

# The Mellinger controller And High level commander

# Goal

- An overview of the Mellinger controller and the High Level Commander

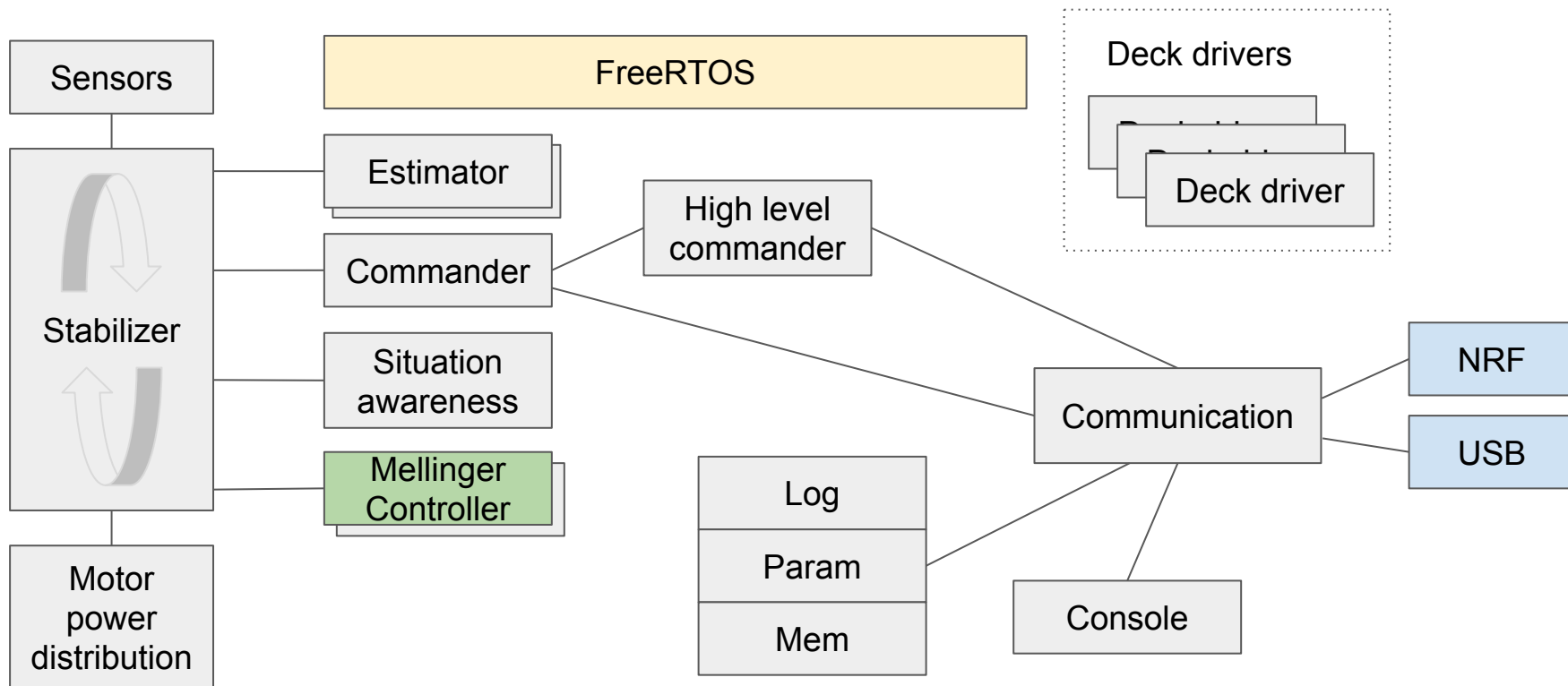
# What is a controller?

- Quadcopter moves by changing speed of motors
  - Attitude - tilt to move
  - Rotation
- A controller sets the speed of the motors
- Possible goals
  - Position
  - Velocity
  - Acceleration
  - Attitude
- The desired goal is called a setpoint
- All controllers do not support all actions

# Controllers in the Crazyflie firmware

- Plugin system
- PID controller
  - Simple
  - Robust
  - Sluggish
  - Position and attitude separated
  - Good for manual flight and autonomous flight with LPS
- Mellinger controller
  - Higher level of control
  - Agile
  - Less forgiving
  - Sensitive to positioning errors, good for mocap or lighthouse

# Crazyflie firmware overview



# Mellinger controller

- Based on paper from Daniel Mellinger, Vijay Kumar<sup>1</sup>
- Contributed as part of Crazyswarm by Wolfgang Hoenig and James Preiss<sup>2</sup>
- High level of control
- Setpoints contain
  - Position
  - Velocity
  - Acceleration
  - Attitude
- Possible to do advanced maneuvers

