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3D MAPPING AND PLANNING FOR AUTONOMOUS NAVIGATION OF MICRO AERIAL VEHICLES IN COMPLEX GNSS-DENIED ENVIRONMENTS

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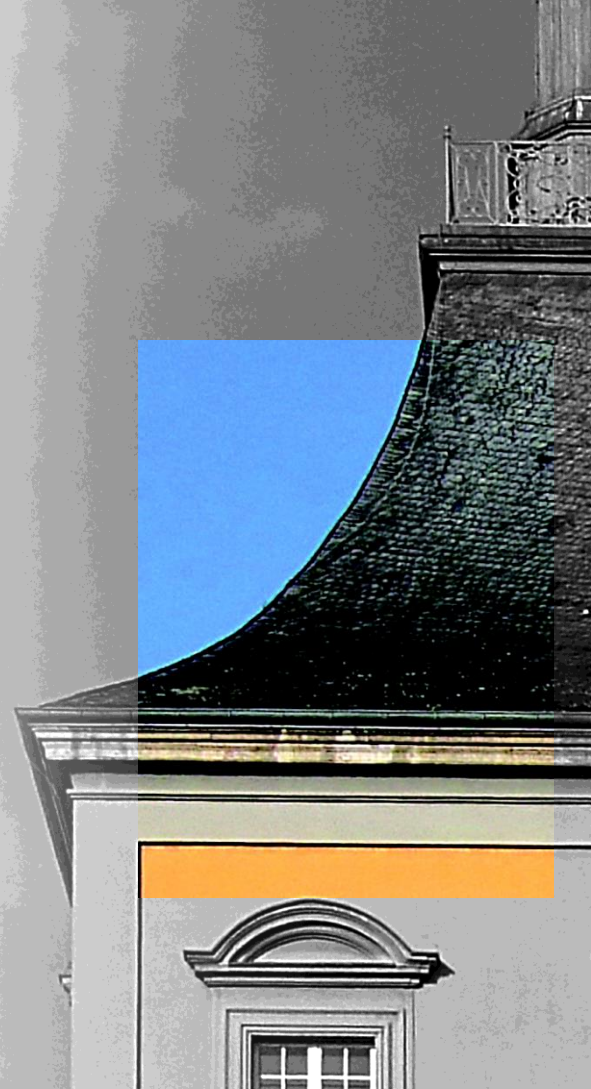
Computer Science Institute VI
Autonomous Intelligent Systems



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AUTONOMOUS BEHAVIOUR

- Mapping
  - Map of the scene
  - Semantic understanding

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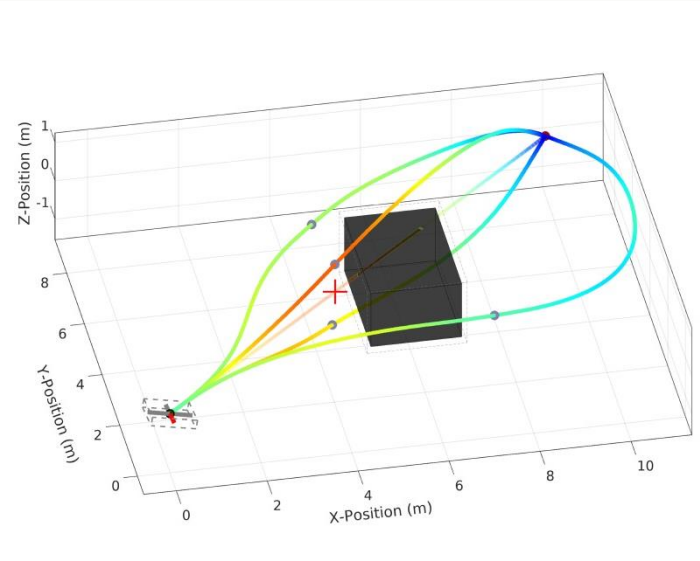
AUTONOMOUS BEHAVIOUR

