16.485: **VNAV** - Visual Navigation for Autonomous Vehicles

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Lecture 6

based on slides by Markus Ryll

Agile Navigation with Aerial Vehicles

Vijay Kumar et al.
@Penn, 2012

Quadrocopter Pole Acrobatics

Raffaello D'Andrea et al.
@ETH, 2015

ETH Zürich

MIT AEROASTRO

Agile Navigation with Aerial Vehicles

Skydio (>~ 2015)

Agile Navigation with Aerial Vehicles

Design Concepts

- ## Single rotor

- ➕ ✓ Good Controllability and maneuverability
- ➖ - Complex mechanics
    - Large rotor

- ## Tandem rotor

- ➕ ✓ Good Controllability and maneuverability
- ➖ - Complex mechanics
    - Large size

- ## Coaxial rotor

- ➕ ✓ Compactness
    ✓ Simple mechanics
- ➖ - Complex aerodynamics
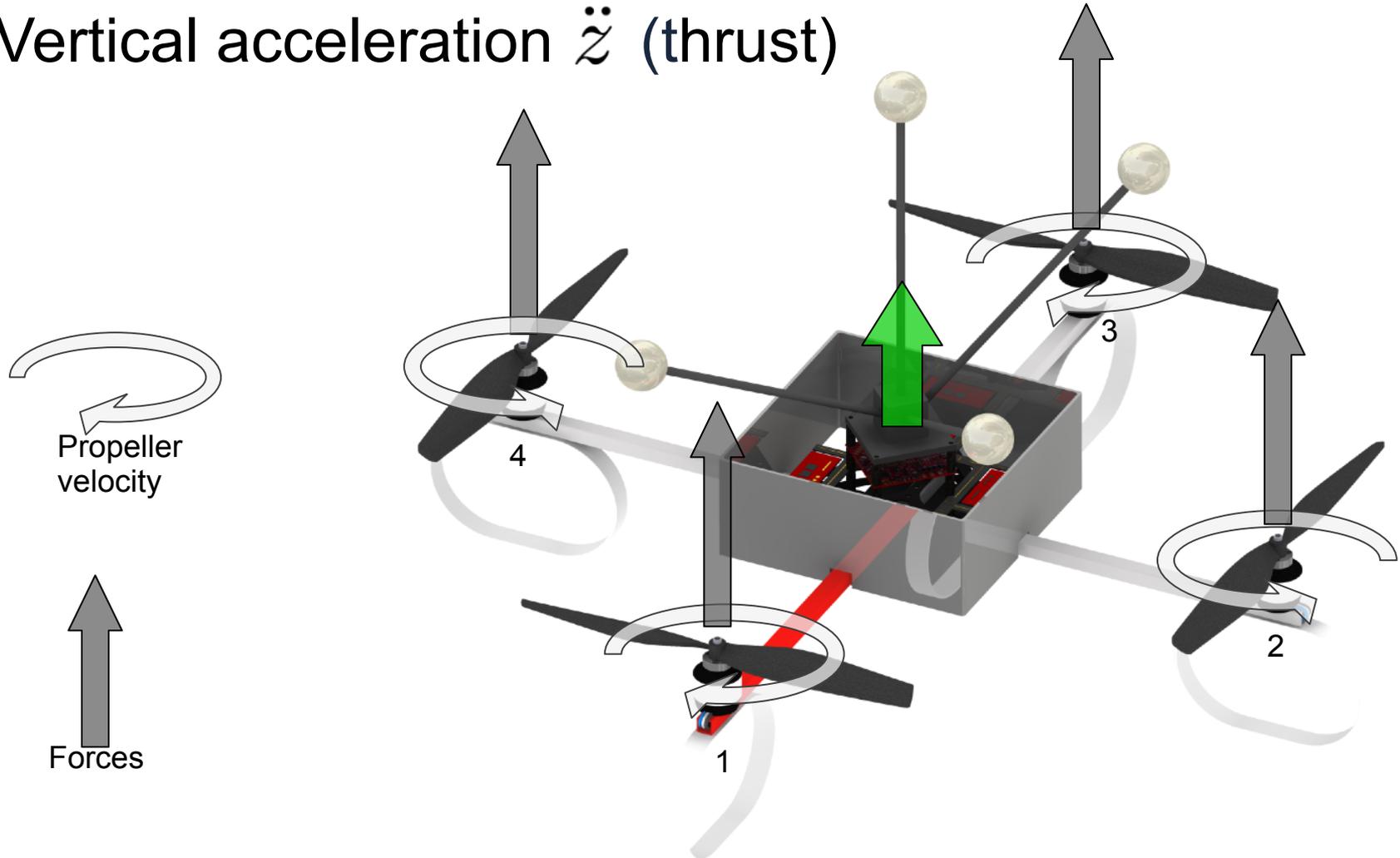
- ## Quadrotor