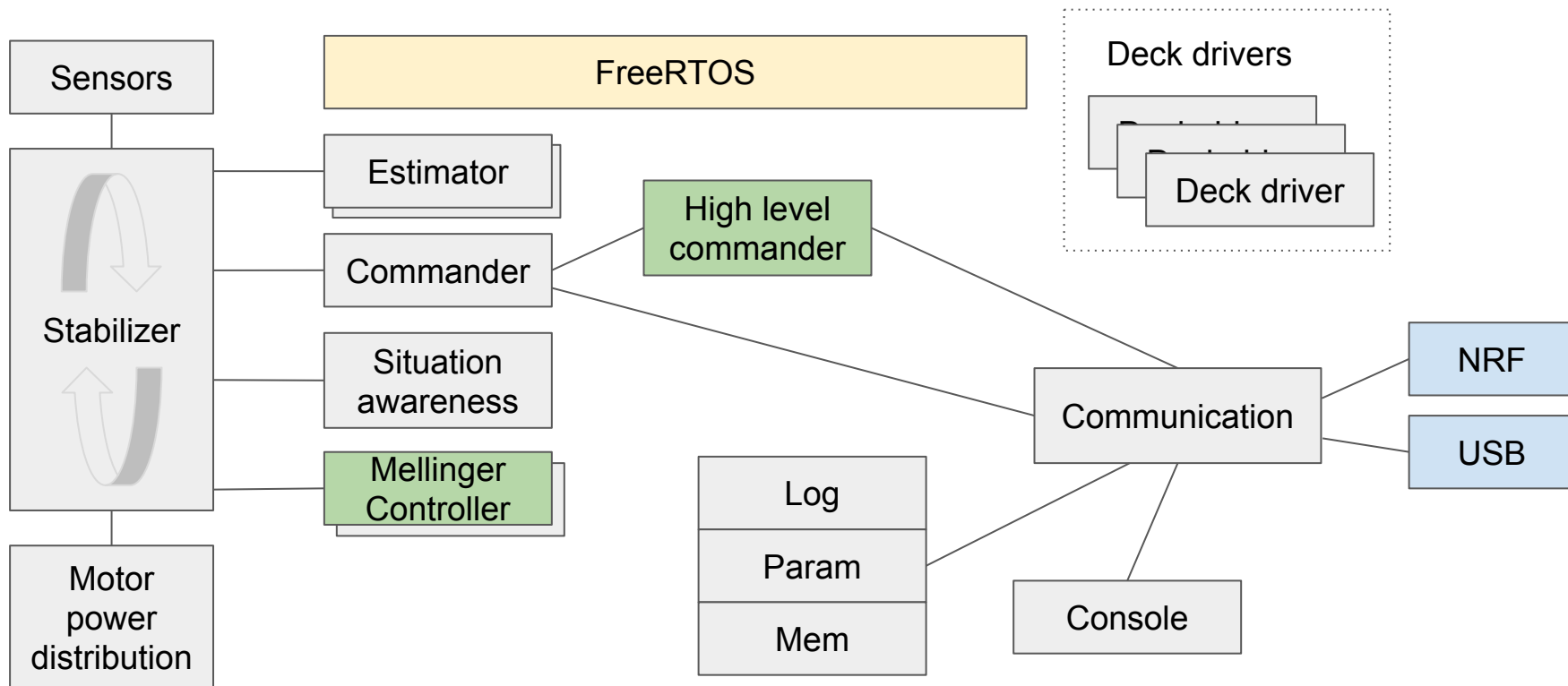
<sup>1</sup>Mellinger, Daniel, and Vijay Kumar. "Minimum snap trajectory generation and control for quadrotors." *2011 IEEE International Conference on Robotics and Automation*. IEEE, 2011.

<sup>2</sup>Preiss, James A., et al. "Crazyswarm: A large nano-quadcopter swarm." *2017 IEEE International Conference on Robotics and Automation (ICRA)*. IEEE, 2017.

# High level commander

- Feeds setpoints to the controller
- Follows a path and continuously calculates
  - Position
  - Velocity
  - Acceleration
  - Attitude
- 7 degree polynomial x 4
  - X, Y, Z, yaw

# Crazyflie firmware overview





# Trajectories

- A trajectory is a sequence of short paths executed one after each other
- With 7 degree polynomials it is possible to design trajectories with continuous position, velocity and acceleration through the joints
- Trajectories are played from memory
- Trajectories can be uploaded to the Crazyflie via radio

# Trajectory generation

- Slightly complex
- 3D animation tools
- Python script using Bezier curves
- Other tools

# Conclusions

- The Mellinger controller is very agile but sensitive to errors
- The High level commander adds support for trajectories