From the Pointless algorithm to IndoorGML, point clouds deliver fast methods for indoor mapping and navigation networks

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- 1989 MSc Geodesy TU Delft
- 1990 – now Military Service, platoon commander, reserve Major in Army
- 1991 – now: CGI, current role **VP Consulting**

Ancillary functions:

- 2015 – now: guest researcher at TU Delft
- 2015 – now: guest lecturer at American University in Cairo
- 2017 – now: member of the board of Geobusiness Nederland
- 2018 – now: member of NCG committee Basisgegevens
- 2019 – now: member of field committee MGI master at Wageningen University and Research
- 2019 – now: member of the Professional Advisory Board for the Master's Programme Geo-information Science and Earth Observation at University of Twente

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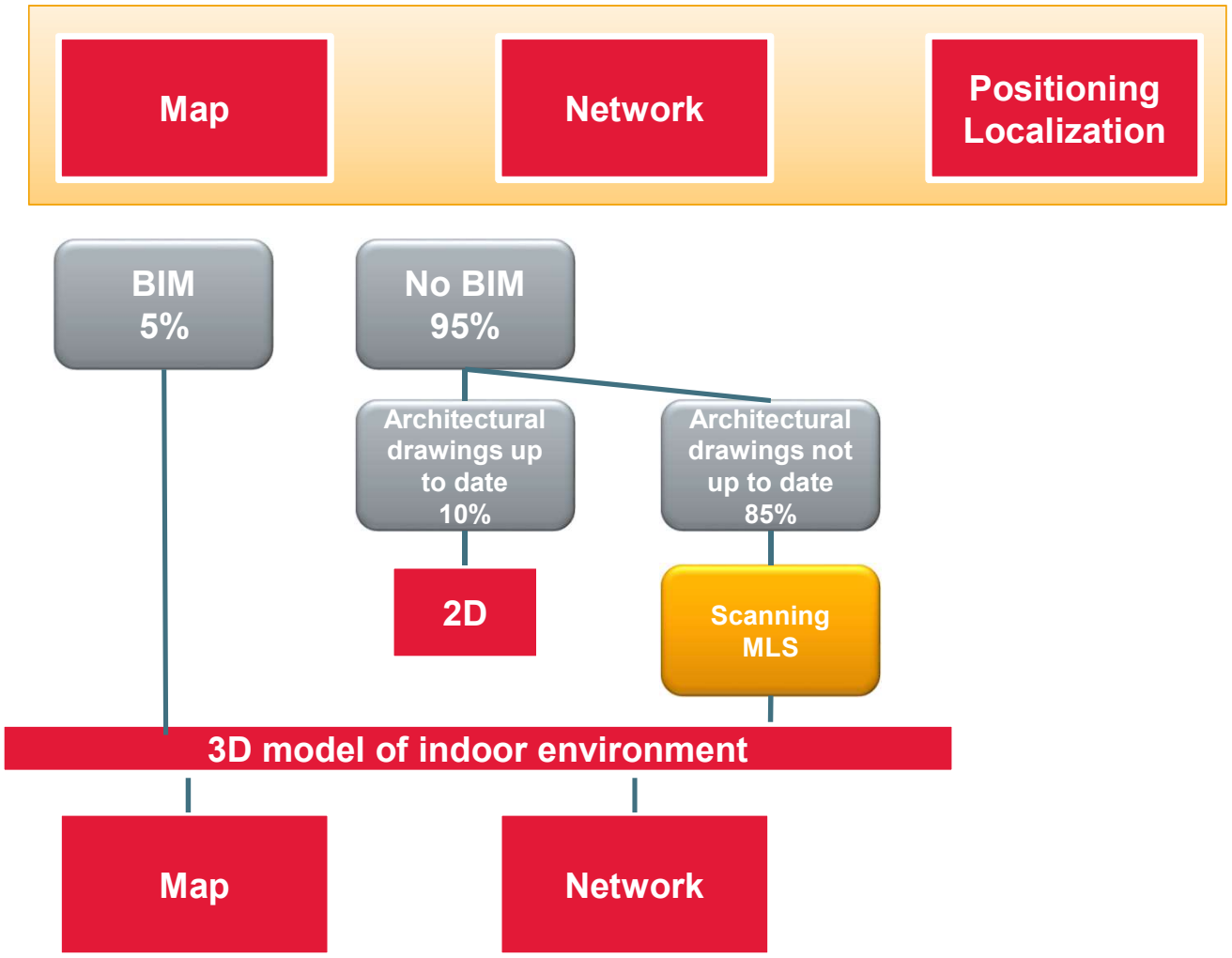
Research done: Indoor 3D mapping, Indoor 3D localization, high precision surveying with drones

Why do we need new ways of modelling?



- Wifi
- BLE
- UWB
- LORA
- 5G
- Ultrasound
- EMF
- ~~GNSS~~

Pointclouds and speed

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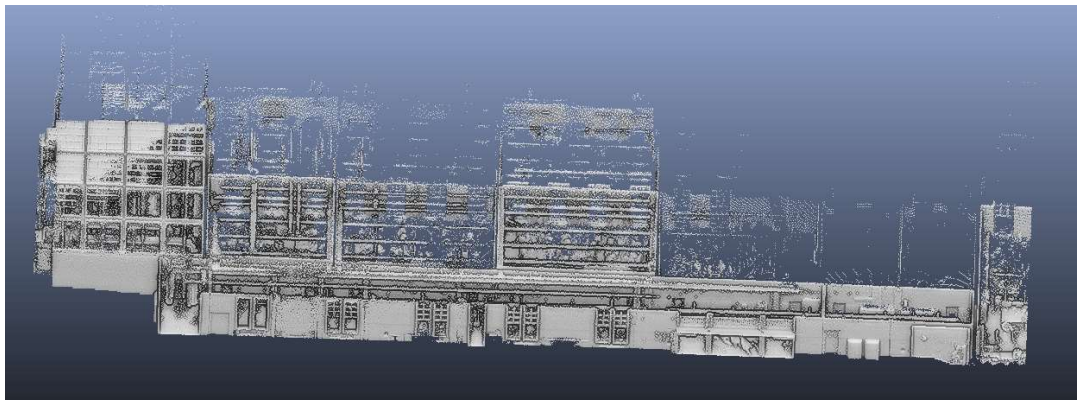
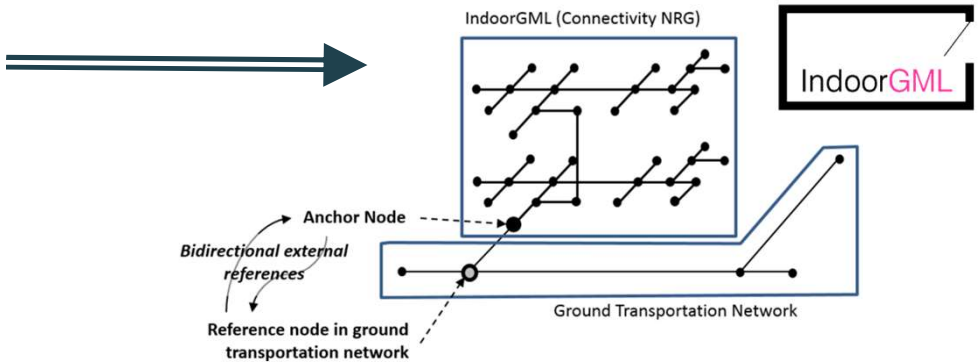
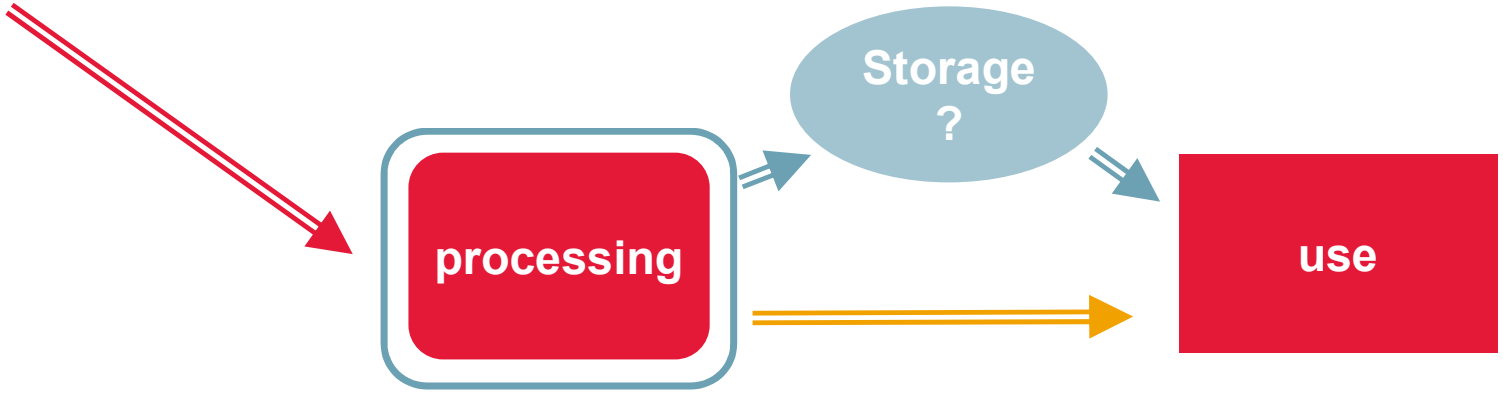
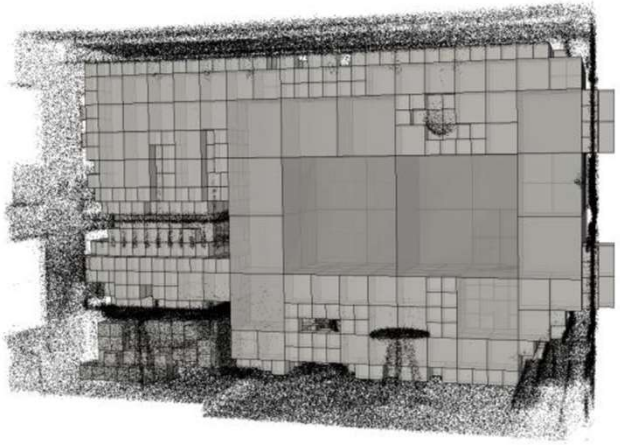






