PATH PLANNING FOR FLYING DRONES

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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
System Overview
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?
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
Collision Free Path – Collision checking

- Simplified drone model
  - Symmetric
  - Collision points

- Collision checking
  - Swept volume – ray tracing
  - Check against environment representation
  - Offline/online calculations
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
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
Challenges

• Limited computation power

• Drones are flying
  • Drift and inaccurate movement
  • High response demands
  • No emergency stop

• High voltages
  • High risk
  • Possible interference
Technology for a better society