- Mapping
  - Map of the scene
  - Semantic understanding
- Planning
  - Collision avoidance
  - Time-optimal control



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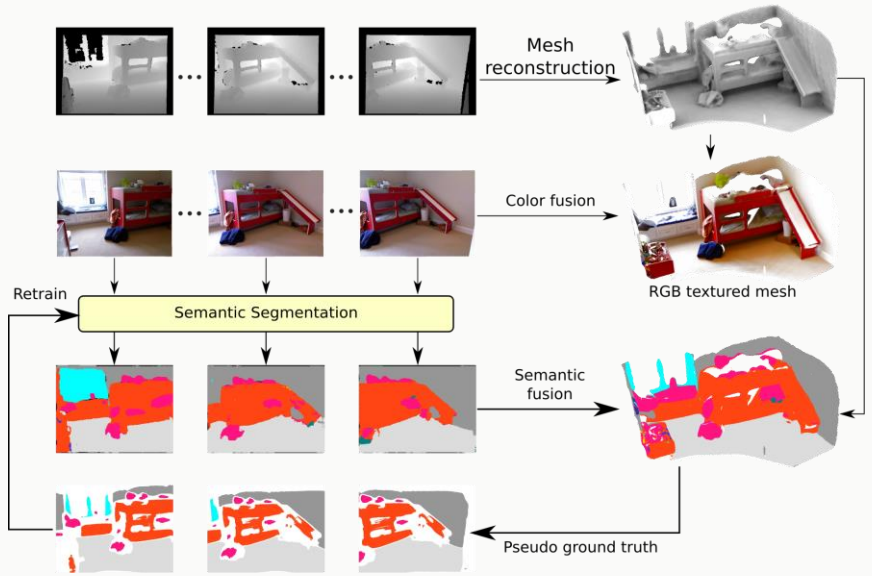
SEMANTIC TEXTURE

- Scene as lightweight mesh
- Semantic and RGB as high-res texture
- Iterative self-improvement through Label Propagation



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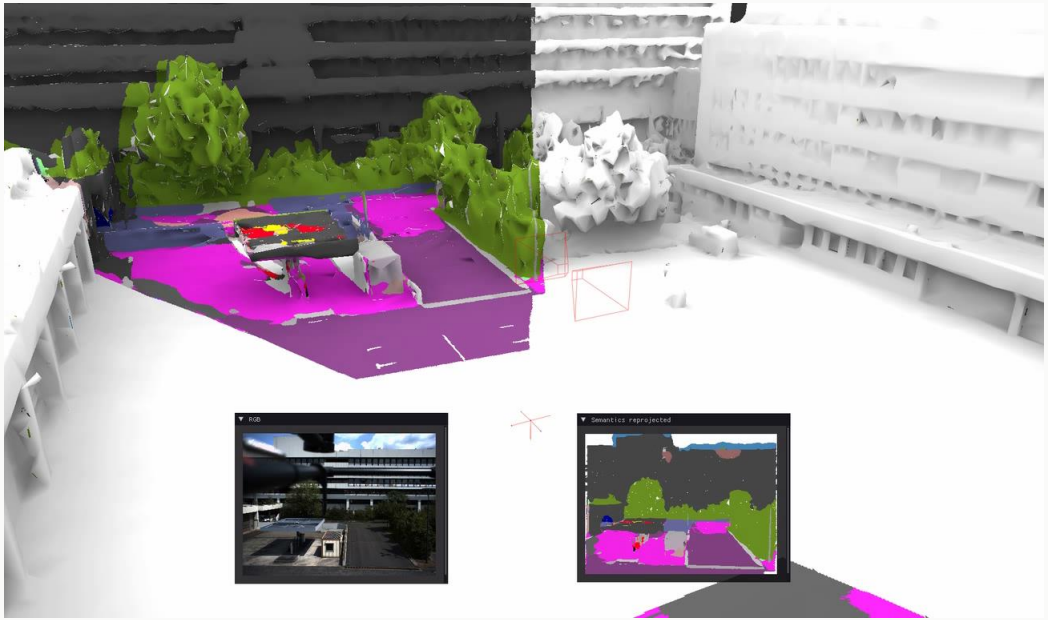
SEMANTIC TEXTURE