“Pointless” algorithm



Using a linear octree to identify empty space in indoor point clouds for 3D pathfinding

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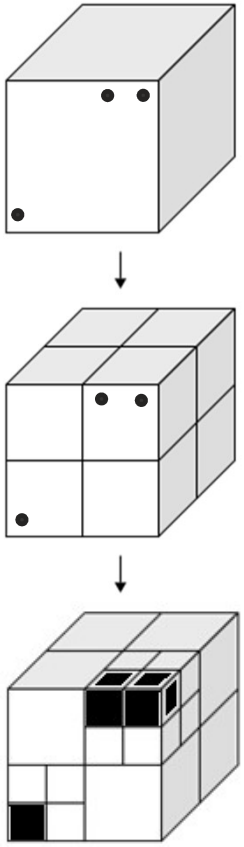
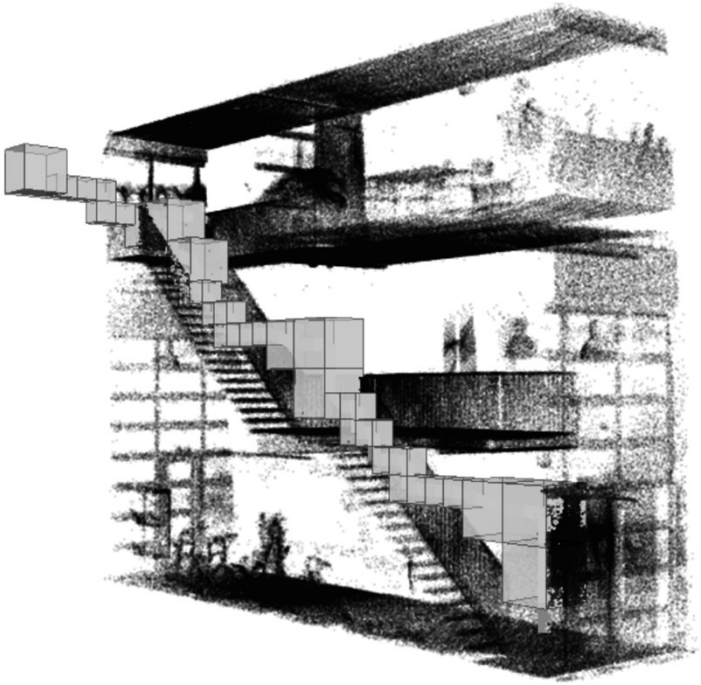


Octree

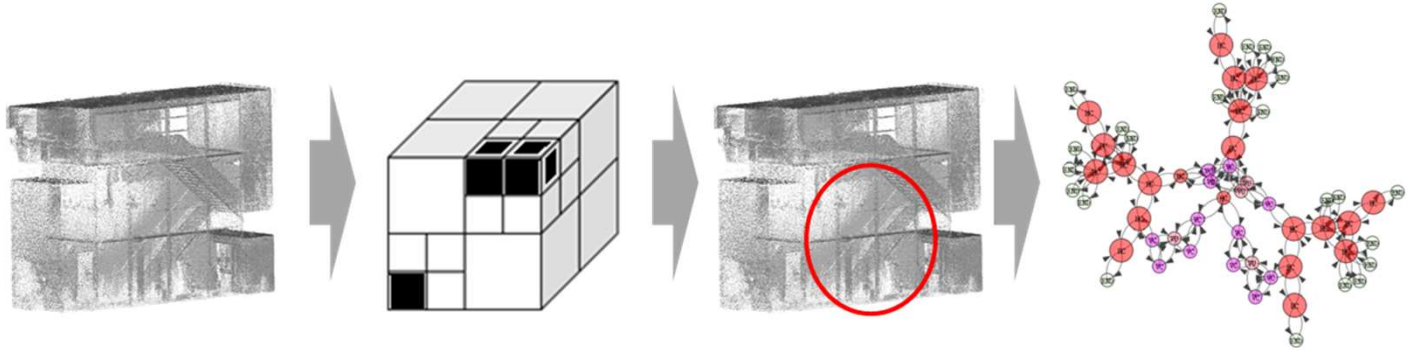


The route in processing

All using parts of “Pointless”

Semantic enrichment of a point cloud based on an octree for multi-storey pathfinding

MSc research by Florian Fichtner (2016)



To what extent can an octree support semantic enrichment of point clouds for the purpose of multi-storey pathfinding?

TU Delft 3Dgeoinfo

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Identification of walkable space in a voxel model, derived from a point cloud and its corresponding trajectory

Bart Staats

P5

July 5th 2017

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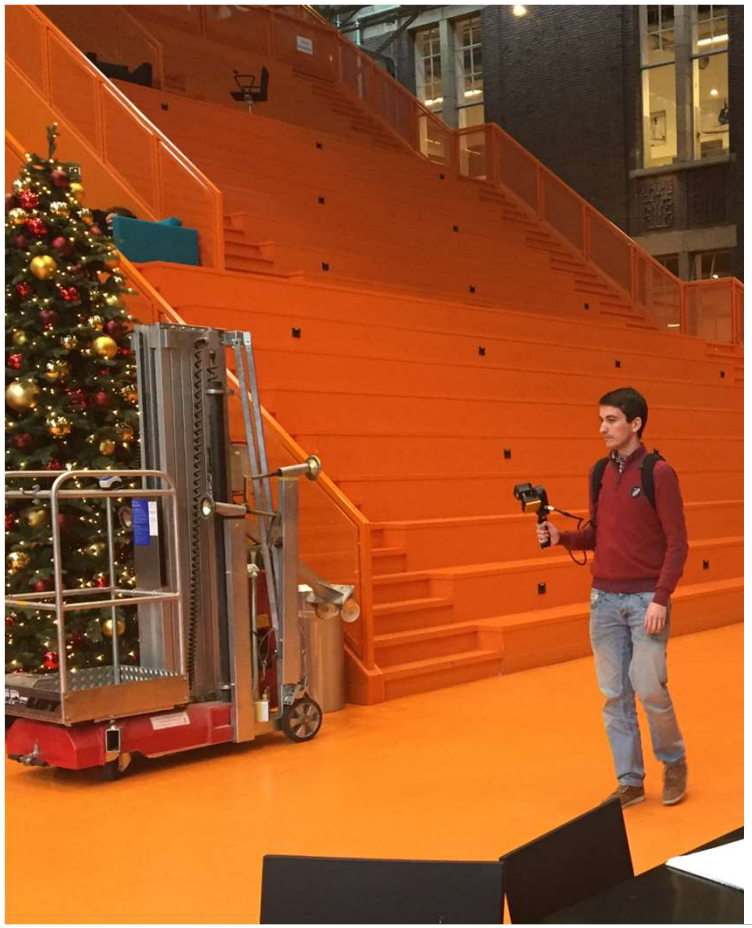
Data capture



