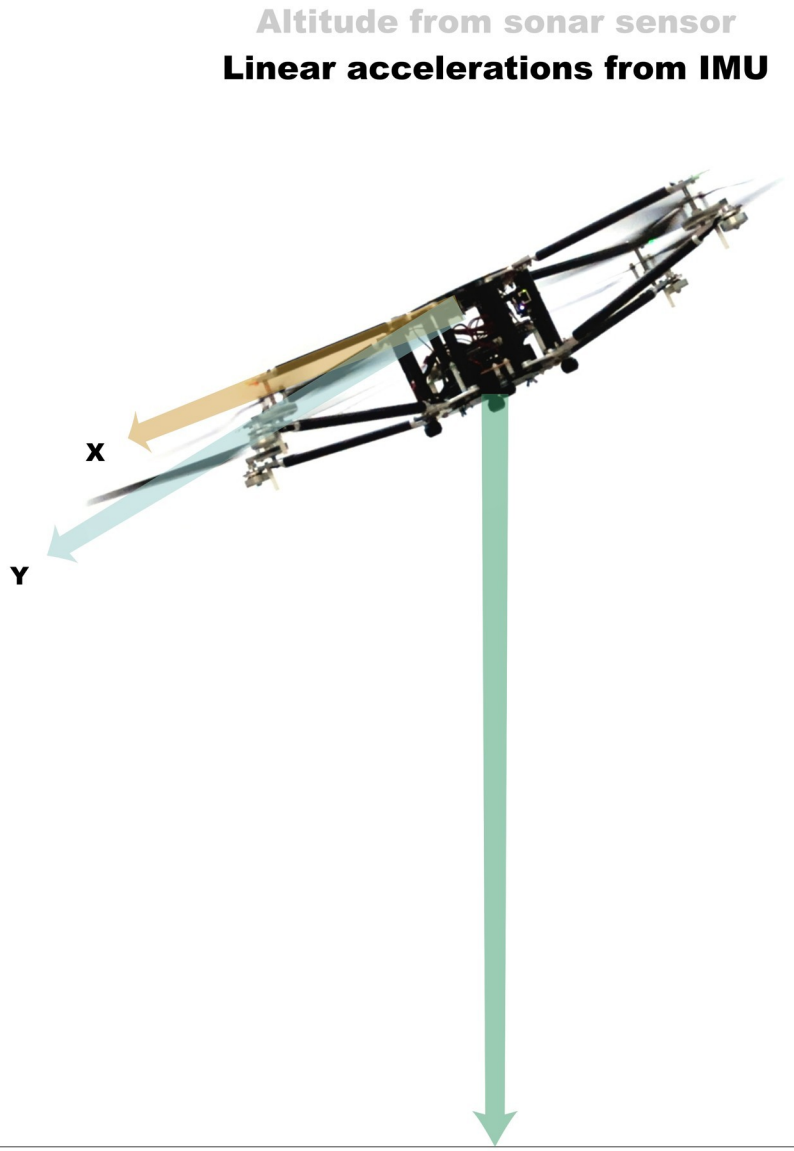
Altitude Control

Altitude from sonar sensor

Linear accelerations from IMU



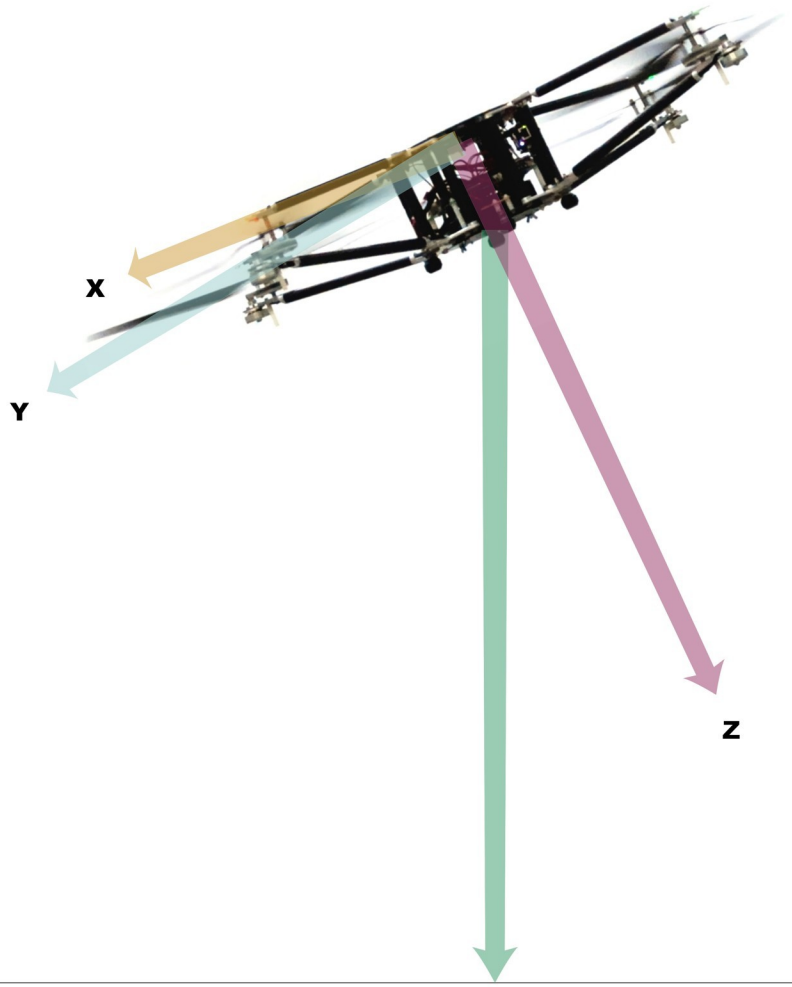
Altitude Control



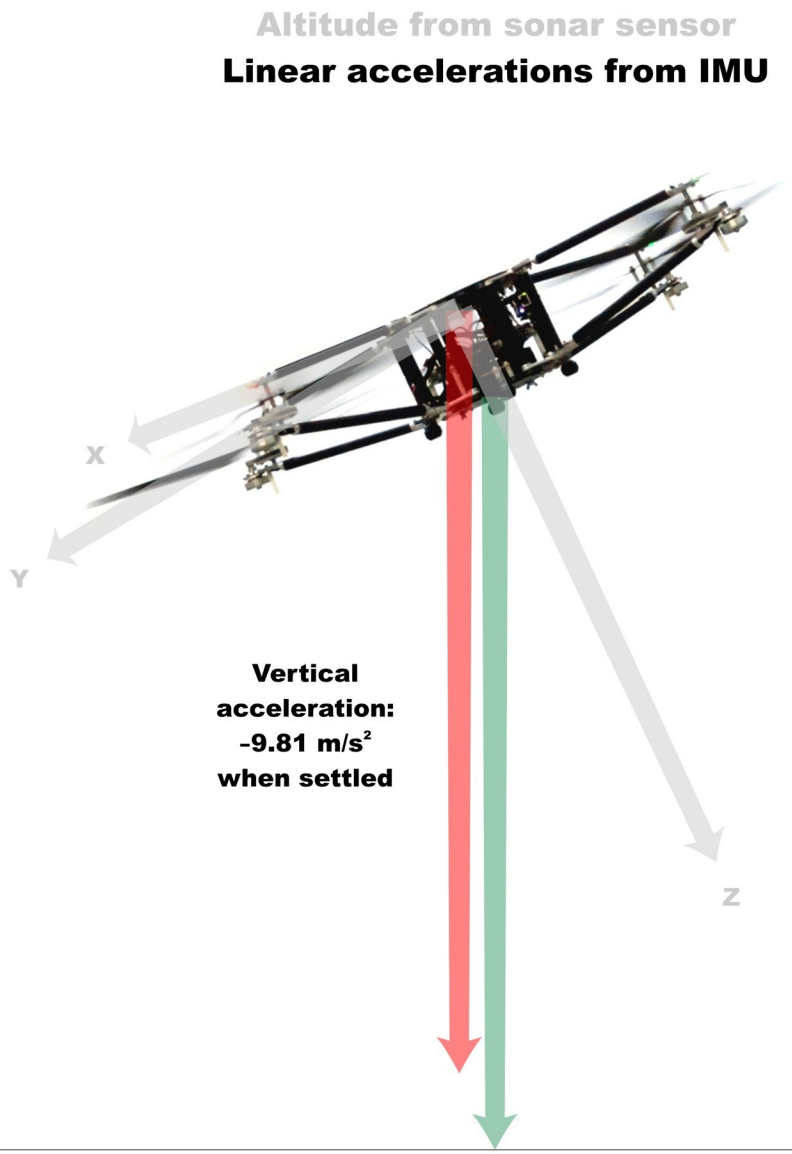
Altitude Control