- Probabilistic fusion
- High resolution texture
- 66 semantic classes



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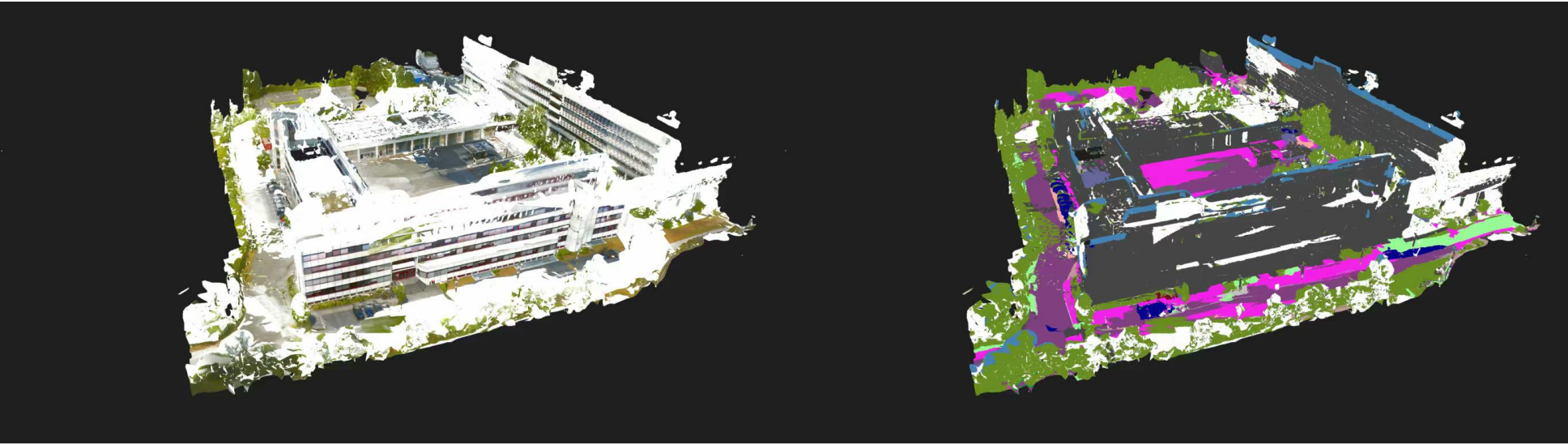
AUTONOMOUS MAV



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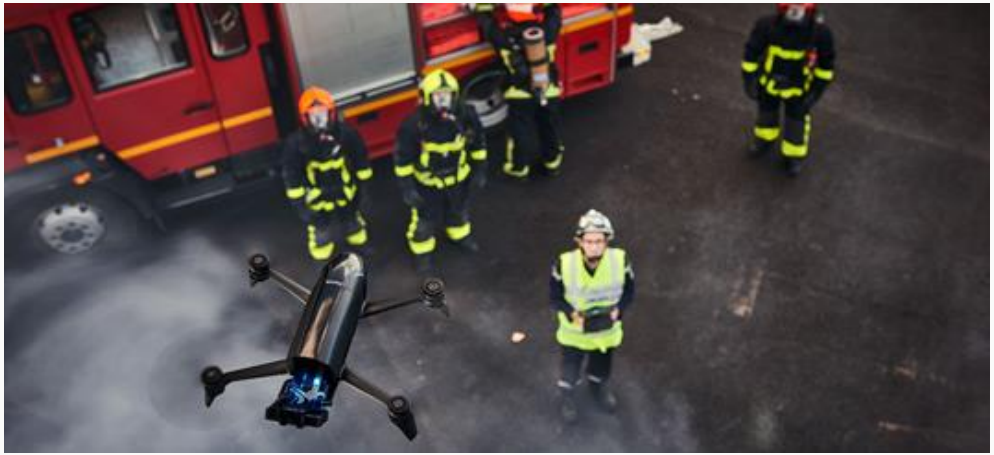
MAVS FOR FIREFIGHTING