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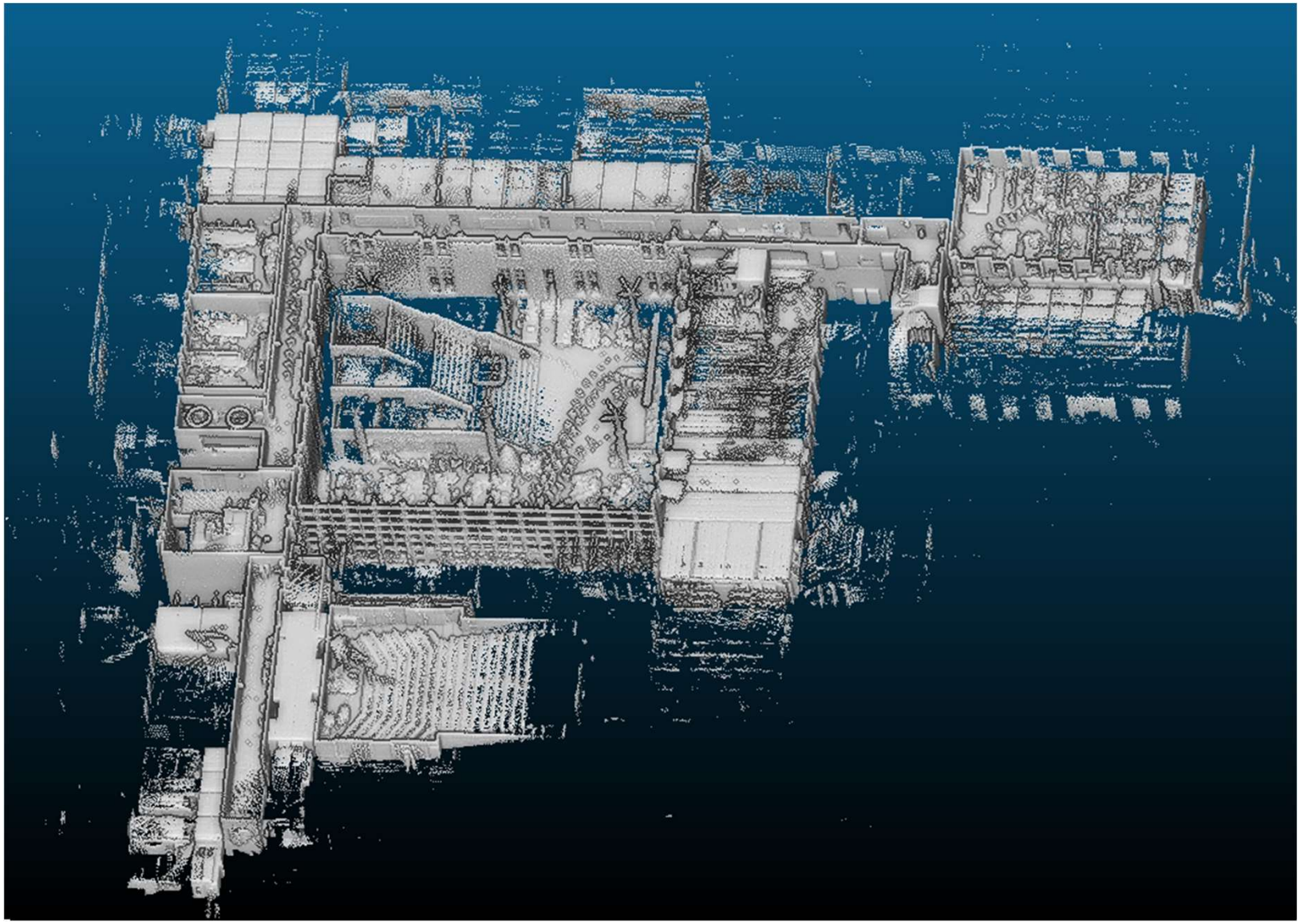

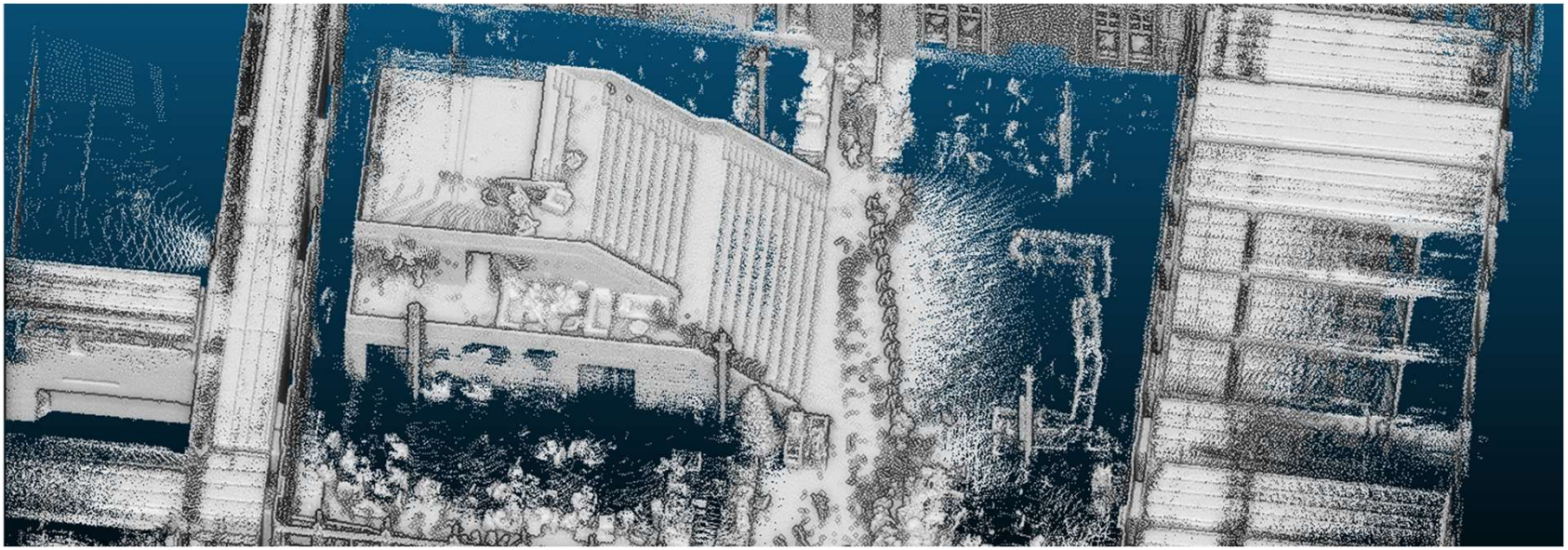

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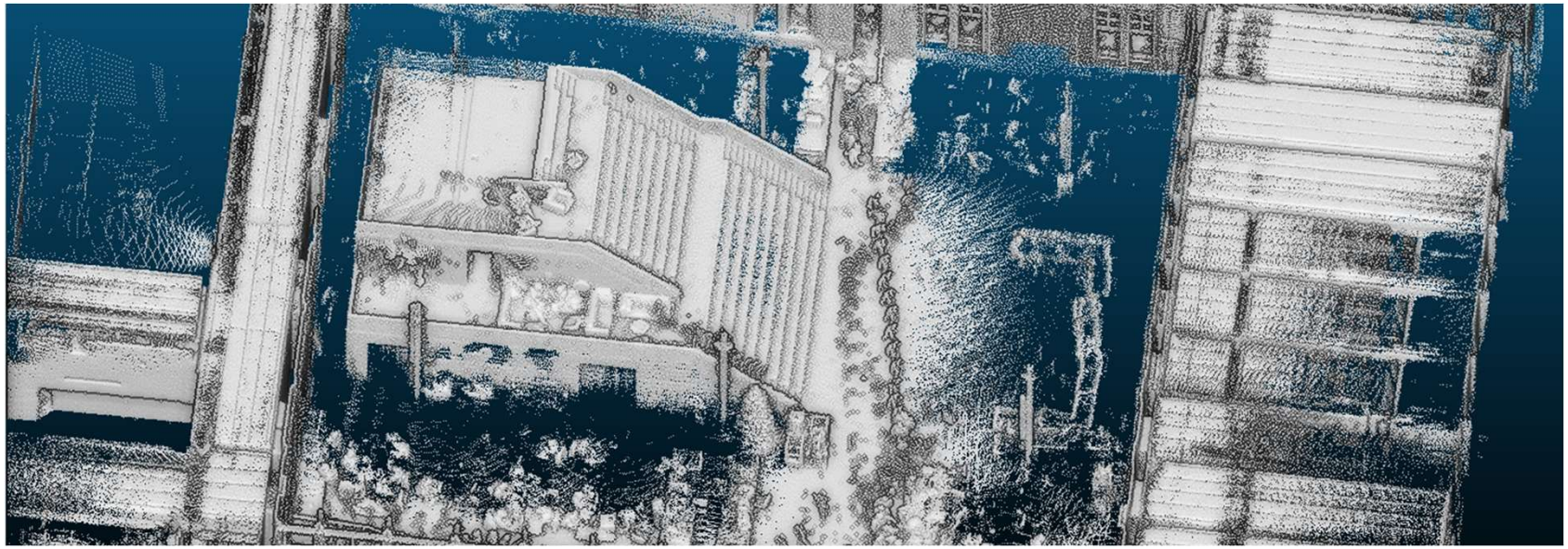

