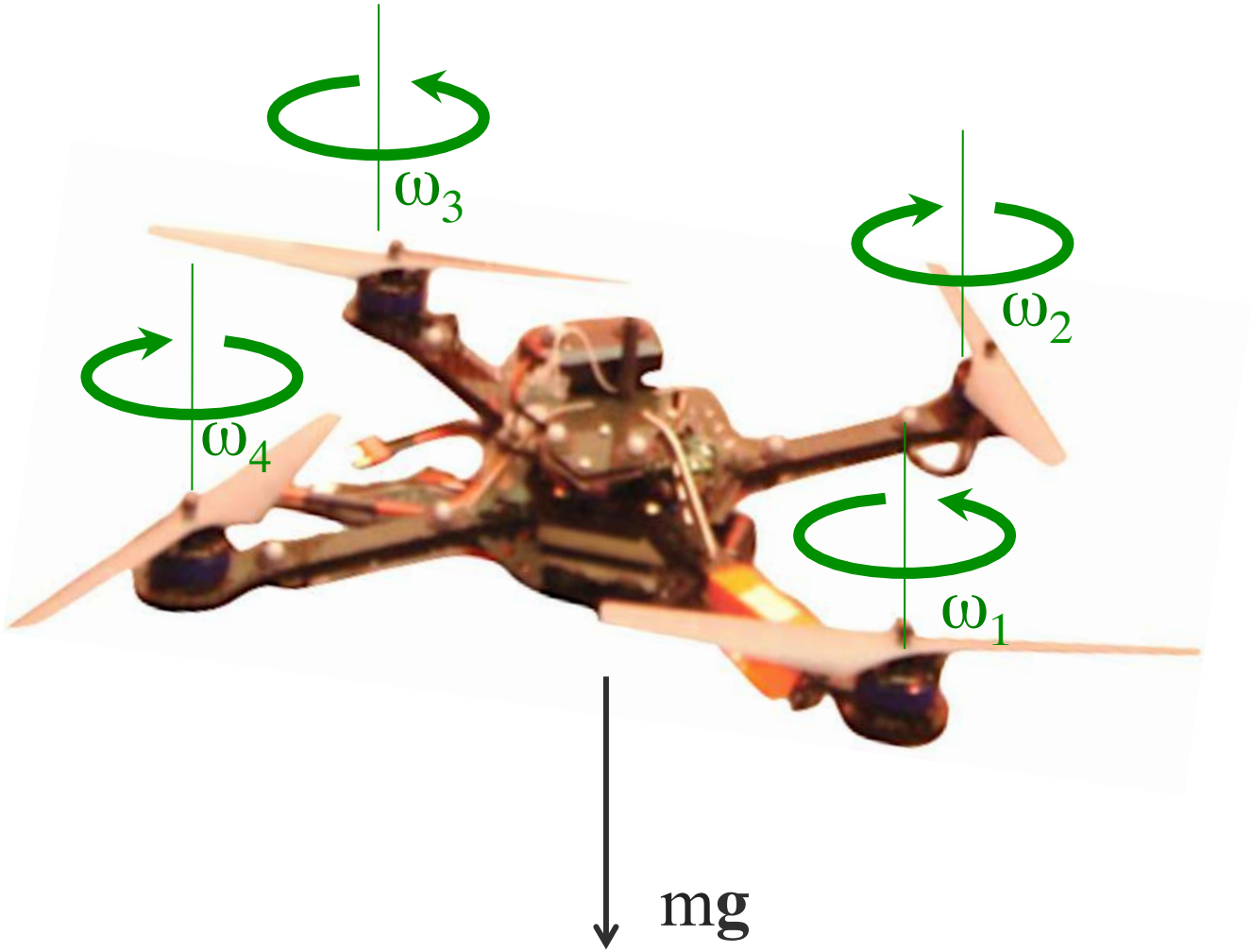