- Fast reconnaissance
- Detect people or latent fires
- Multi drone communication




Menu
Thermal
RGB

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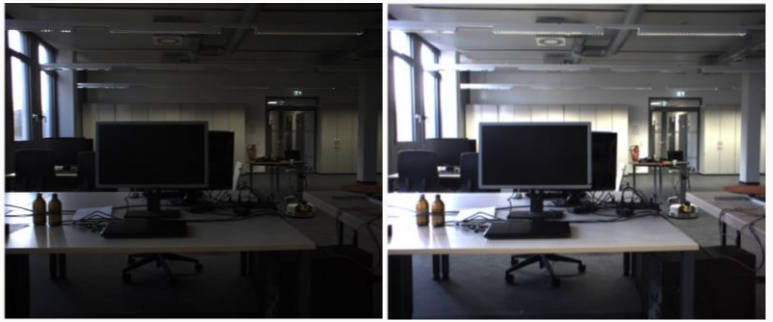
IMAGE CORRECTION

- Image intensities change over time

Vignetting



Exposure changes

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IMAGE CORRECTION

- Image intensities change over time
- Estimate vignetting, camera response and exposure changes

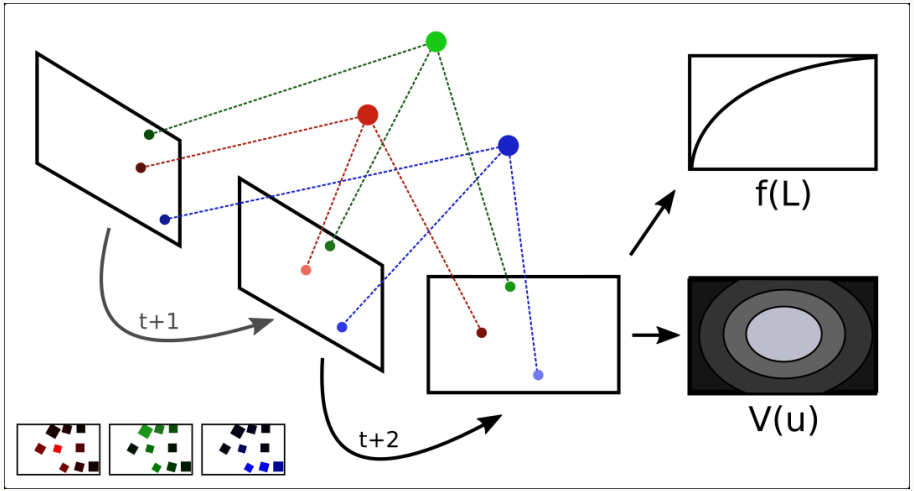

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IMAGE CORRECTION

- Image intensities change over time
- Estimate vignetting, camera response and exposure changes
- Thin plate spline for interpolation of correction factors