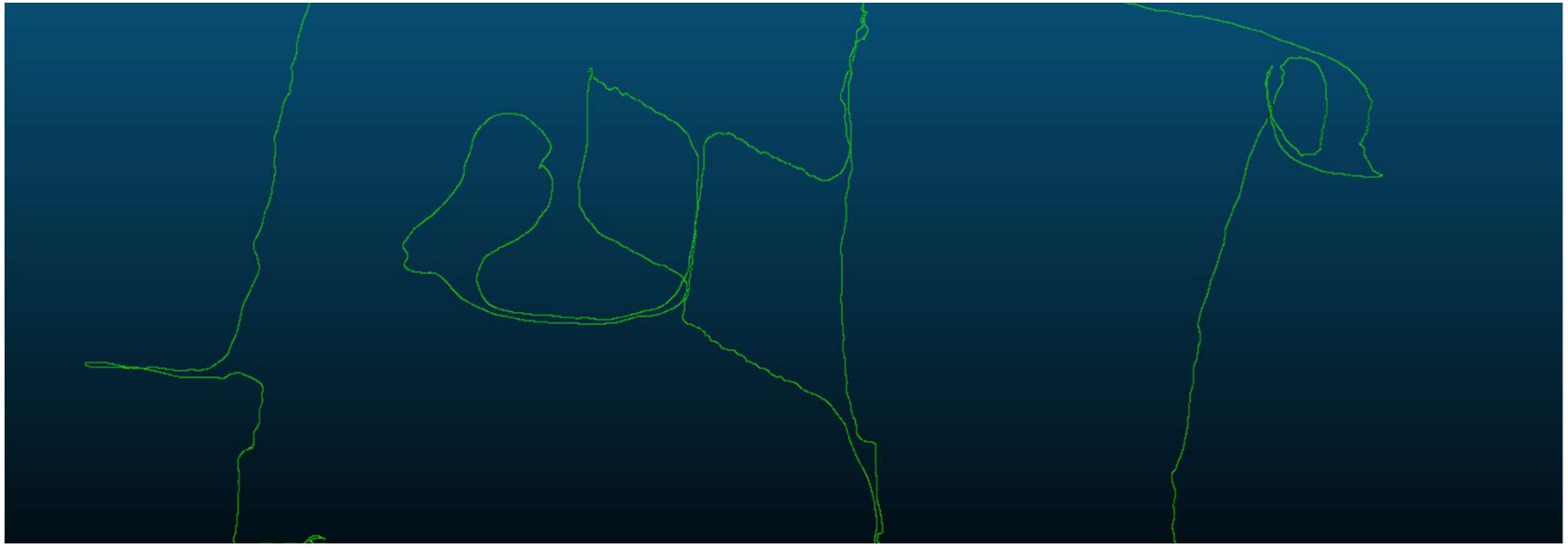

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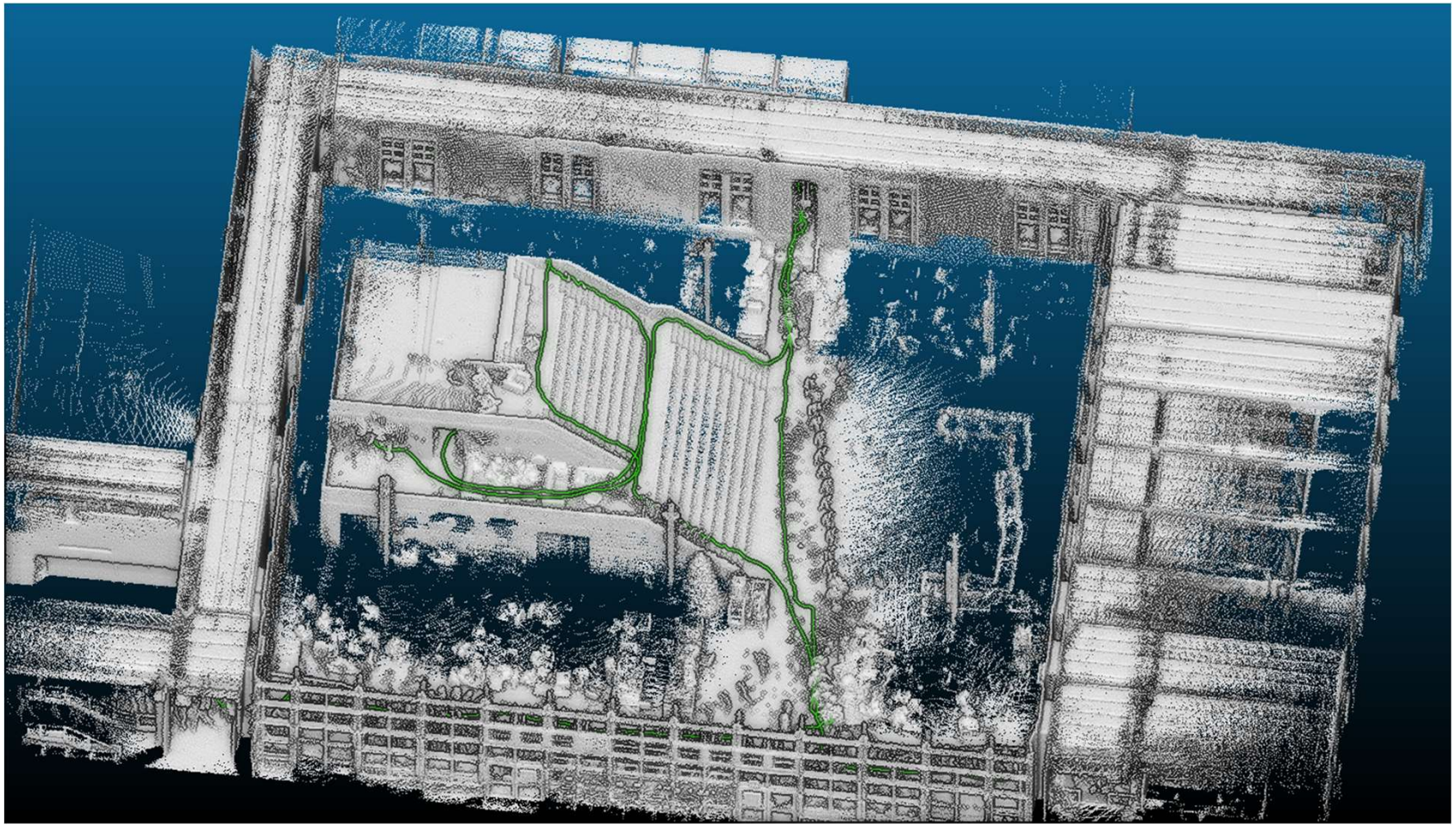

