PATH PLANNING FOR FLYING DRONES

Øystein H. Holhjem (Research Scientist)

SINTEF Digital

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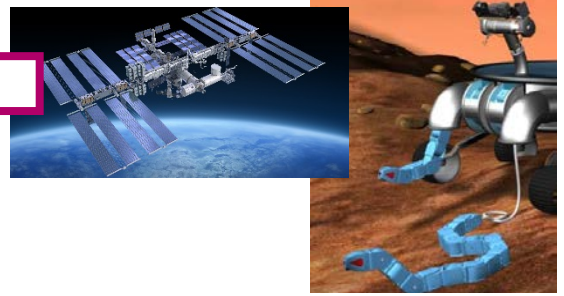
Outline

- Path Planning at SINTEF
- System Overview
- Localization – Where am I?
- Path Planning – How to get from A to B?
- Computing – Calculating the Path
- Challenges

Path Planning at SINTEF



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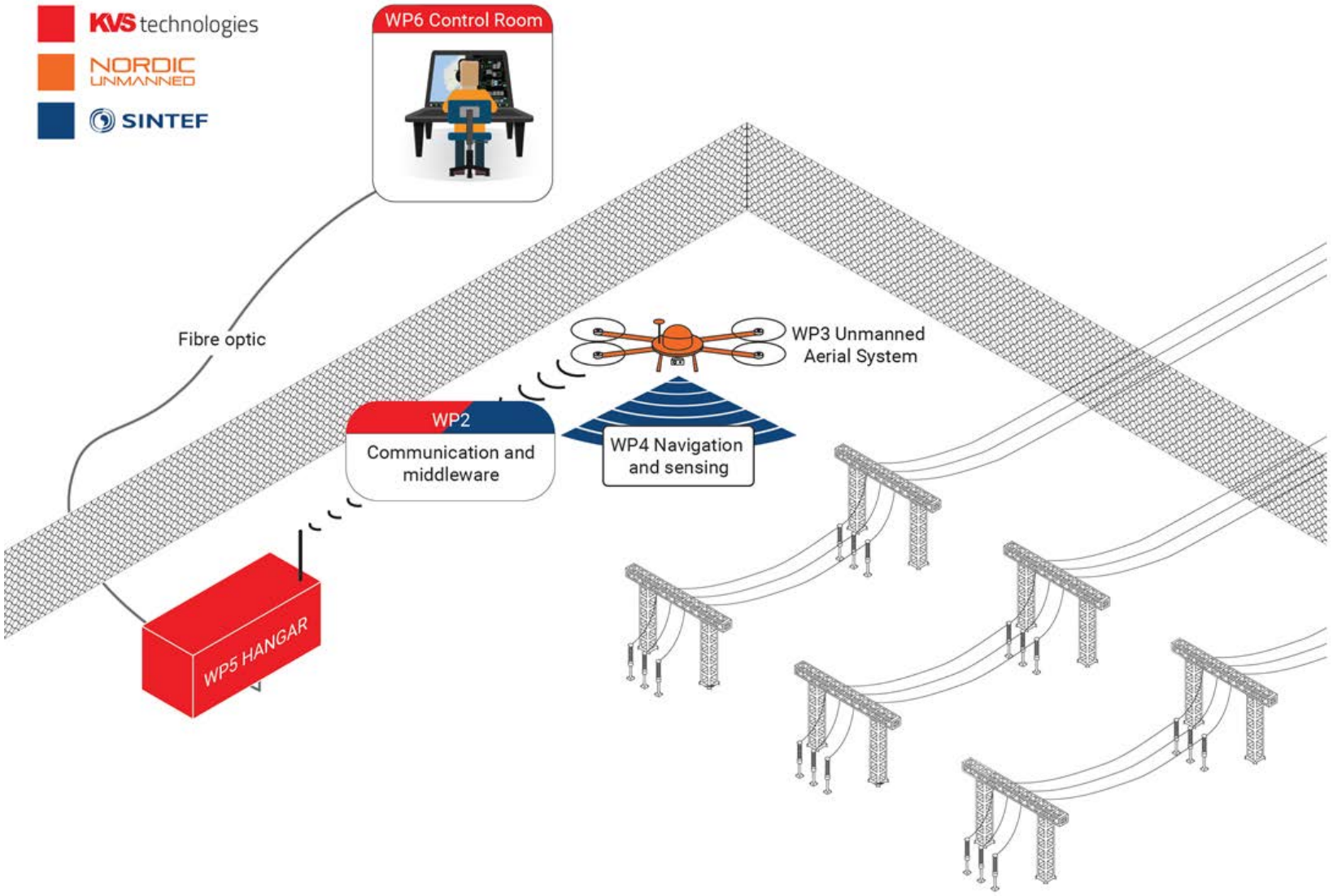
System Overview