- ➕ ✓ Good maneuverability
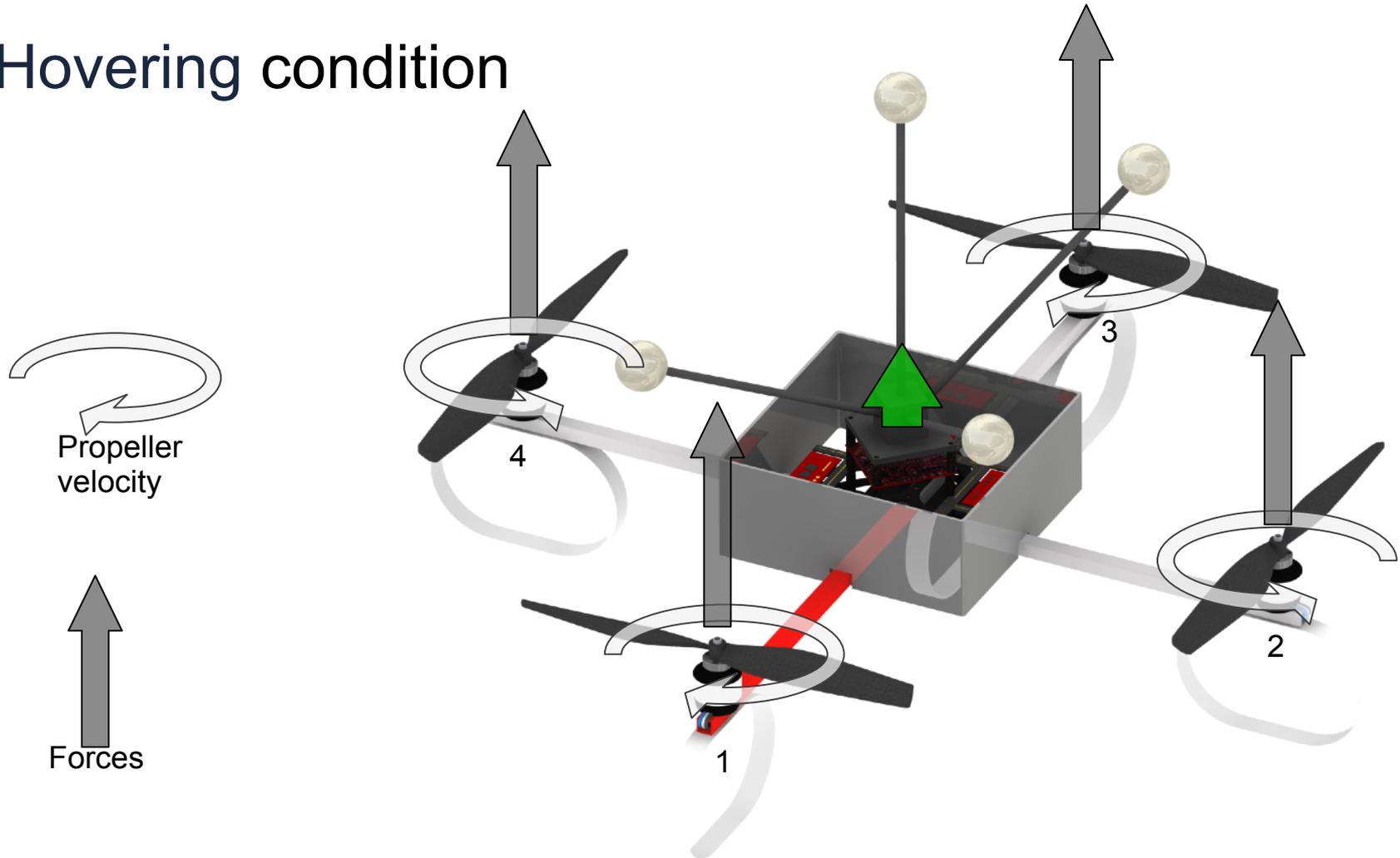   ✓ Simple mechanics
    ✓ Big payload
- ➖ - High energy consumption