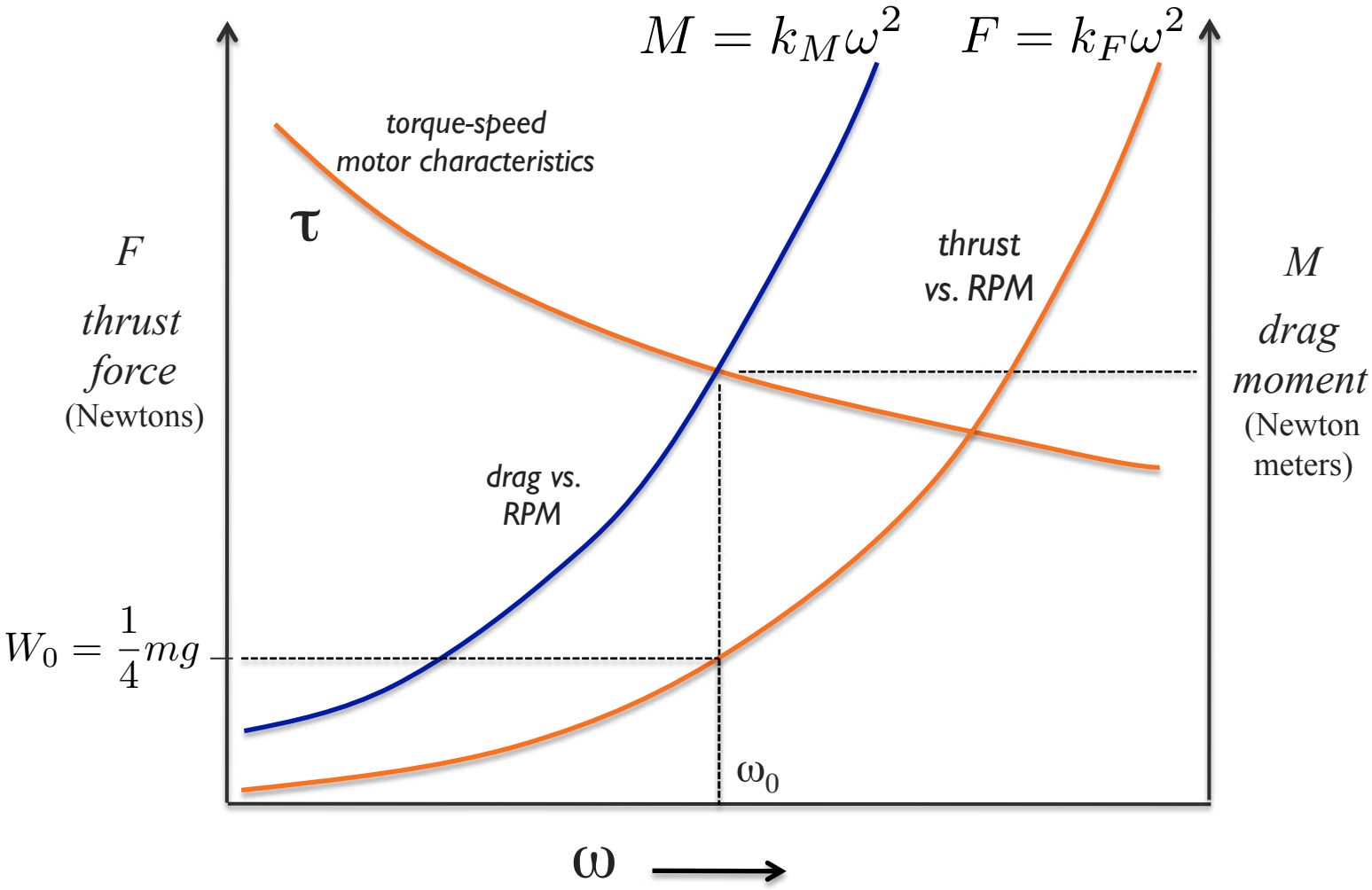
Goals

