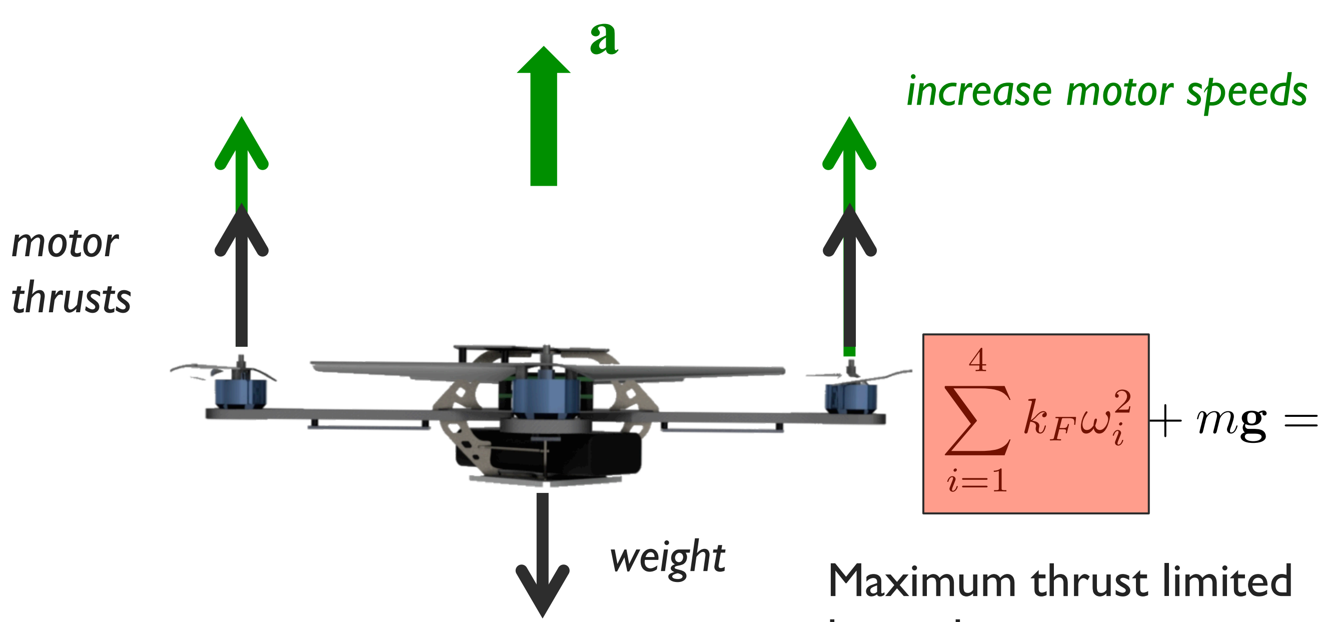
Goals

- Basic mechanics
- Control
- Design considerations
- Agility
- Component selection
- Effects of size

Effect of Maximum Thrust



$$\boxed{\sum_{i=1}^{4} k_F \omega_i^2} + m\mathbf{g} = m\mathbf{a}$$

Maximum thrust limited
by peak motor torque

Maximum thrust T_{max}

Maximum acceleration a_{max}

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Control with Thrust Limitations

Effect of Maximum Thrust on Input

$$u = \frac{1}{m}\left[\sum_{i=1}^{4} k_F \omega_i^2 + m\mathbf{g}\right]$$

$$= \frac{1}{m}\left[T\uparrow + m\mathbf{g}\downarrow\right]$$

Input, defined in terms of the thrust

$$T_{max}$$

Maximum thrust, as determined by peak motor torque

$$u_{max} = \frac{1}{m}\left[T_{max}\uparrow + m\mathbf{g}\downarrow\right]$$

Maximum input, as determined by maximum thrust

PD control

$$u(t) = \min(\ddot{x}^{des}(t) + K_V \dot{e}(t) + K_P e(t), u_{max})$$

PID control

$$u(t) = \min(\ddot{x}^{des}(t) + K_V \dot{e}(t) + K_P e(t) + K_I \int_0^t e(\tau) d\tau, u_{max})$$