Original image | Correction factor | Corrected image

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DYNAMIC OBJECTS

- Dynamic objects need to be treated separately

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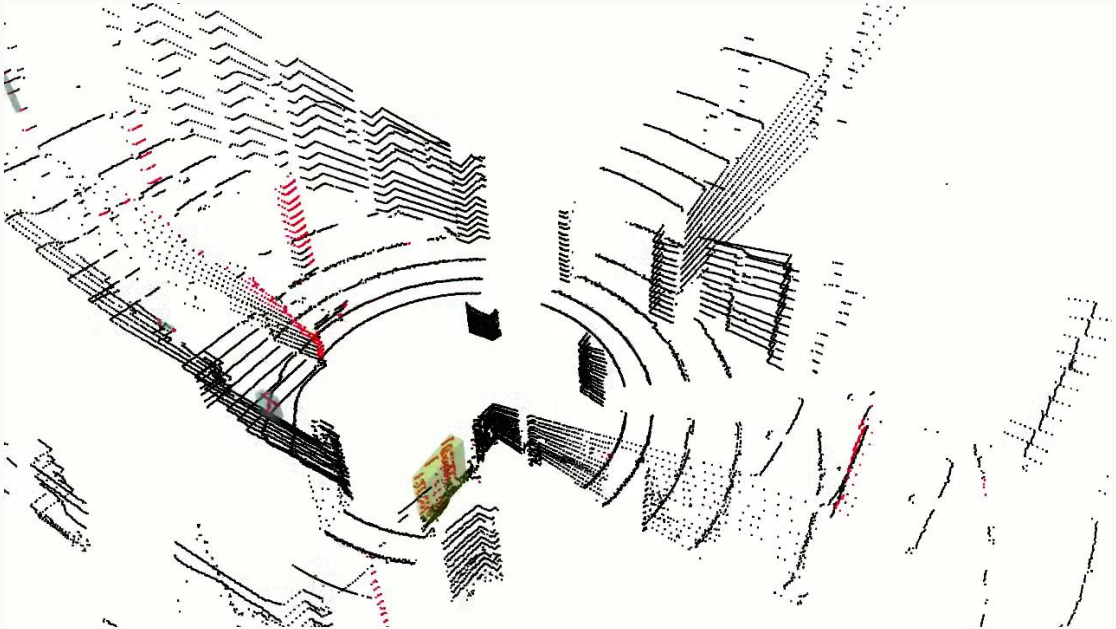
DYNAMIC OBJECTS

- Dynamic objects need to be treated separately
- Track the objects



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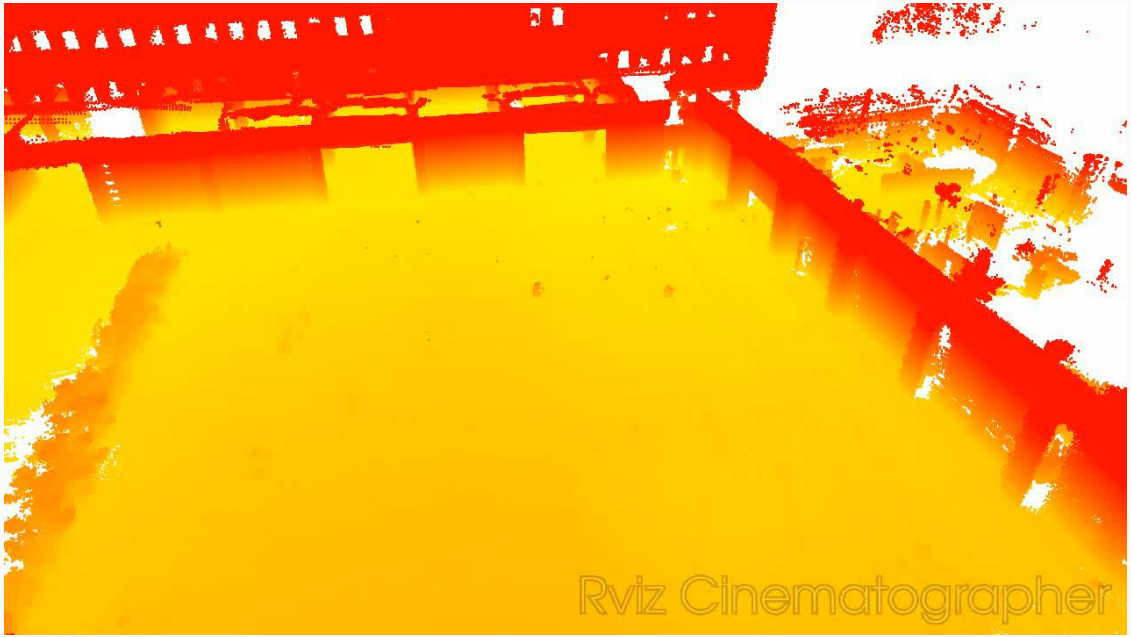
DYNAMIC OBJECTS