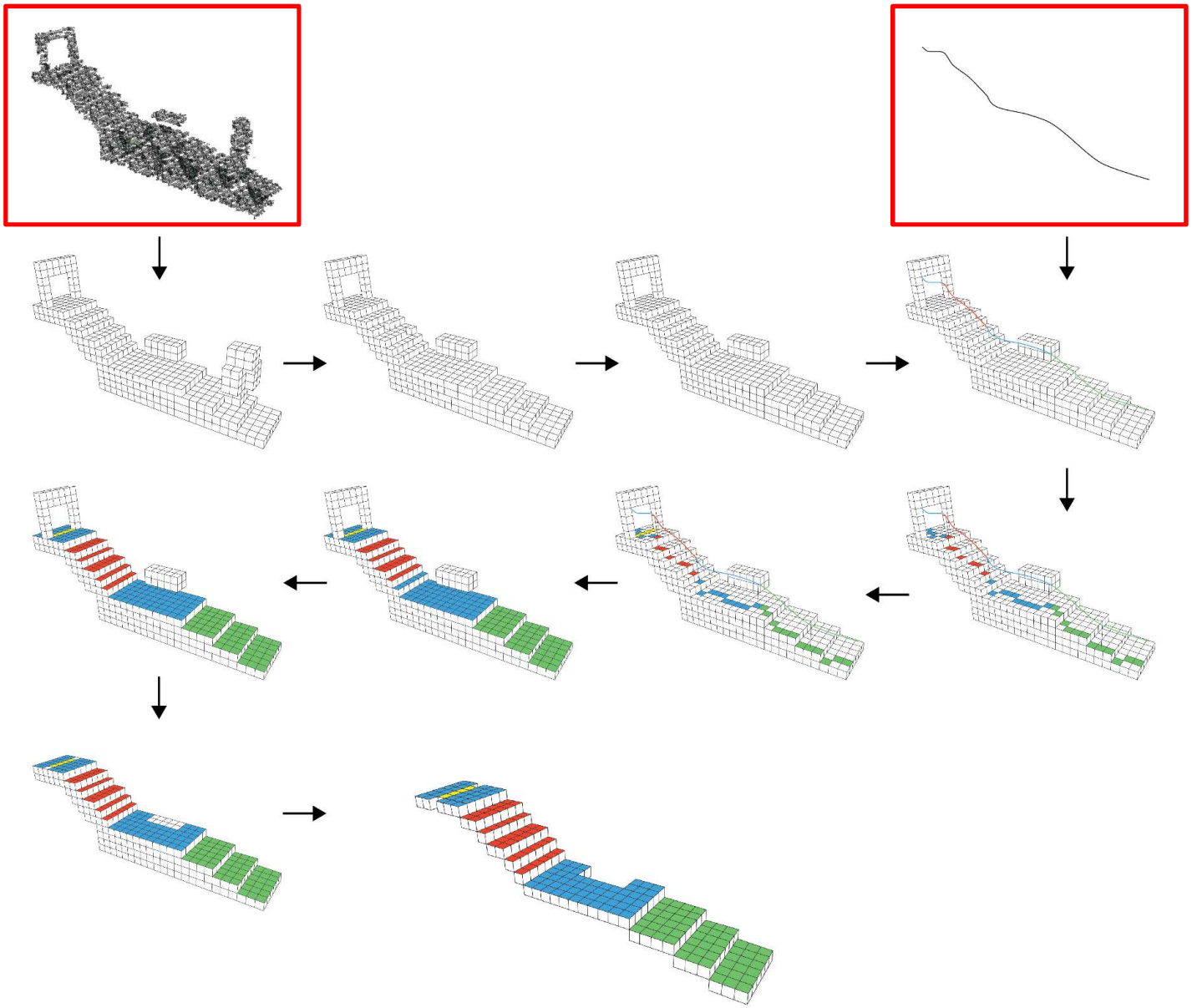

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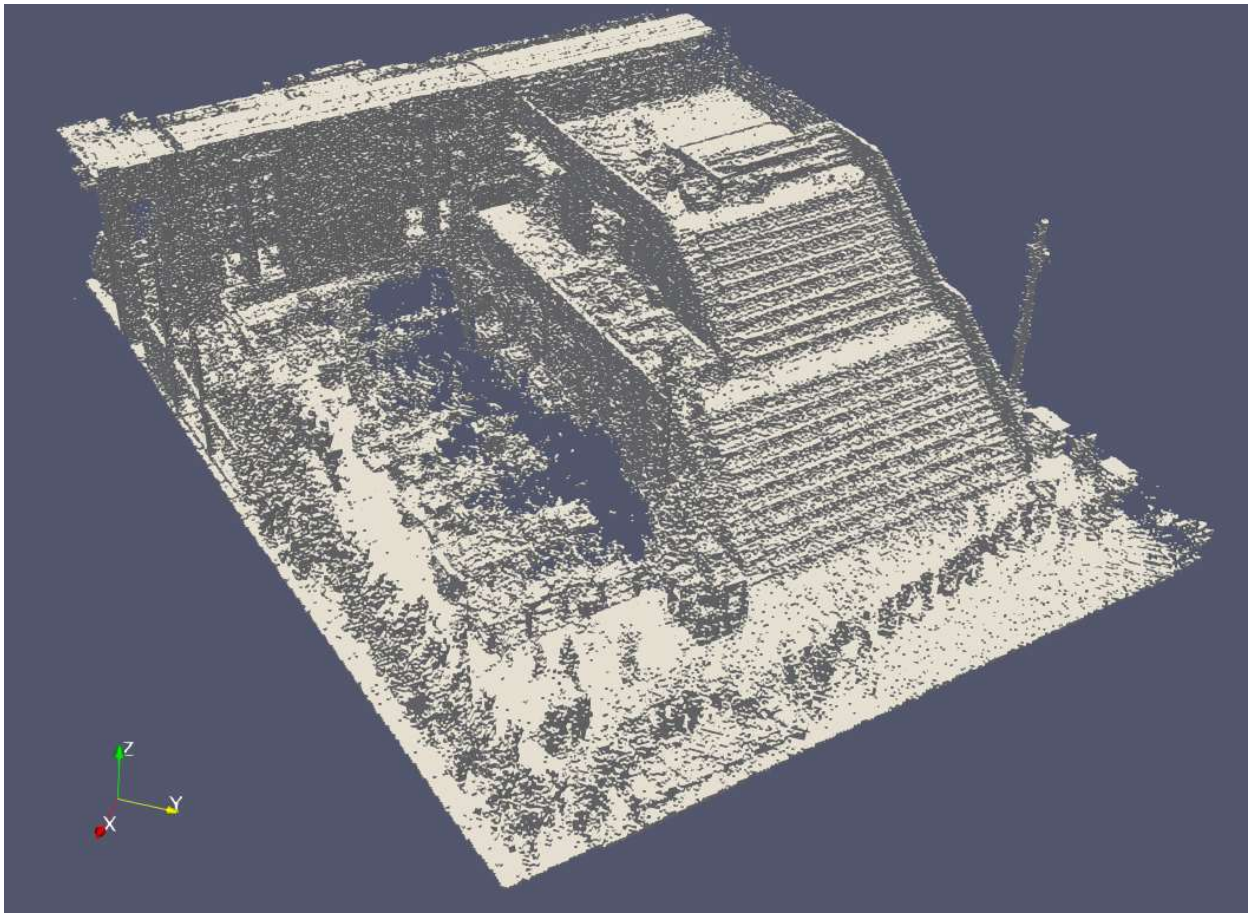
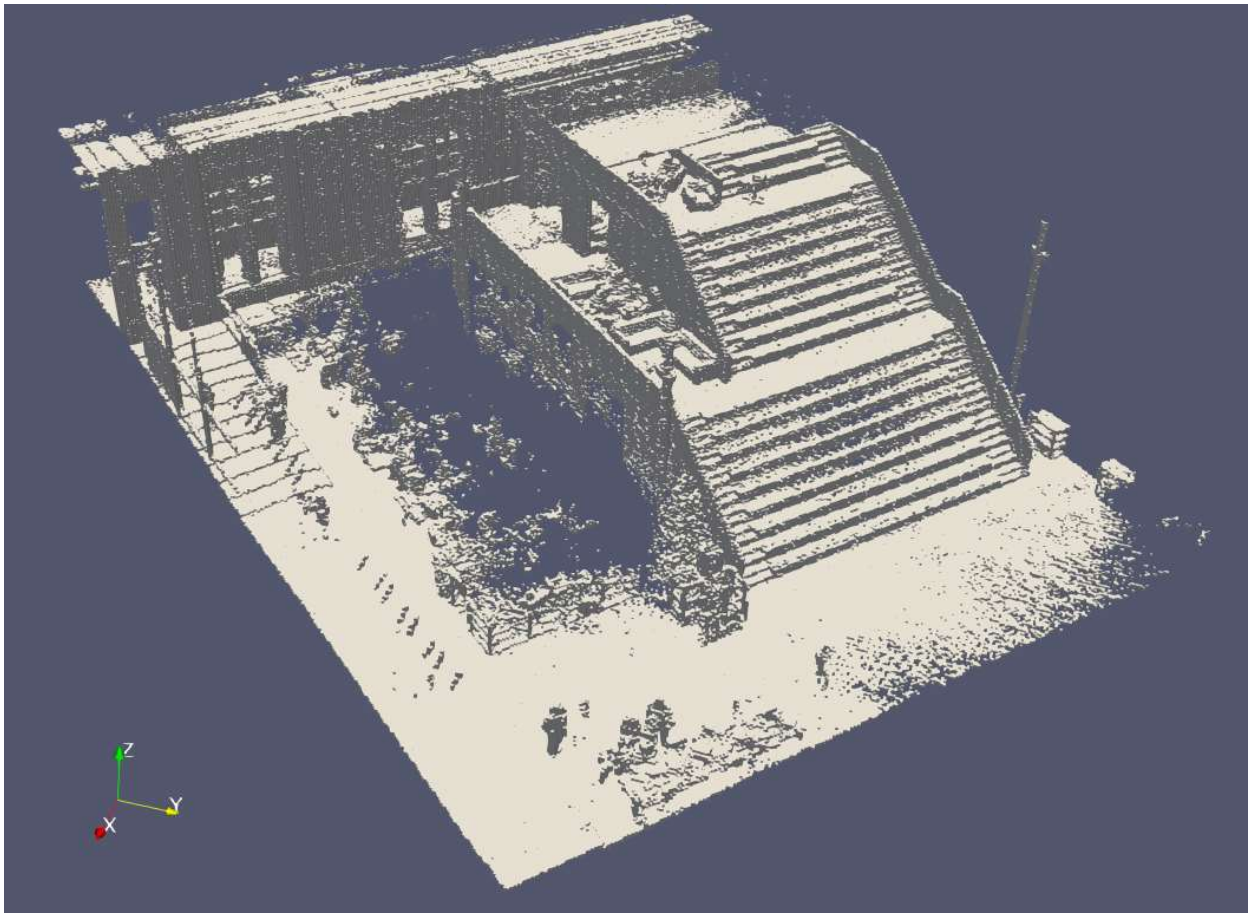
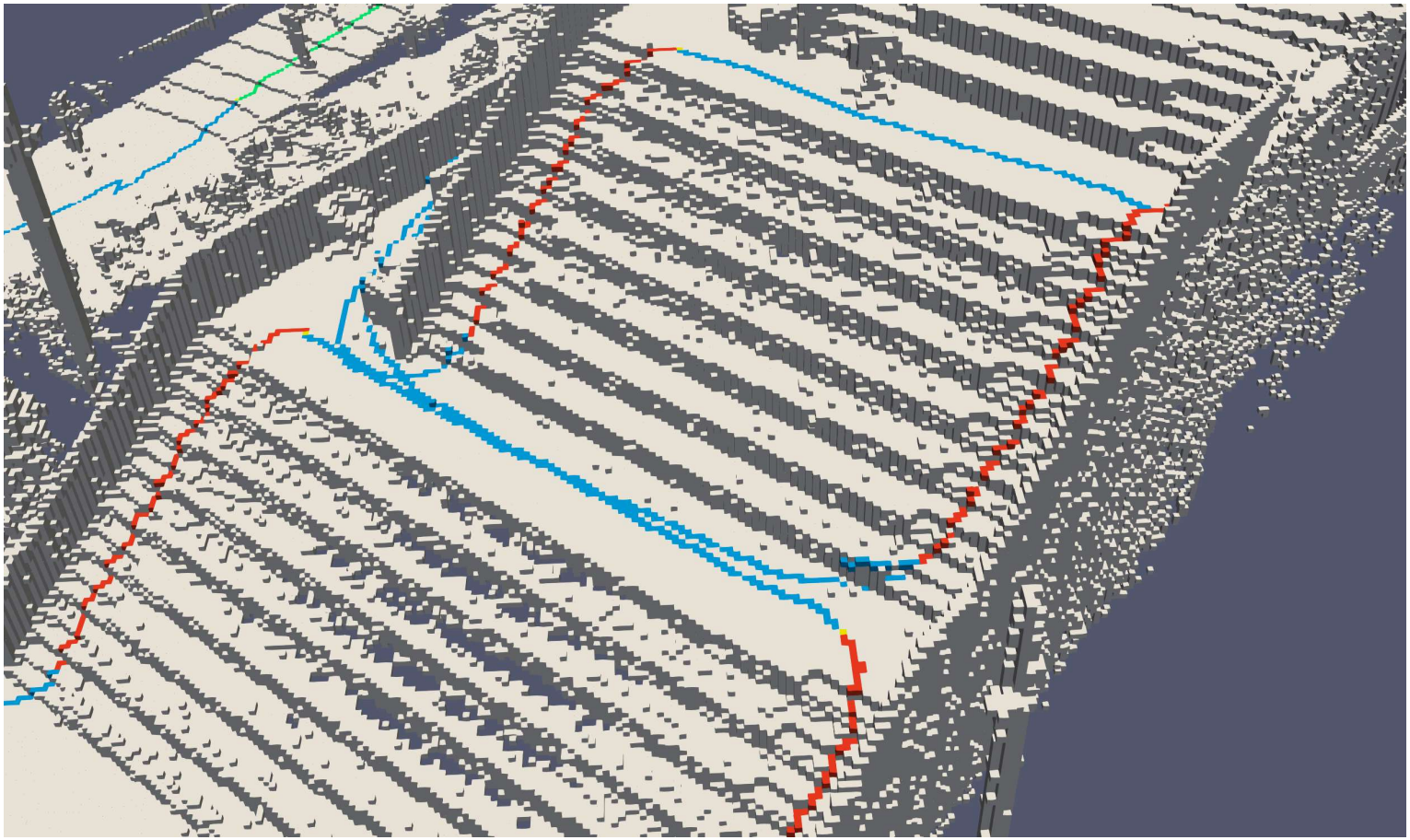
Remove dynamic objects



