AVOIDING COLLISIONS IN CHALLENGING CONDITIONS

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SINTEF DIGITAL

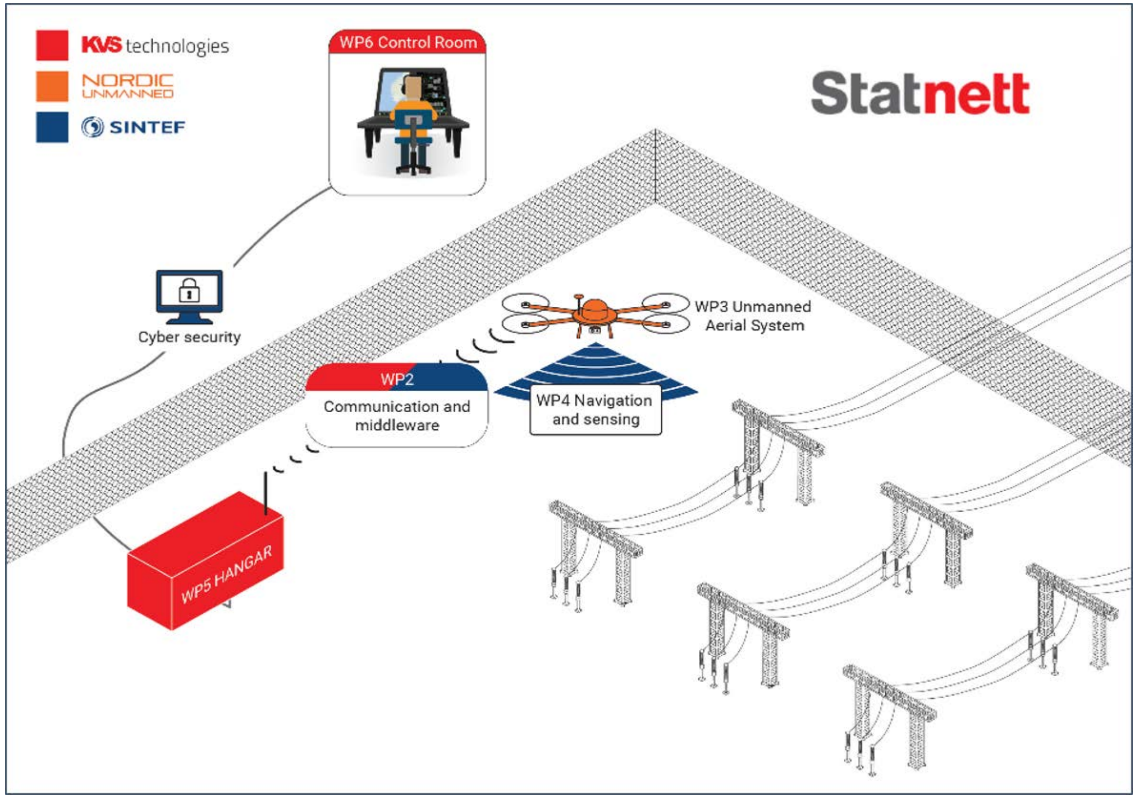
NNF Drone Navigation Seminar

15/11/2018

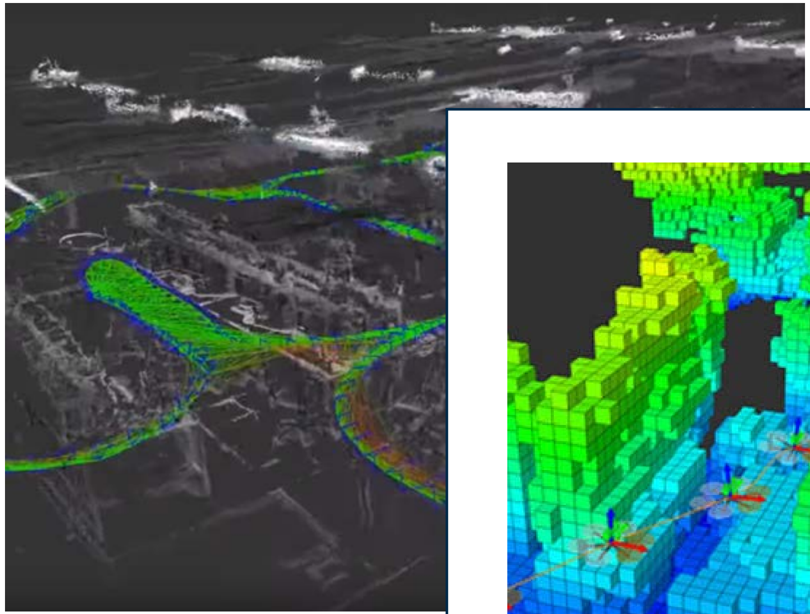
Outline

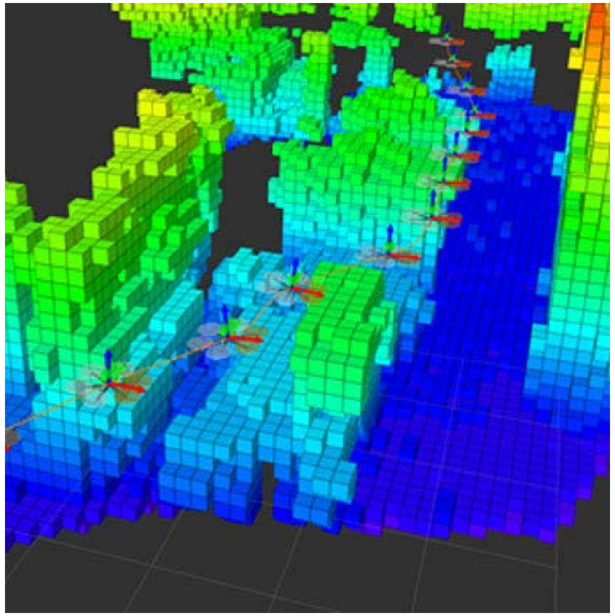
- Statnett case intro
- Sense and avoid
  - General approaches
  - Sensors
  - State of the art
- System design
- Summary

Danger! High Voltage – Catastrophe Avoidance for Drones in Critical Operations



Sense and Avoid: Approaches





~~SLAM~~

- Computationally fast
- Robust localisation even in difficult sensing conditions
- Allows integration with intelligent path planner
- Modular

SLAM

- Typically monocu scanning lidar