- Dynamic objects need to be treated separately
- Track the objects
- Real-time filtering



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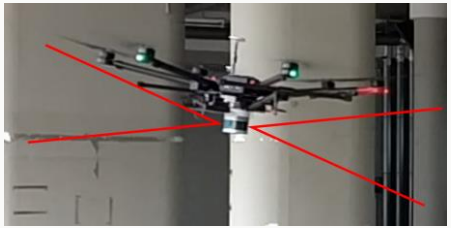
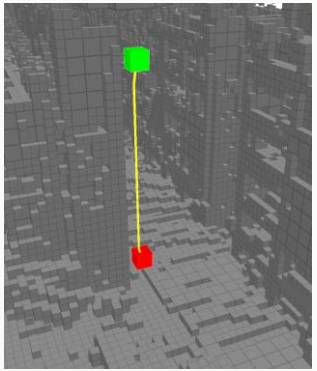
PLANNING UNDER CONSTRAINTS

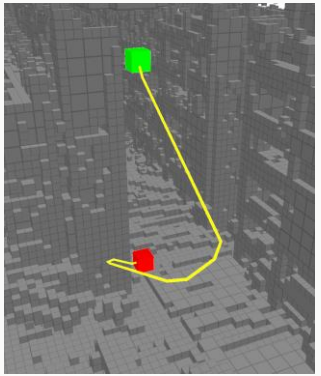
- Sensors have blindspots
- Planning needs to take them into consideration for safety
- Modified A* and CHOMP trajectory optimization