Altitude from sonar sensor

Linear accelerations from IMU



Altitude Control

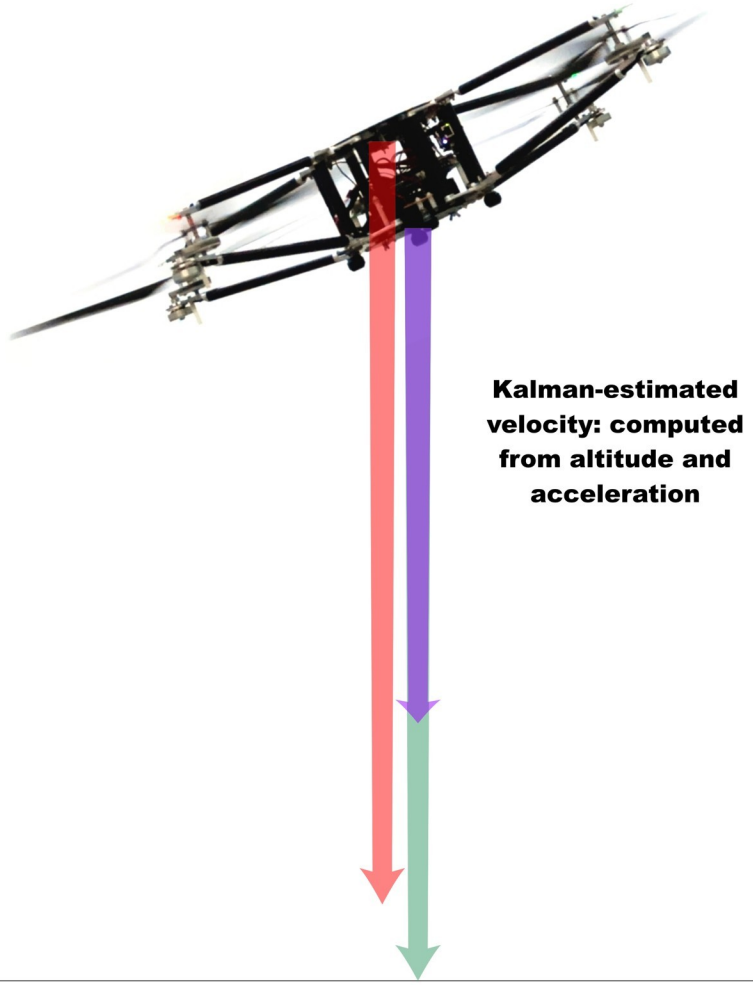


Altitude Control

Altitude from sonar sensor

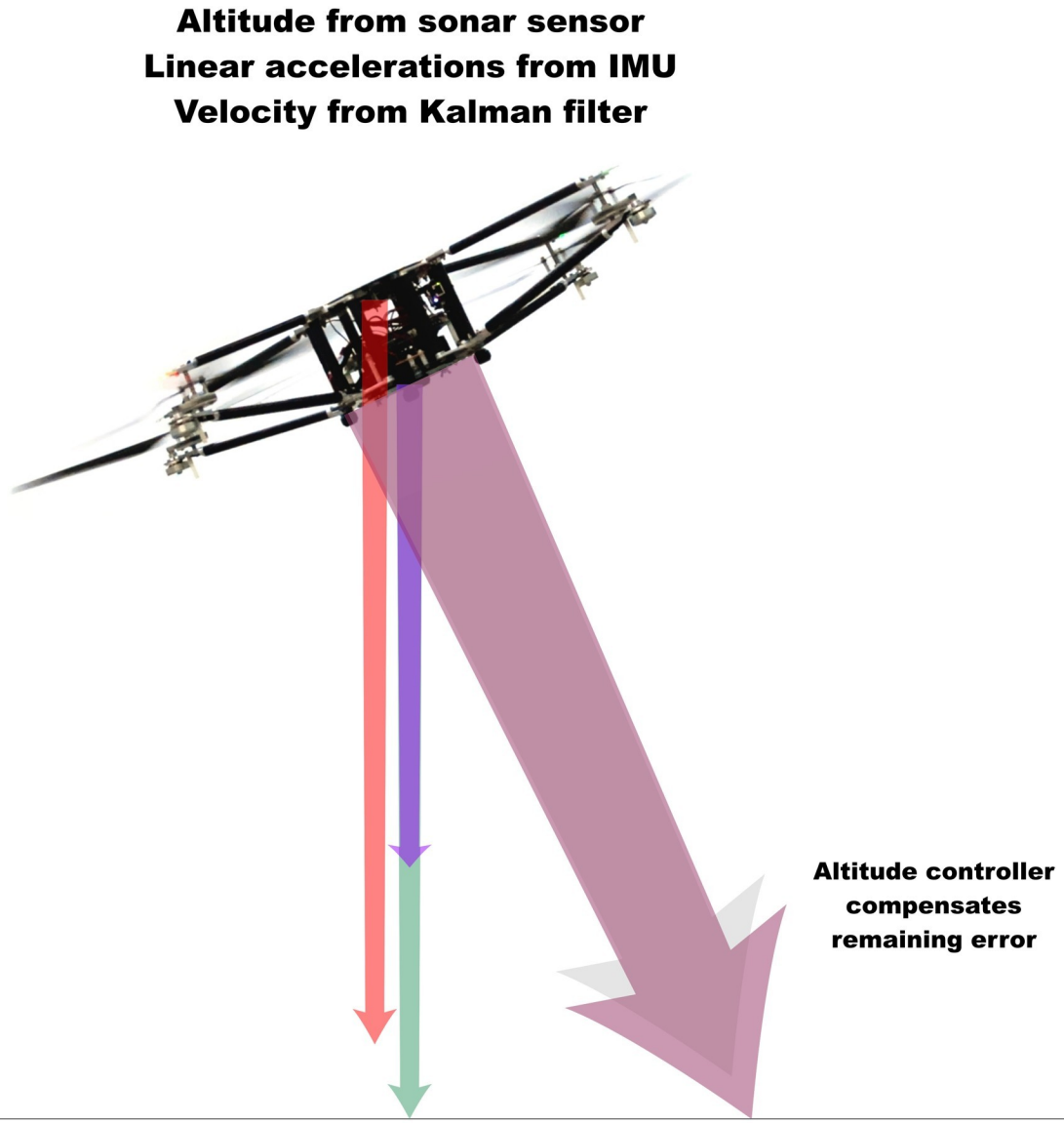
Linear accelerations from IMU

Velocity from Kalman filter



Kalman-estimated velocity: computed from altitude and acceleration

Altitude Control



Flying the JAviator

Improvements

- Hardware
  - More sophisticated sonar sensor at 100 Hz
  - IMU set to 100 Hz to match sonar frequency
  - Motor signals with Fast PWM at 250 Hz
- Software
  - Controllers extended from PID to PIDD
  - Acceleration term used for **dampening**
  - More complex filtering incorporated

The Great Break-Through

VCLP0043.AVI

Thank You!

Questions?