Autonomous Navigation for Flying Robots

Lecture 1.3: Flying Principle of a Quadrotor

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Quadrotor: Flying Principle

What do we need to do to keep the position?

http://blog.parrot.com/2010/02/10/macworld-2010-fly-the-parrot-ardrone/
Quadrotor: Flying Principle

Keep position:

- Thrust compensates for earth gravity

http://blog.parrot.com/2010/02/10/macworld-2010-fly-the-parrot-ardrone/
Quadrotor: Flying Principle

Keep position:

- Thrust compensates for earth gravity
- Torques of all four rotors sum to zero

http://blog.parrot.com/2010/02/10/macworld-2010-fly-the-parrot-ardrone/
Quadrotor: Basic Motions

Ascend

Descend
Quadrotor: Basic Motions

Turn Left

Turn Right
Quadrotor: Basic Motions

Move forward

Move backwards
Quadrotor: Basic Motions

Move left

Move right
Example: Parrot Ardrone 2.0

- **Actuators**
  - 4 brushless motors, 14.5W
  - AVR CPU motor controllers
  - LiPo battery, 1000mAh

http://ardrone2.parrot.com/ardrone-2/specifications/
Example: Parrot Ardrone 2.0

- Sensors
  - Gyroscope, accelerometer, magnetometer (IMU)
  - Ultrasound height sensor
  - Pressure sensor
  - Visual odometry sensor (60fps)
  - Front camera (720p, 30fps)

http://ardrone2.parrot.com/ardrone-2/specifications/
Example: Parrot Ardrone 2.0

- Embedded Linux system
  - ARM Cortex A8, 1GHz
  - Linux 2.6.32
  - USB 2.0 host
  - WiFi b,g,n
  - Open-source API

http://ardrone2.parrot.com/ardrone-2/specifications/
Available Platforms

- Commercial platforms
  - Parrot Ardrone
  - AscTec Hummingbird, Pelican, Firefly
  - Bitcraze Crazyflie
  - …

- Community/open-source projects
  - Mikrokopter
  - …
Interactive Exercise

- Test your understanding of the flight principle
- Web-based quadrotor simulator
- Programmable in Python
- For the moment, assume we have no noise
- Specify a sequence of motor commands to
  - Ascend, descend, fly forward, fly left, …
  - Fly 1m forward, 1m left, …
  - Fly (blindly) through the parcours!