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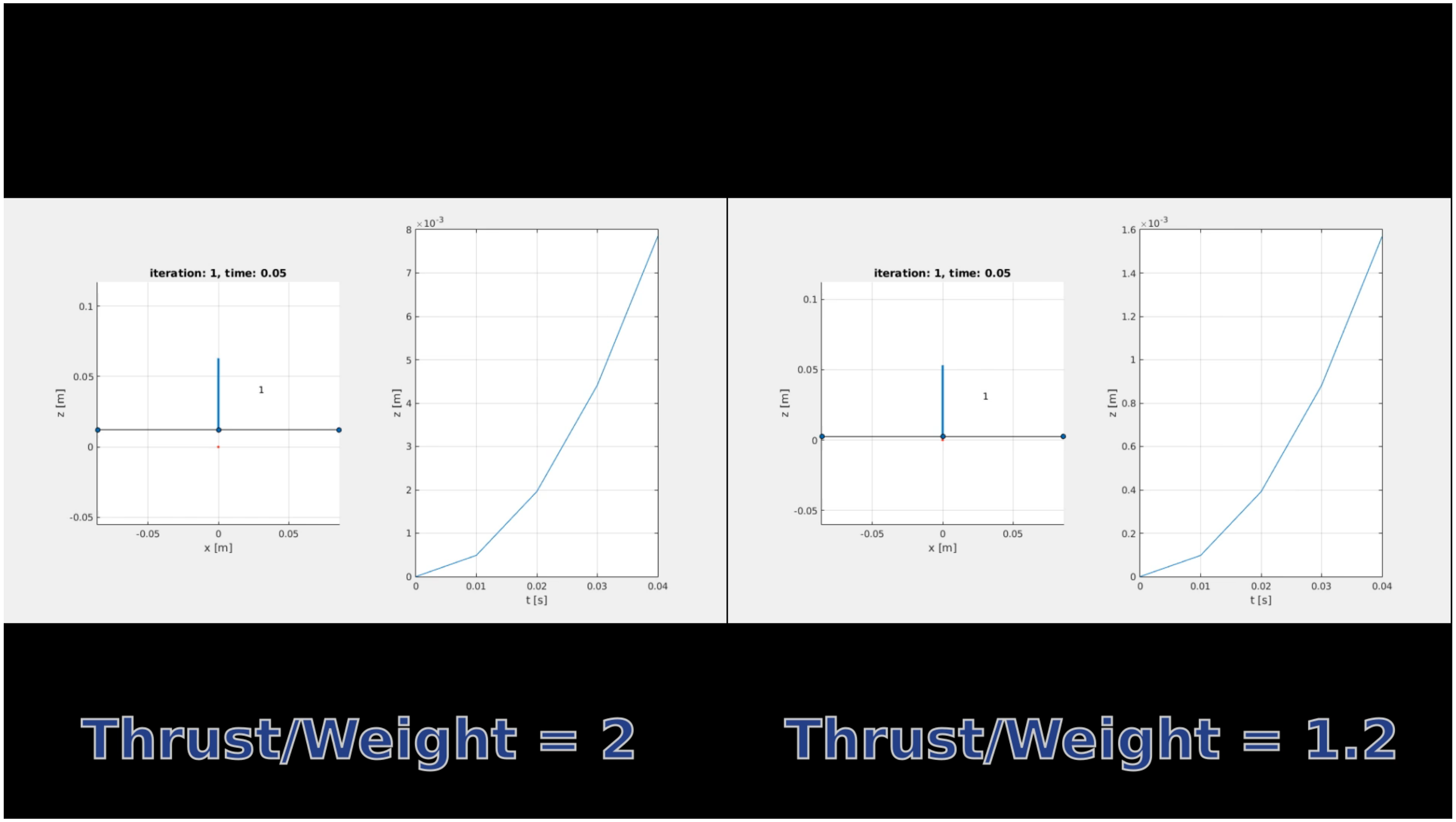
Effect of the Thrust/Weight Ratio

What happens if the payload of the robot is increased (with the same motors and propellers)?



Exercise

- We'll use the same height controller from the previous exercise but now we have a limit on the max thrust for the robot.
- In this exercise, you will explore how the thrust/weight ratio affects the control response of the quadrotor. Change the mass (payload) of the robot and see how the response changes.
- We may be interested in the maximum payload that the robot can carry before the response time is degraded significantly. Using the simulation determine the maximum mass for which the rise time is less than 1s?