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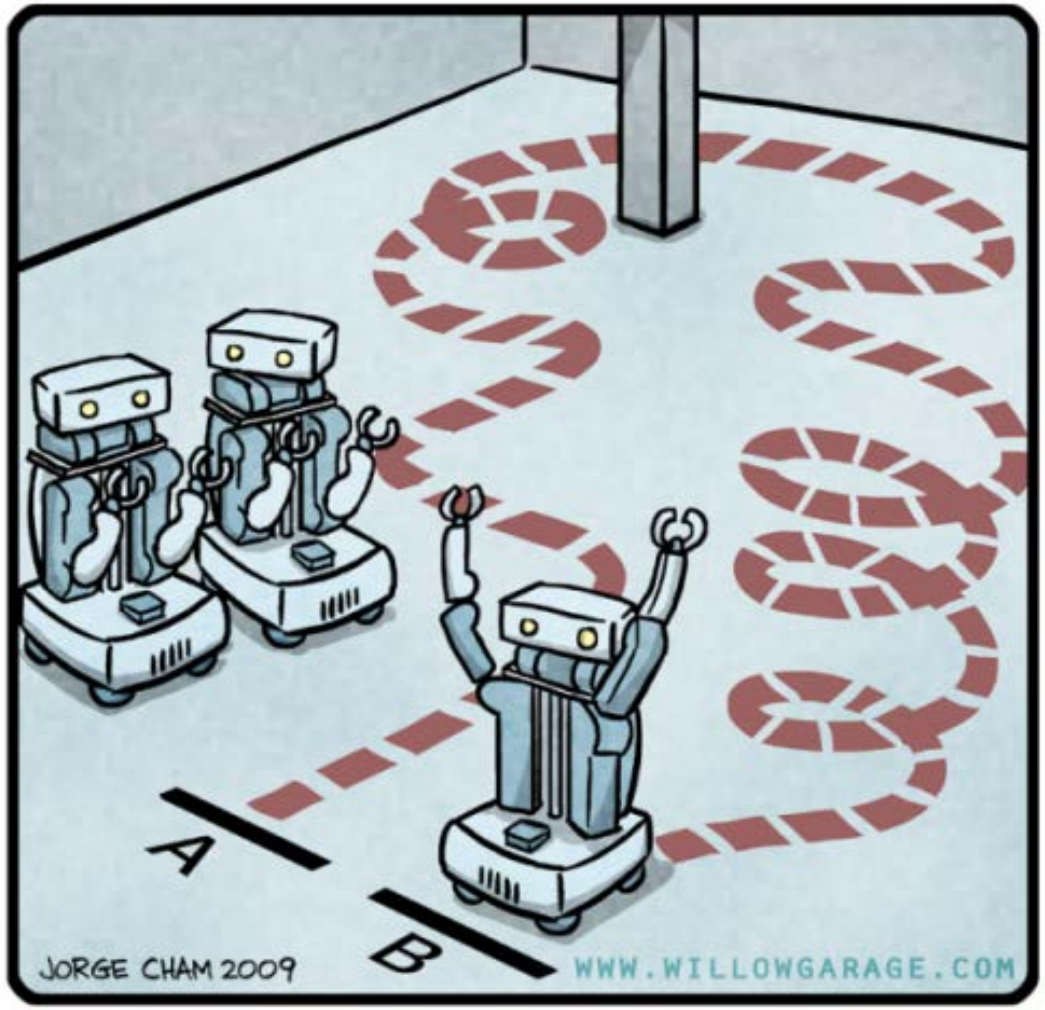
Localization – Where am I?