- Very wide FoV but sparse
- Optimised for localisation and mapping – not collision avoidance

radar, ToF, optic flow, DL for monocular depth, etc

- Narrower FoV, but can have multiple sensors
- Fast

proof

plifies processing and control

Sense and Avoid: Sensors

Passive optical

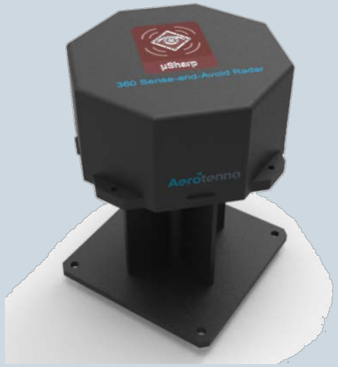
Miniature fisheye camera

Intel RealSense

RADAR

Echodyne phased array RADAR

TI mm-Wave RADAR



Aerotenna µSharp 360

LiDAR / active optical

Quanergy SS LIDAR

PMD Tech ToF

Velodyne Puck LITE

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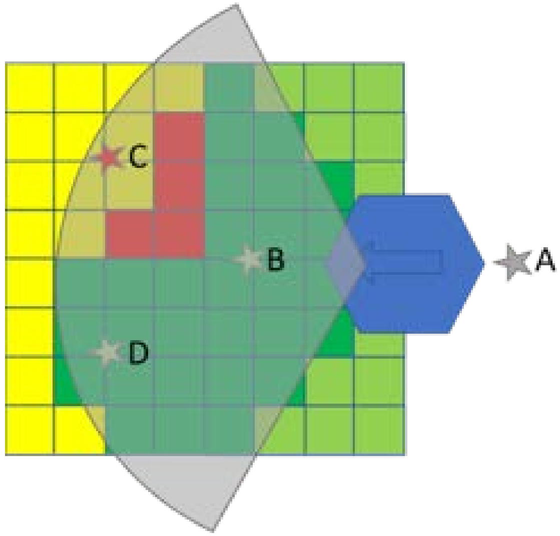
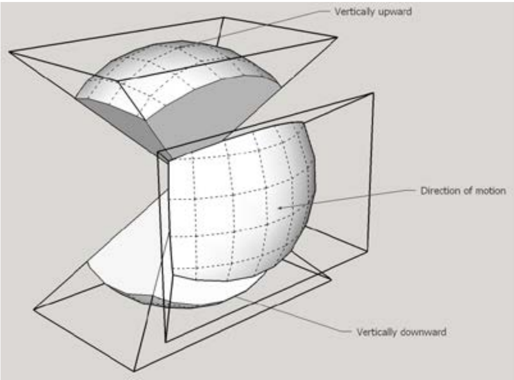
Sense and Avoid: State of the Art