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Design Concepts
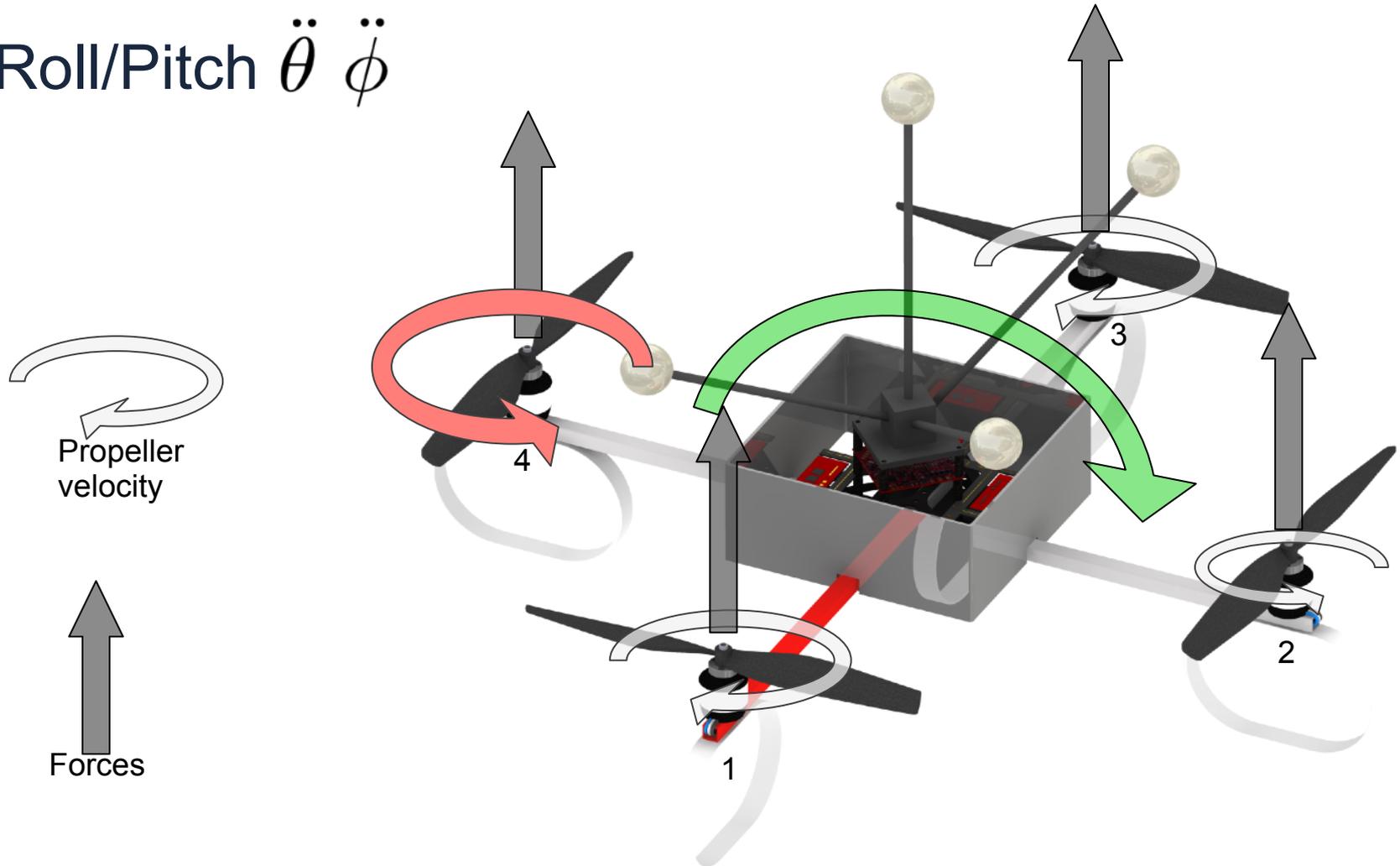
Vertical acceleration $\ddot{z}$ (thrust)