- Basis for all applications
- RTK GNSS
  - Centimetre accuracy
- Dual antennas
  - Good heading measurement
  - No compass needed
- Sensor fusion
  - Kalman filter
  - Inertial measurement unit (IMU)
  - Pose and position estimation

Path Planning – How to get from A to B?



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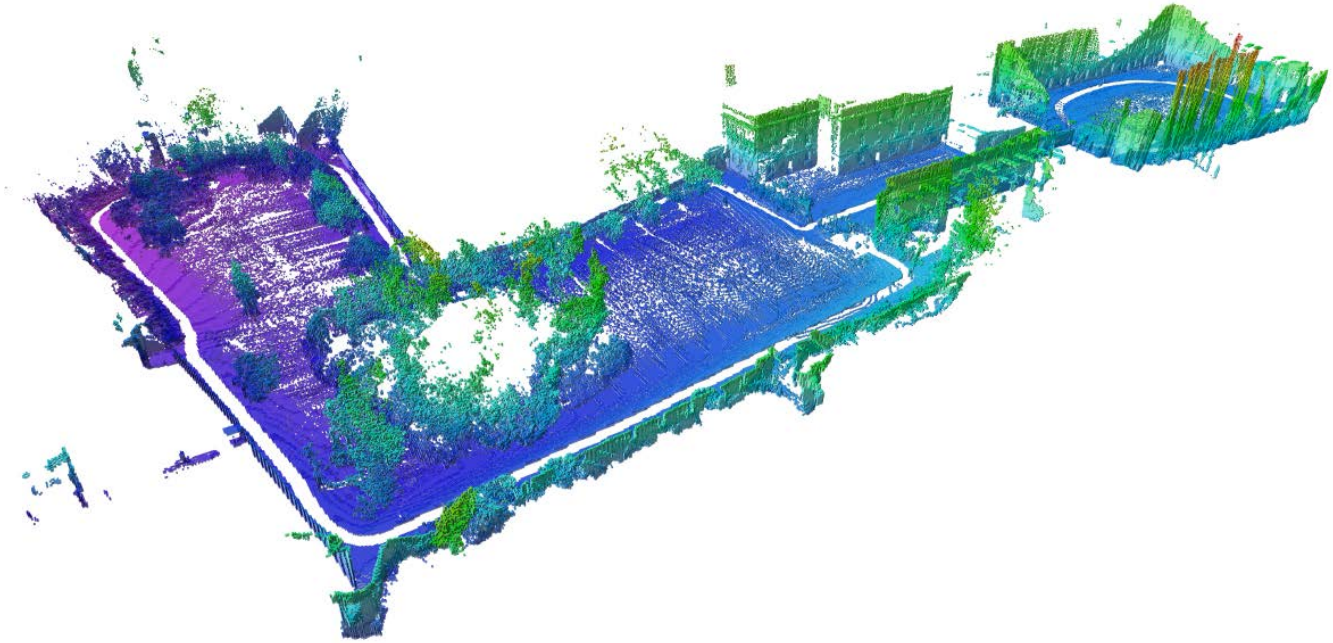
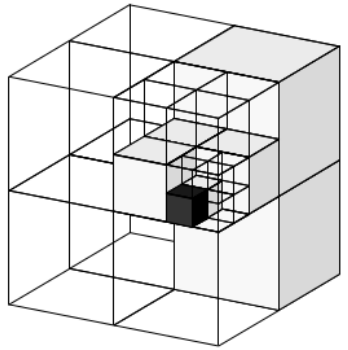
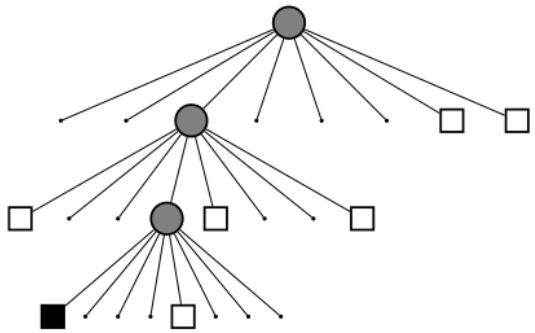
Collision Free Path – Environment Mapping