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

Basic Mechanics

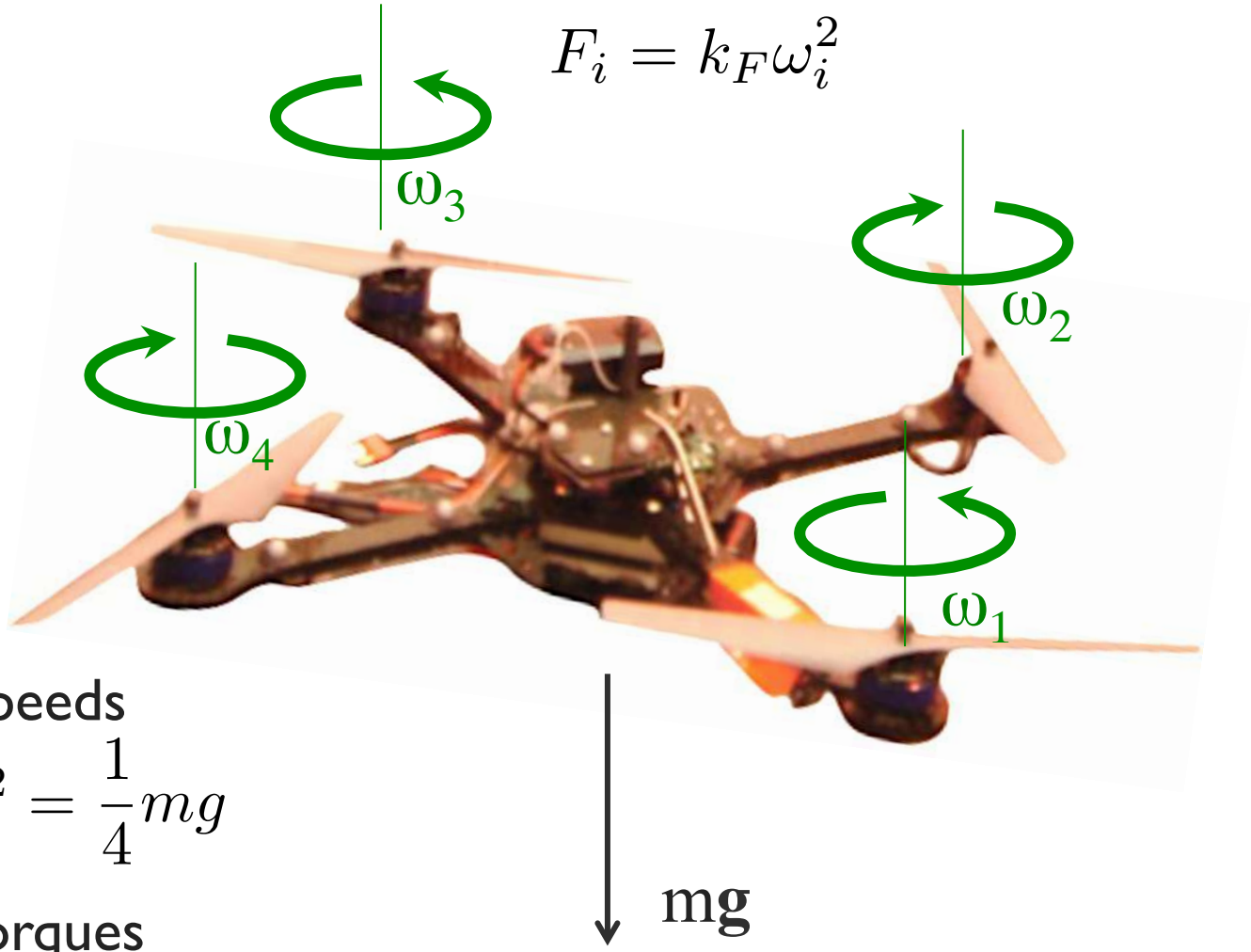


Rotor Physics



Basic Mechanics (Hover)