Design Concepts

Hovering condition

Propeller
velocity

Forces

1

2

3

4

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Design Concepts

Roll/Pitch $\ddot{\theta}$ $\ddot{\phi}$

Propeller velocity

Forces

Design Concepts

Yaw $\ddot{\psi}$

Drag

Forces

1 2 3 4
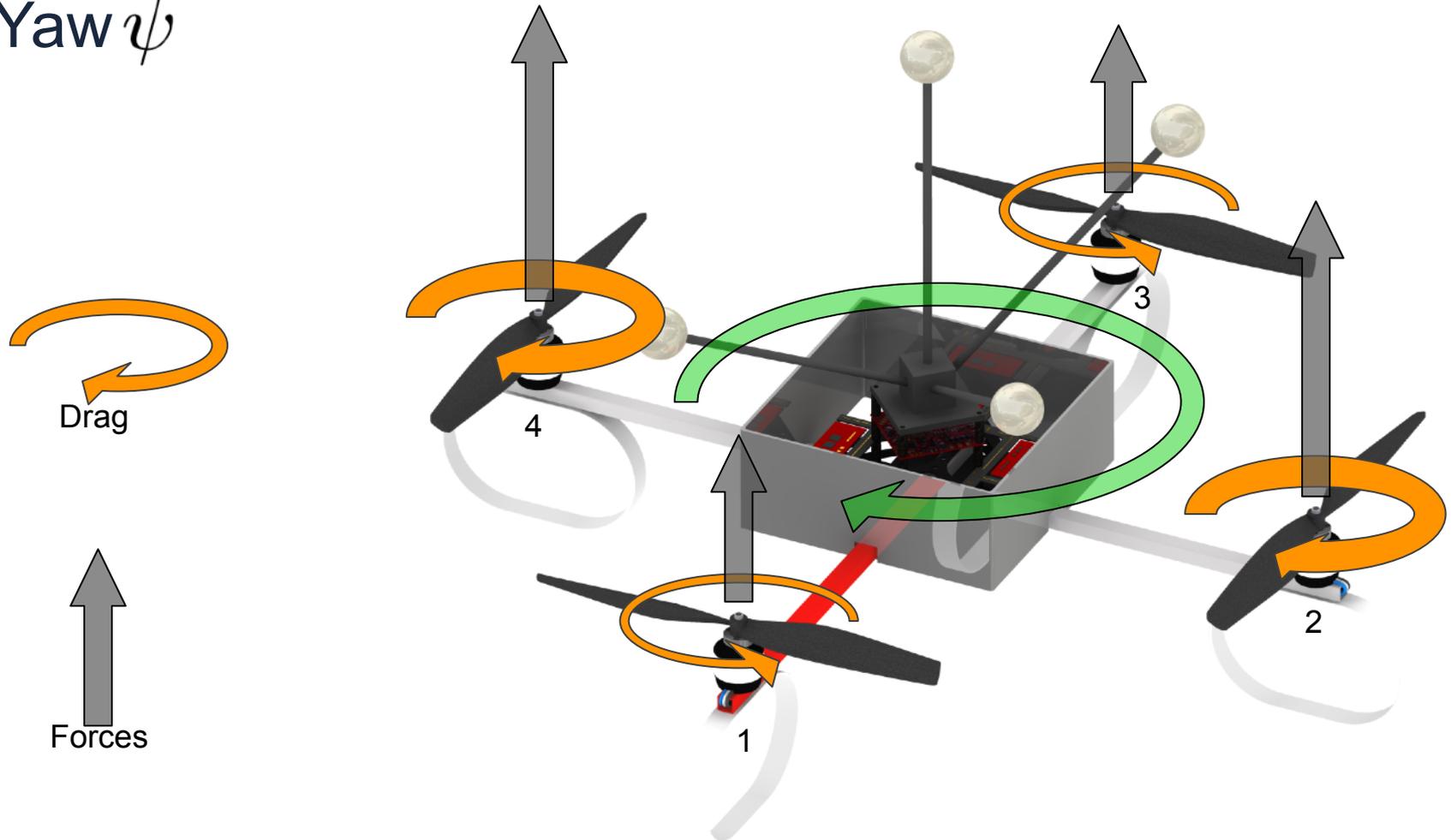
Notation

Design Concepts

Vertical acceleration $\ddot{z}$ (thrust)

Propeller velocity

Forces

4

3

1

2

System view

Source: http://ardupilot.org/copter/_images/ Pixhawk-Inforgraphic2.jpg