- Sensing of the environment
  - Onboard vision sensors
  - 3D data
- Representation of the environment
  - Discretization of data
  - 3D voxels
- Octomap for storing representation
  - Open-source library
  - Memory efficient tree structure
  - Occupied/Open/Unknown







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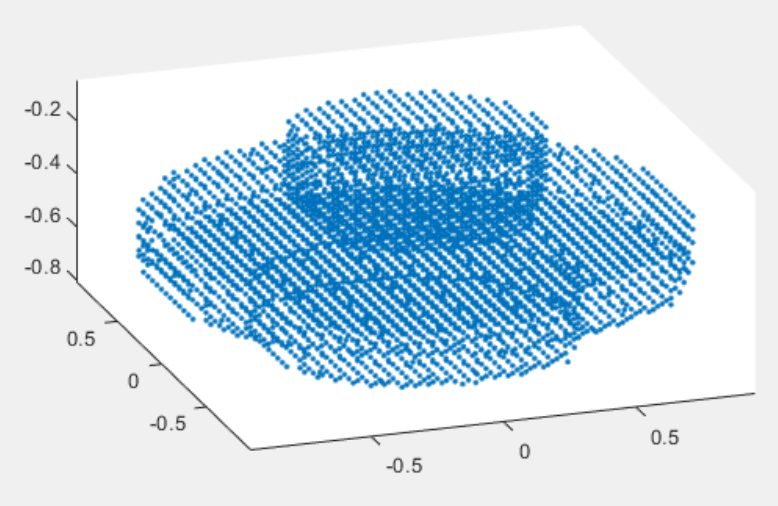
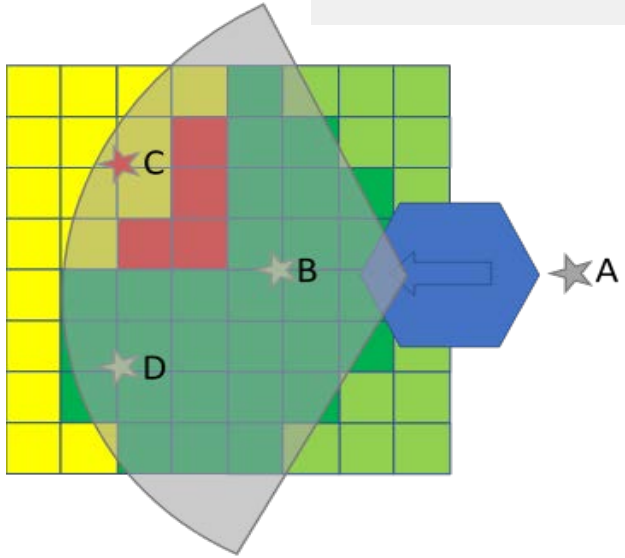
Collision Free Path – Collision checking

- Simplified drone model
  - Symmetric
  - Collision points
- Collision checking
  - Swept volume – ray tracing
  - Check against environment representation
  - Offline/online calculations