$$F_i = k_F \omega_i^2$$



Motor Speeds

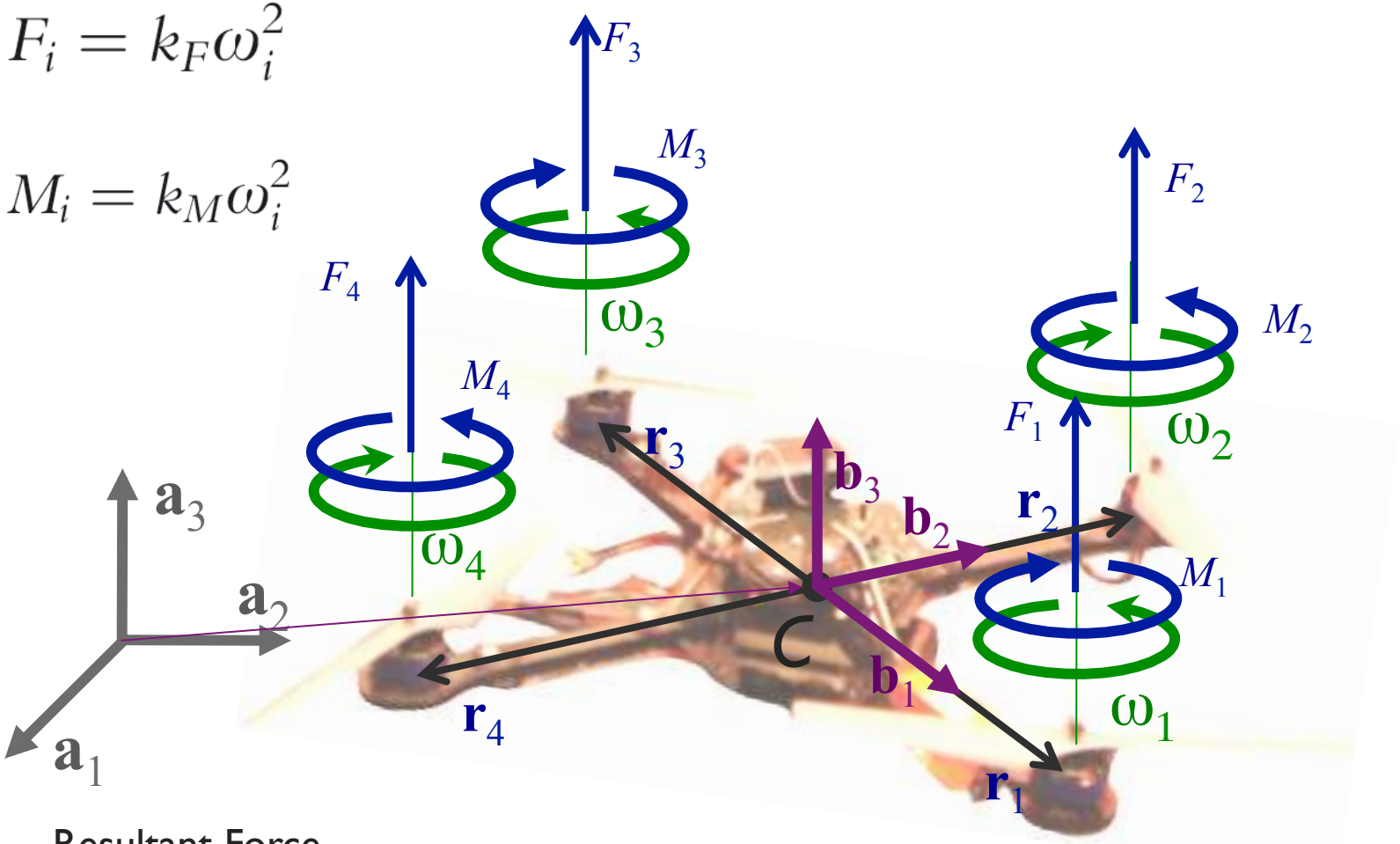
$$k_F \omega_i^2 = \frac{1}{4} mg$$

Motor Torques

$$\tau_i = k_M \omega_i^2$$

$$F_i = k_F \omega_i^2$$

$$M_i = k_M \omega_i^2$$



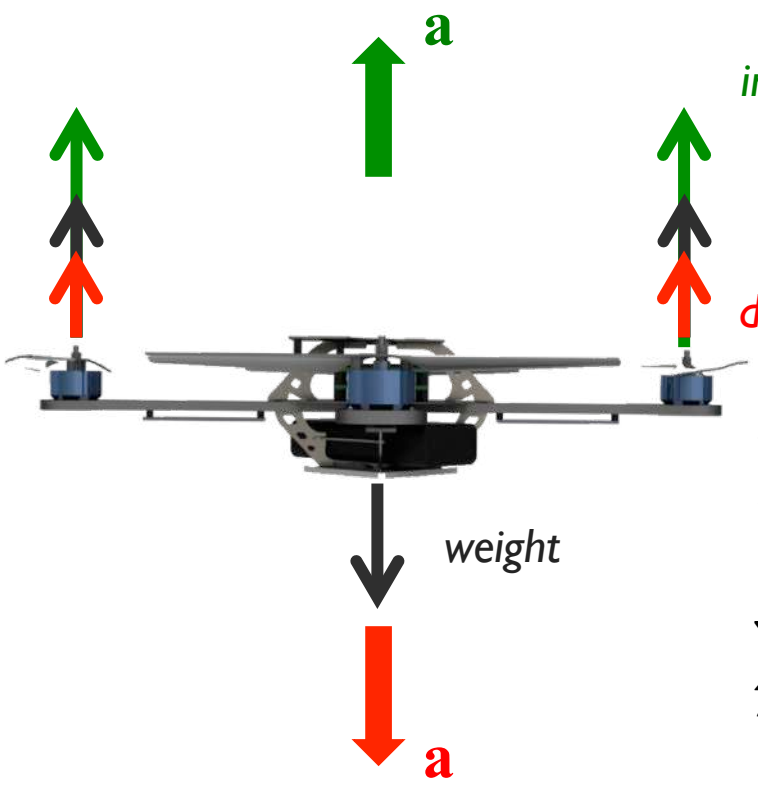
Resultant Force

$$\mathbf{F} = \mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_3 + \mathbf{F}_4 - mg\mathbf{a}_3$$

Resultant Moment

$$\mathbf{M} = \mathbf{r}_1 \times \mathbf{F}_1 + \mathbf{r}_2 \times \mathbf{F}_2 + \mathbf{r}_3 \times \mathbf{F}_3 + \mathbf{r}_4 \times \mathbf{F}_4 + \mathbf{M}_1 + \mathbf{M}_2 + \mathbf{M}_3 + \mathbf{M}_4$$

Acceleration
(in the vertical direction)



increase motor speeds

decrease motor speeds

$$\sum_{i=1}^{4} k_F \omega_i^2 + m\mathbf{g} = 0$$

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