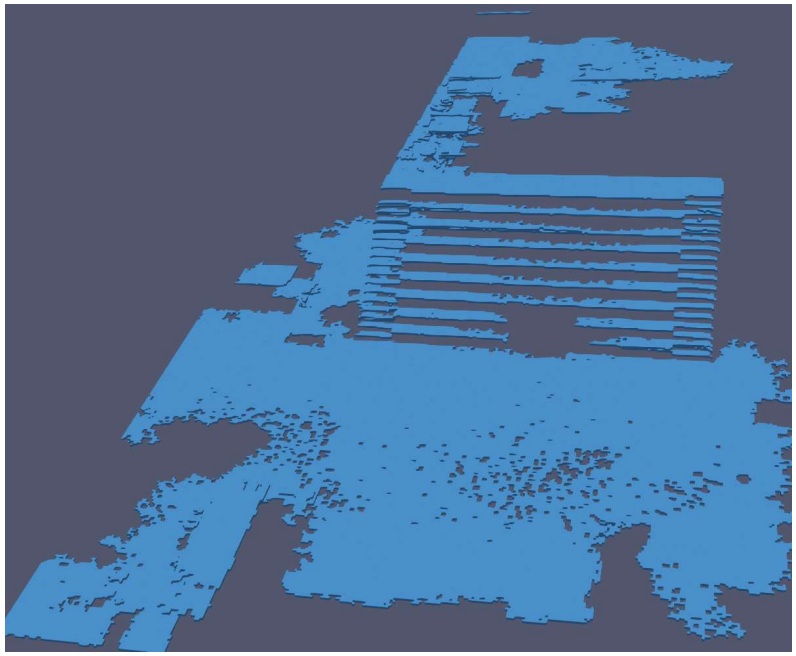
Remove dynamic objects

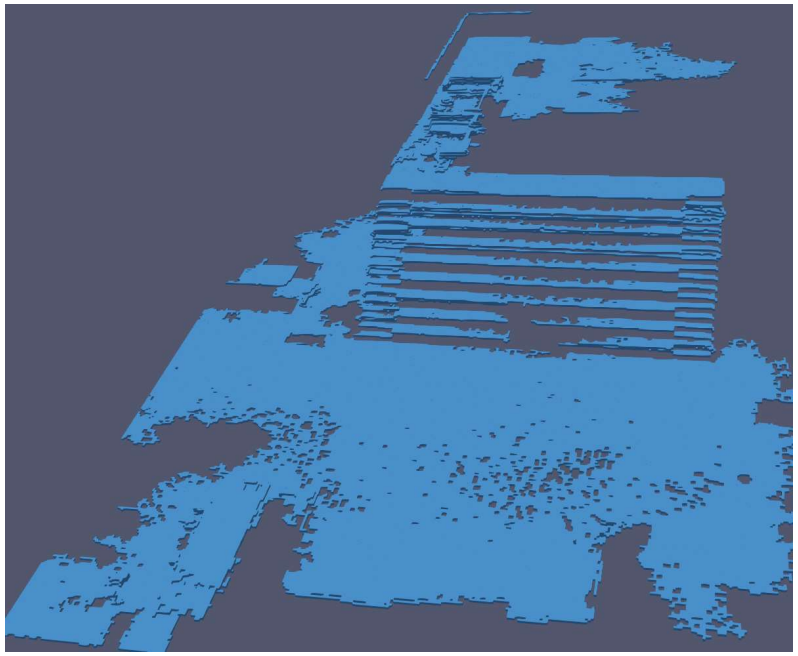


Voxel model + seed voxels



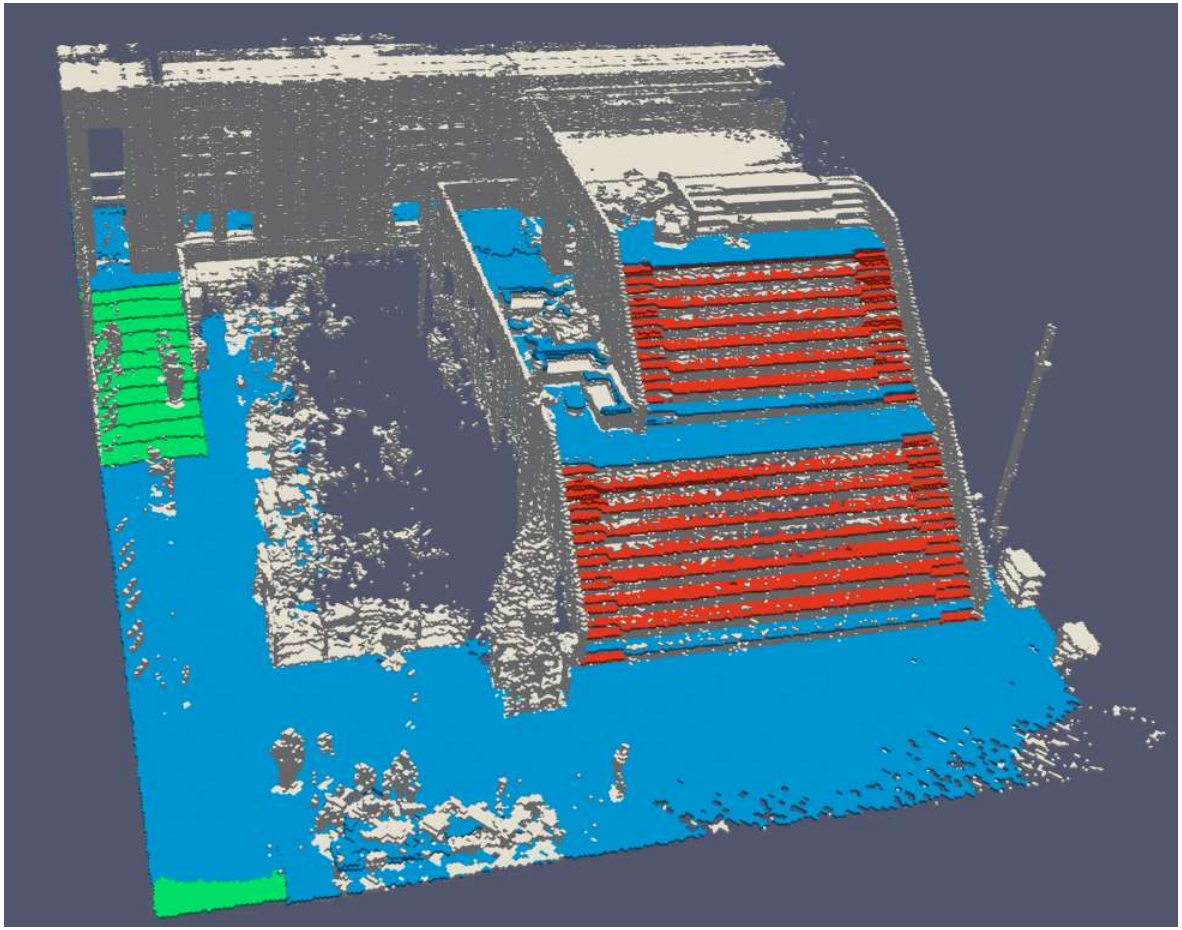
Region growing: two methods





Region growing type	Processing time in minutes	Number of voxels	Largest region in voxels
ClusterDBSCAN eps = 1.5	17	84540	48320
Ordered checking	169	90292	48568