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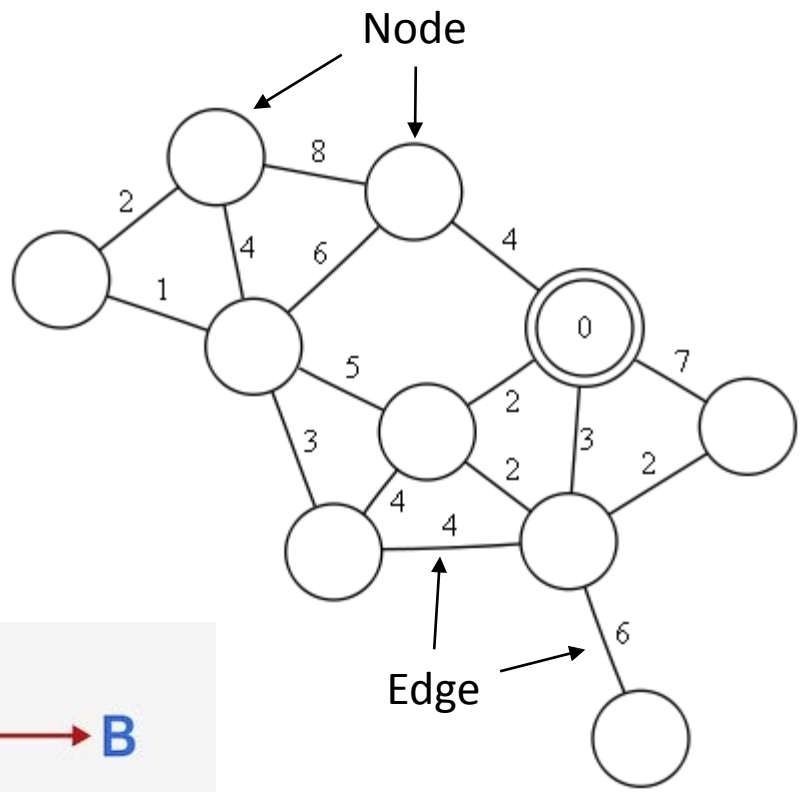
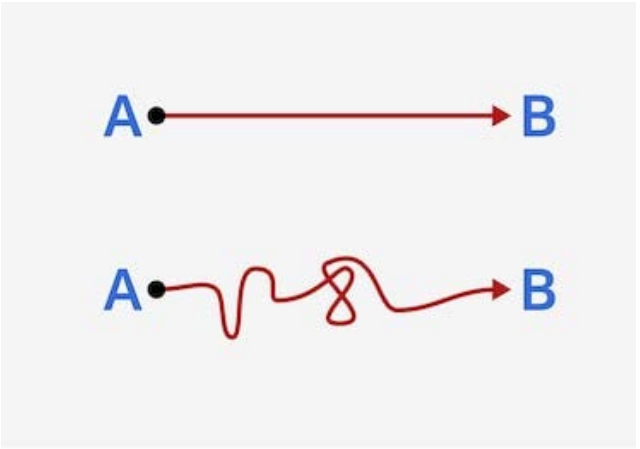
Shortest Path – Graph Search

- Graph - discretizing the movement space
  - Nodes correspond to waypoints in space
  - Edges corresponds to paths between waypoints
- Invalidating/validating occupied nodes and edges
  - Collision checking
- Shortest path through graph
  - A* search algorithm
  - Globally optimal
- Local avoidance
  - Stuck in local minima