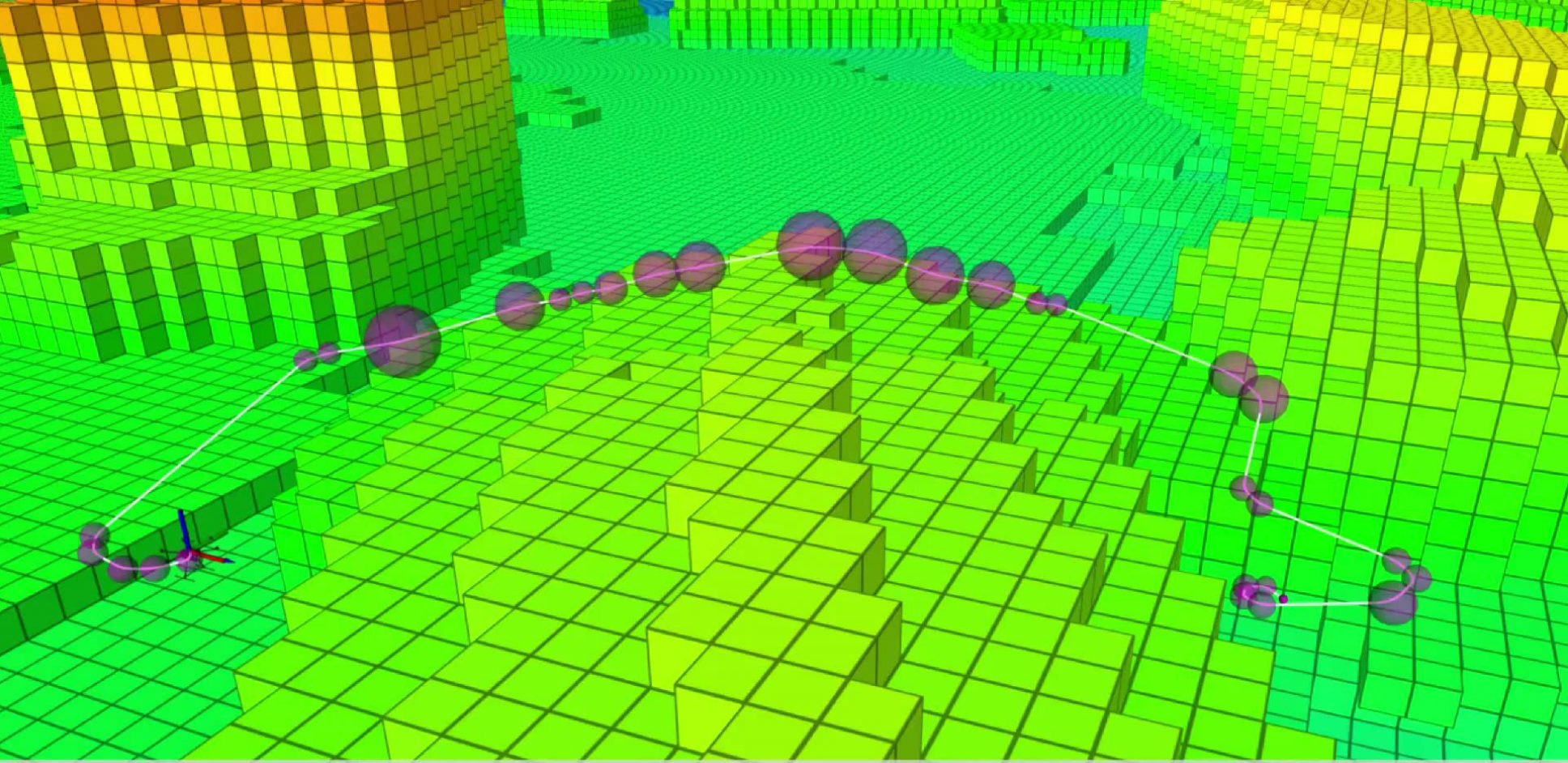
Lidar field of view



Fastest trajectory



With visibility constraints



Planned path with visibility constraints

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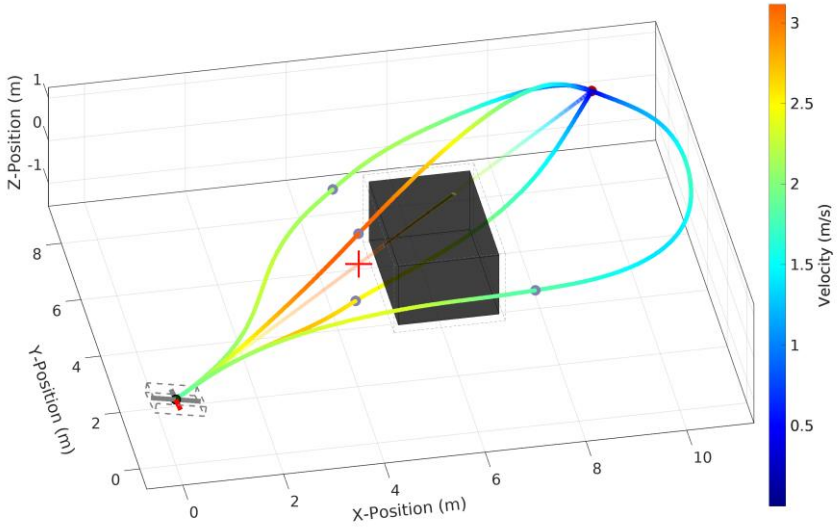
FAST REACTIVE CONTROL

- Fast trajectory generation
- Less than 6ms per trajectory
- Avoid collision with dynamic objects