Results: navigable space



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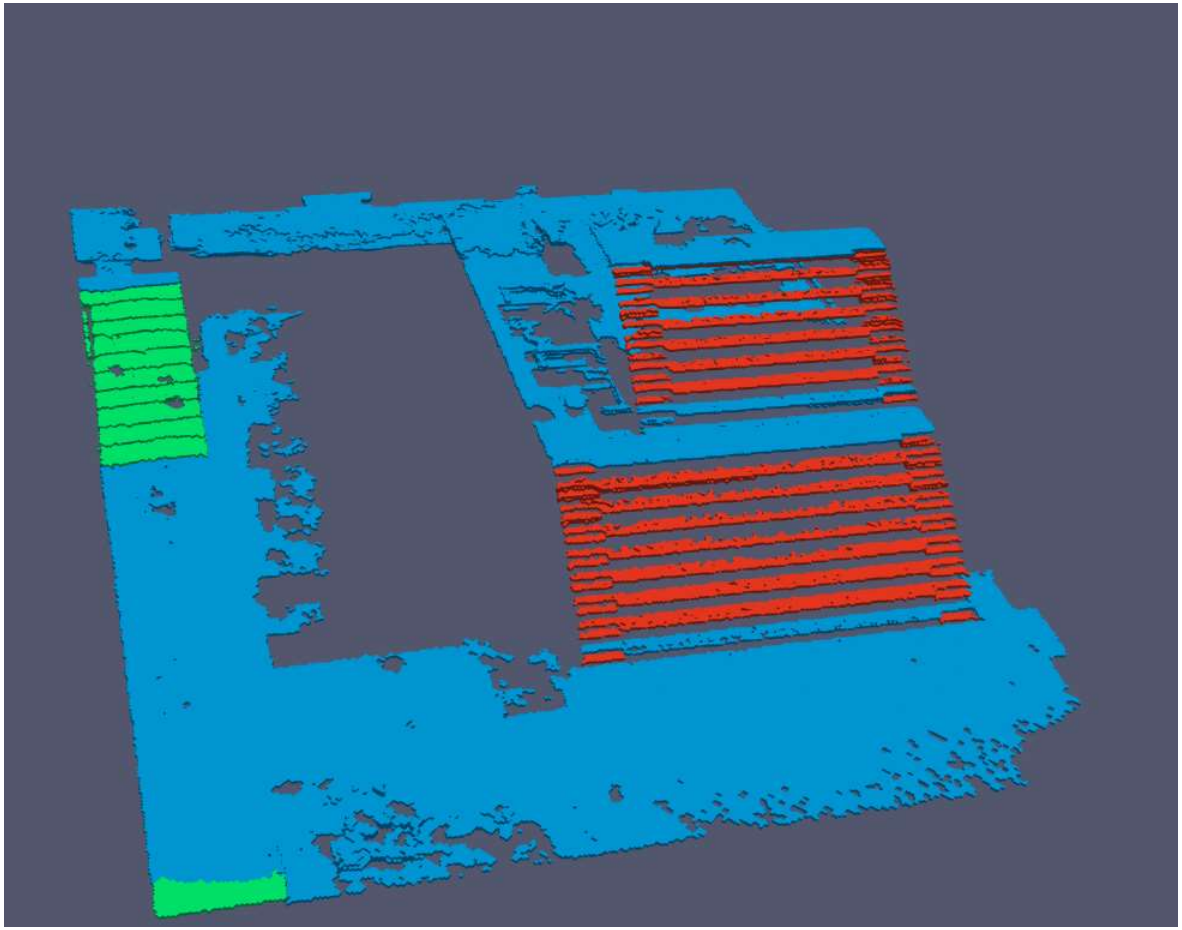
Results: navigable space



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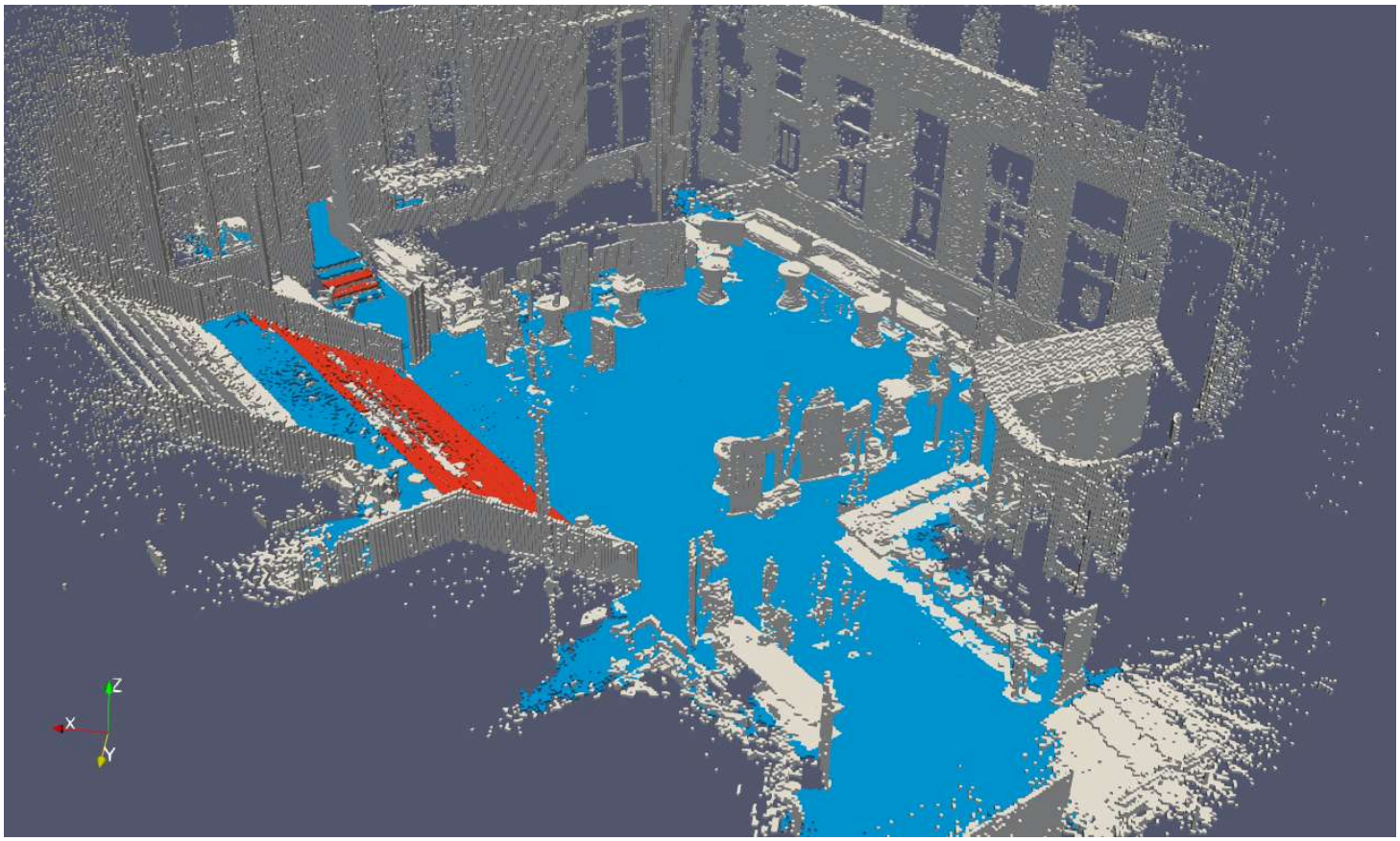
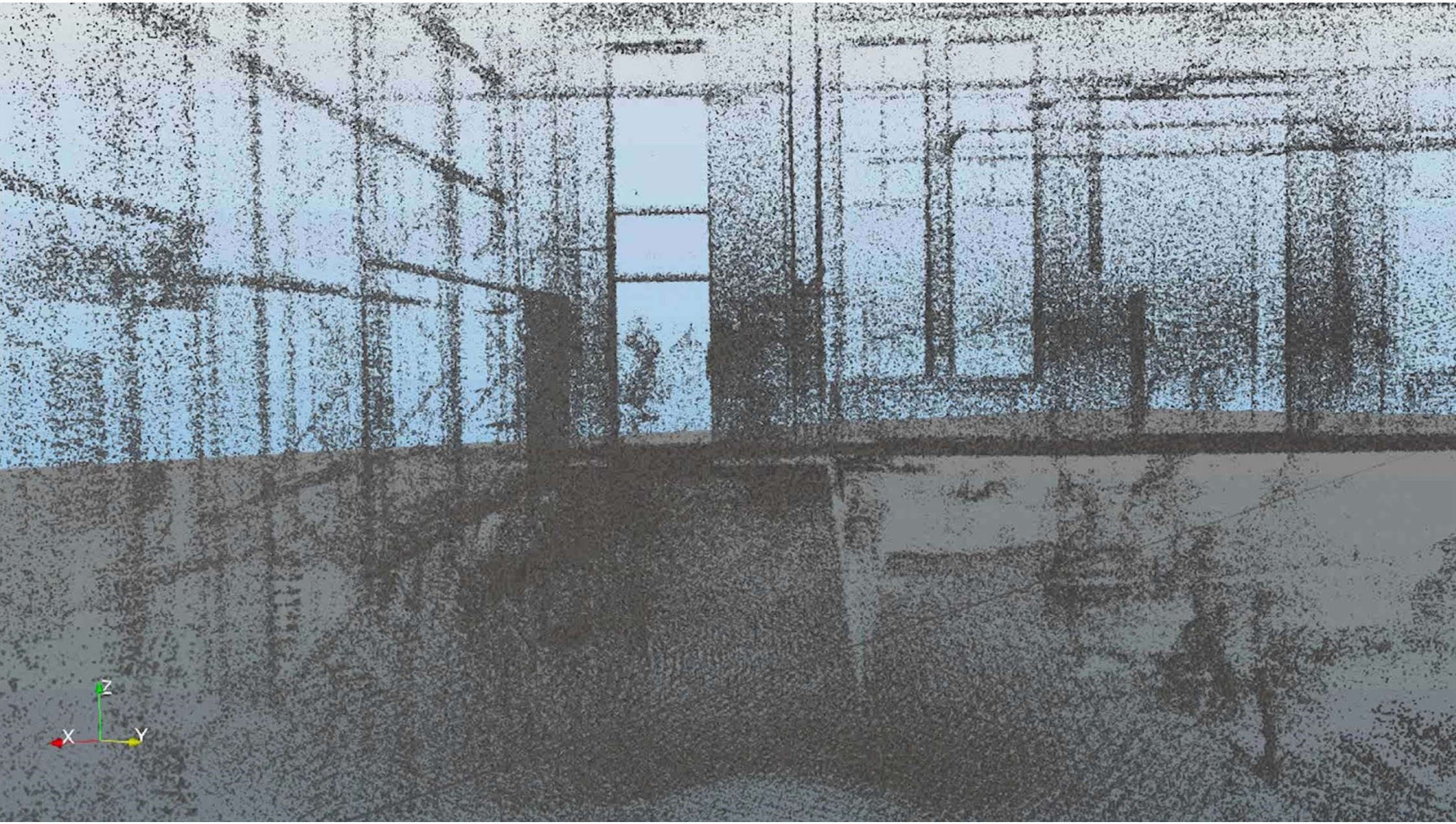
Results: navigable space