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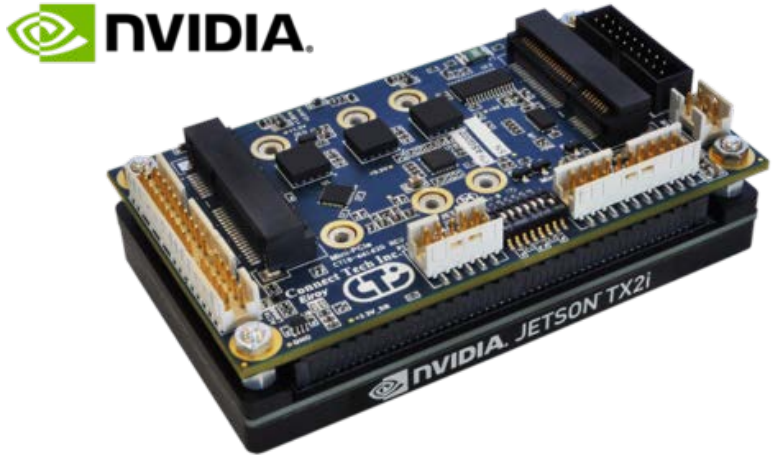
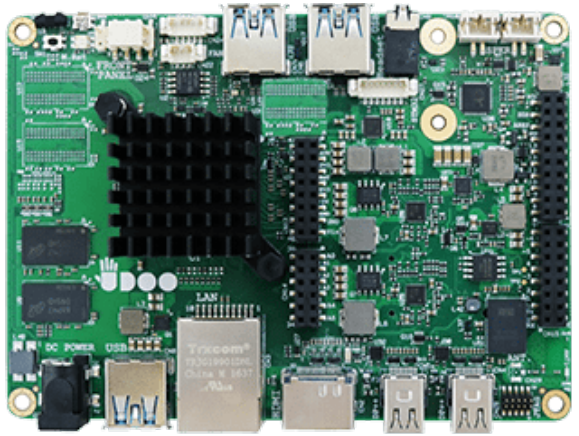
Computing – Calculating the Path

- Sensing, mapping, collision checking and graph search are computational demanding
- Onboard/offboard
  - Weight
  - Power consumption
  - Computation power
  - Communication
- CPU/GPU computing
  - Parallel processing
  - Udoo X86
  - NVIDIA Jetson TX2





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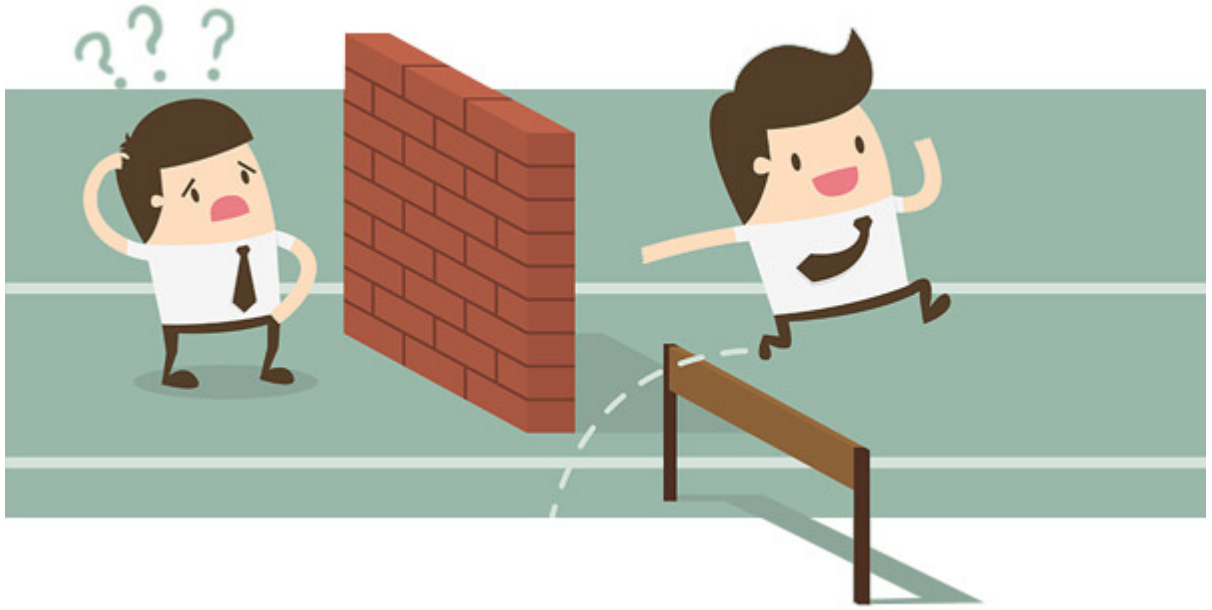
Challenges

- Limited computation power
- Drones are flying
  - Drift and inaccurate movement
  - High response demands
  - No emergency stop
- High voltages
  - High risk
  - Possible interference



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