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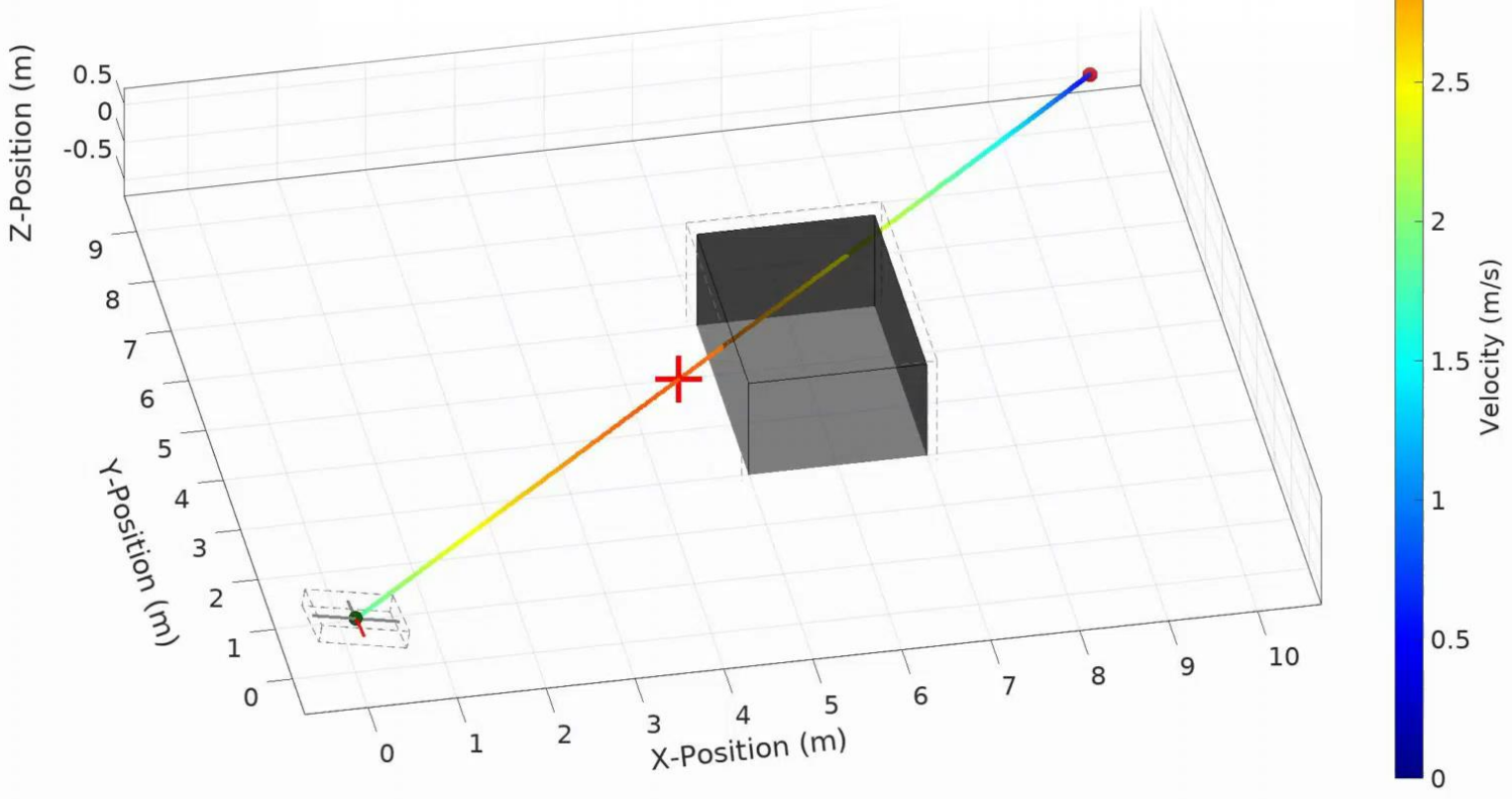
A collision is detected on the original trajectory, ...



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Thank you for your attention!