Skydio
Autonomy Engine

Statnett Case Study – System Design

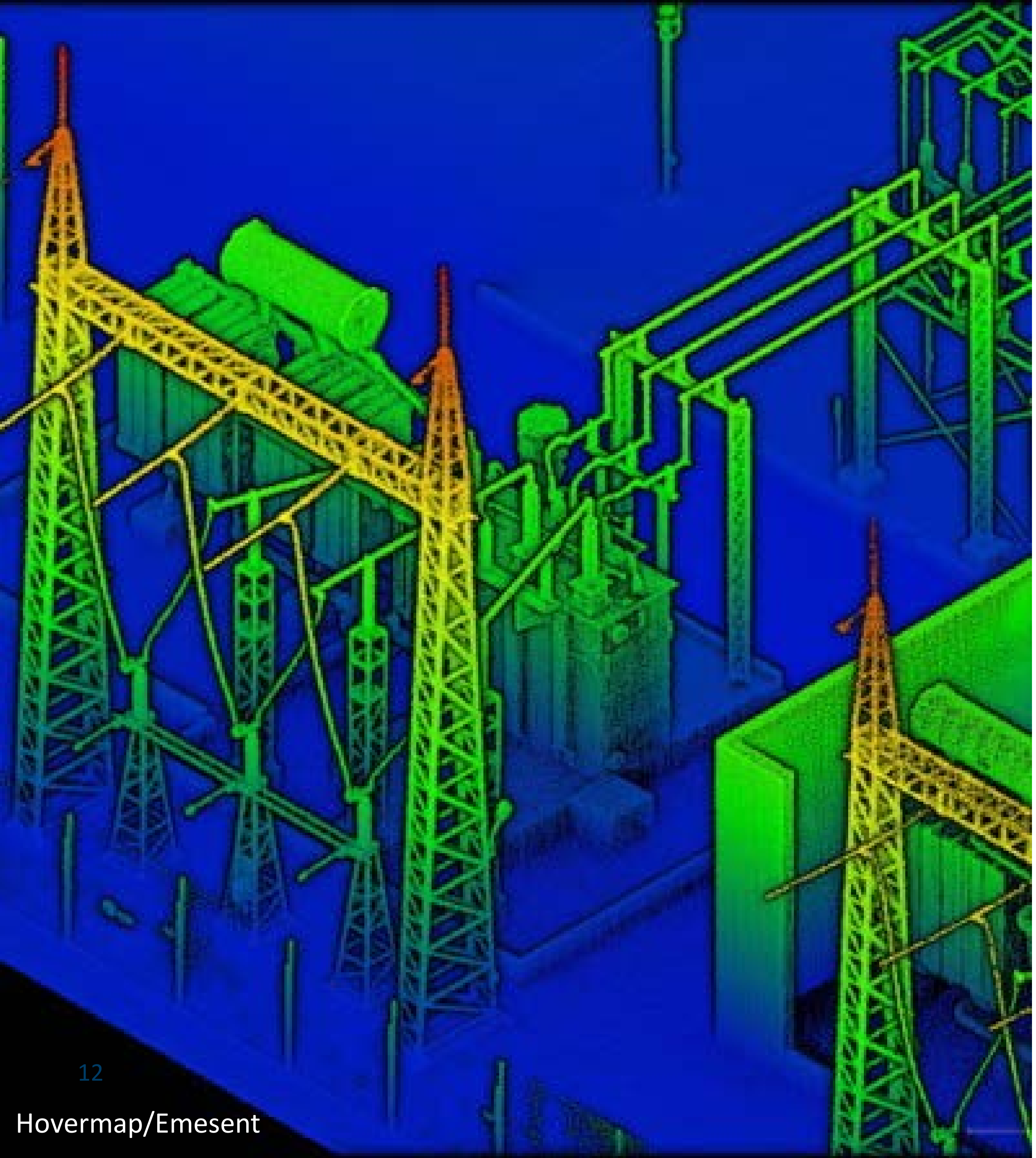


- System overview
  - Dual-antenna RTK for localisation
  - Node graph generated from offline scans
  - Onboard path planner for finding candidate trajectories
  - S&A must only verify path to next node
    - Emphasis on validation of free voxels, rather than precise mapping of structures
- S&A system
  - Multiple RealSense D435 sensors for dense wide-FoV coverage
  - Scanning LIDAR for long-range sensing in horizontal plane
  - Octree-based obstacle map for fast sensor fusion and node validation (path planner)



Statnett Case Study – R&D Goals

- How to best fuse complementary sensor data?
- What sensor data density is required for safe navigation in substation environments?
- How does inclement weather affect required sensor range/density?


Hovermap/Emesent

Summary

- Future directions
  - Achieving high density and high FoV at high frame rates (and low sensor weight/size/cost)
  - Sensor fusion for accurate sensing in poor optical conditions
  - Signal processing (esp. radar)
- Can simplify challenges through smart sensor design
  - Know your limitations

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