Z
X
Y

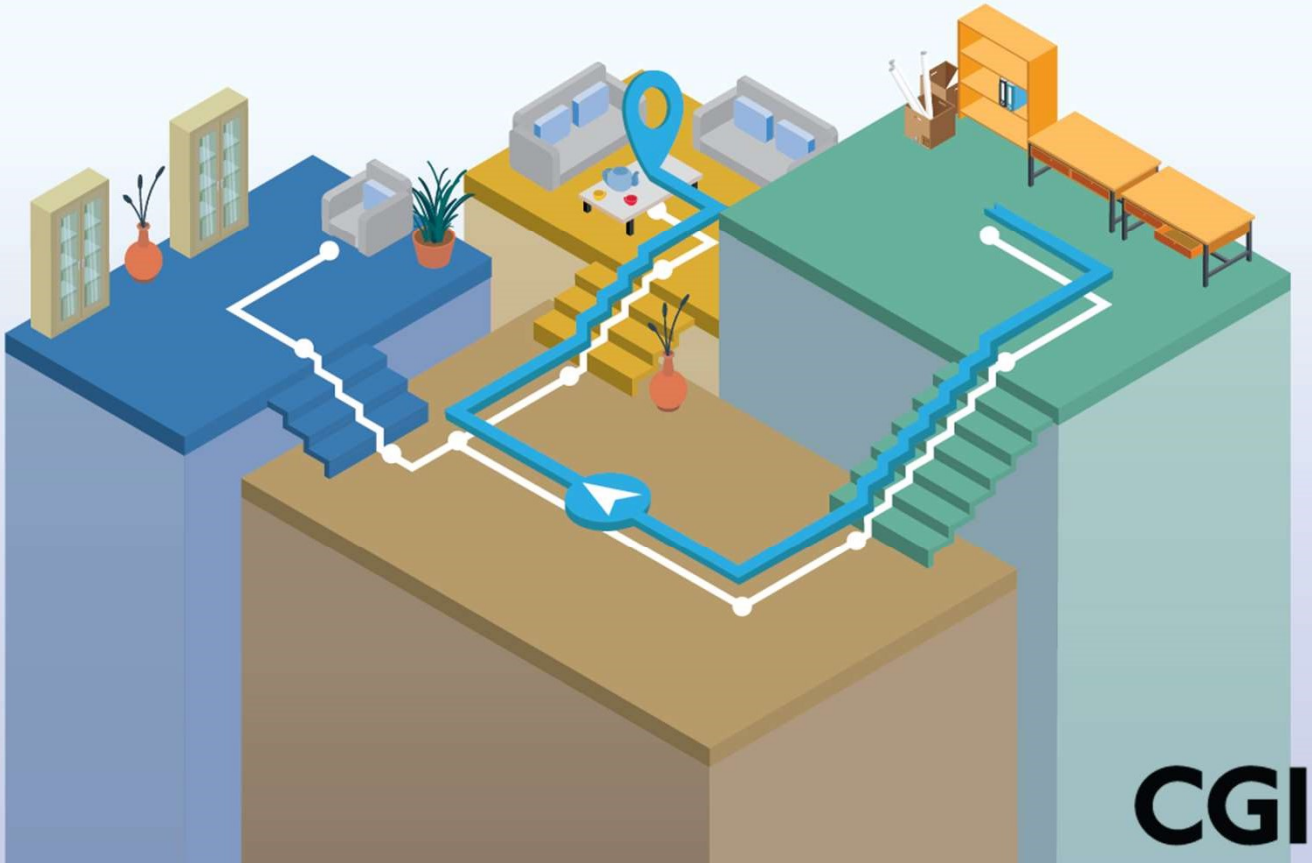
pi1

Automatic Extraction of an IndoorGML Navigation Graph from an Indoor Point Cloud

Puck Flikweert

30-1-2019

Mentor #1	*Ravi Peters*
Mentor #2	*Lucía Díaz-Vilariño*
Mentor CGI	*Robert Voûte*
Delegate of BE	*Frank van der Hoeven*



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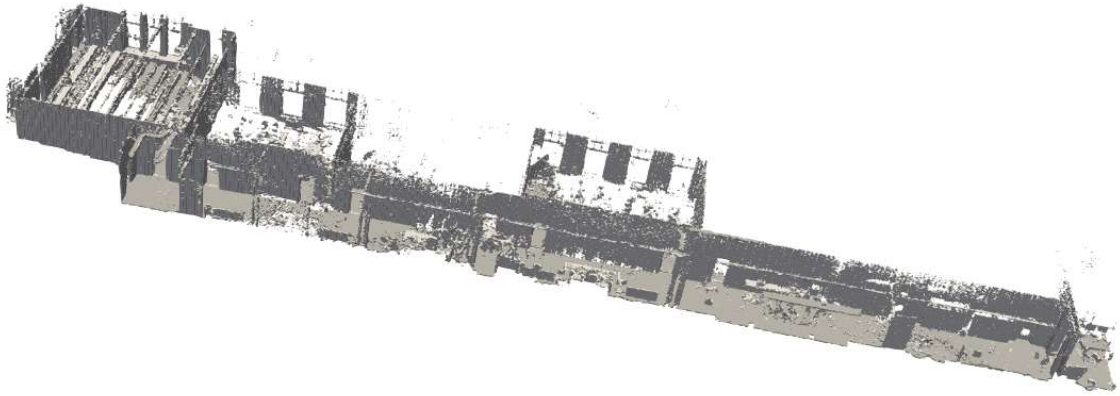
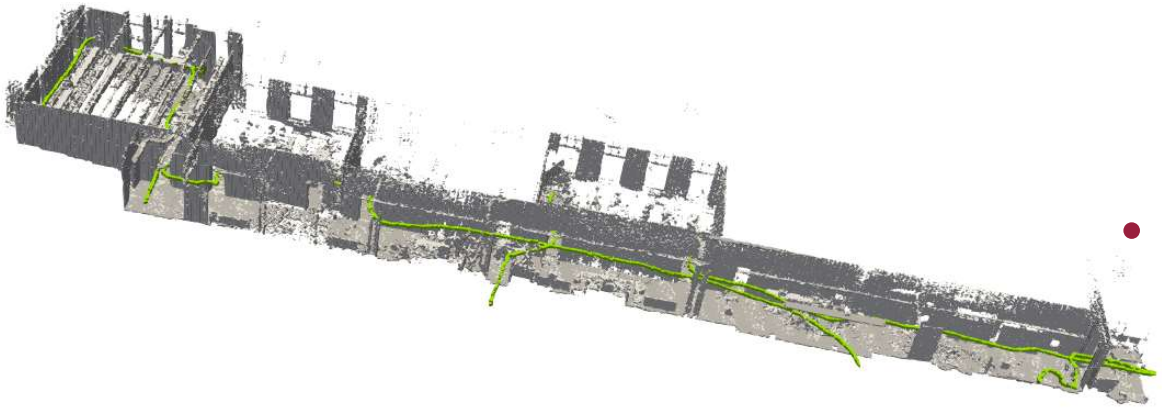
Progress Indicator; 29-1-2019

Use of voxels

- Millions of points become thousands of voxels
- Downscale in data size: faster processing
- Generalization of space

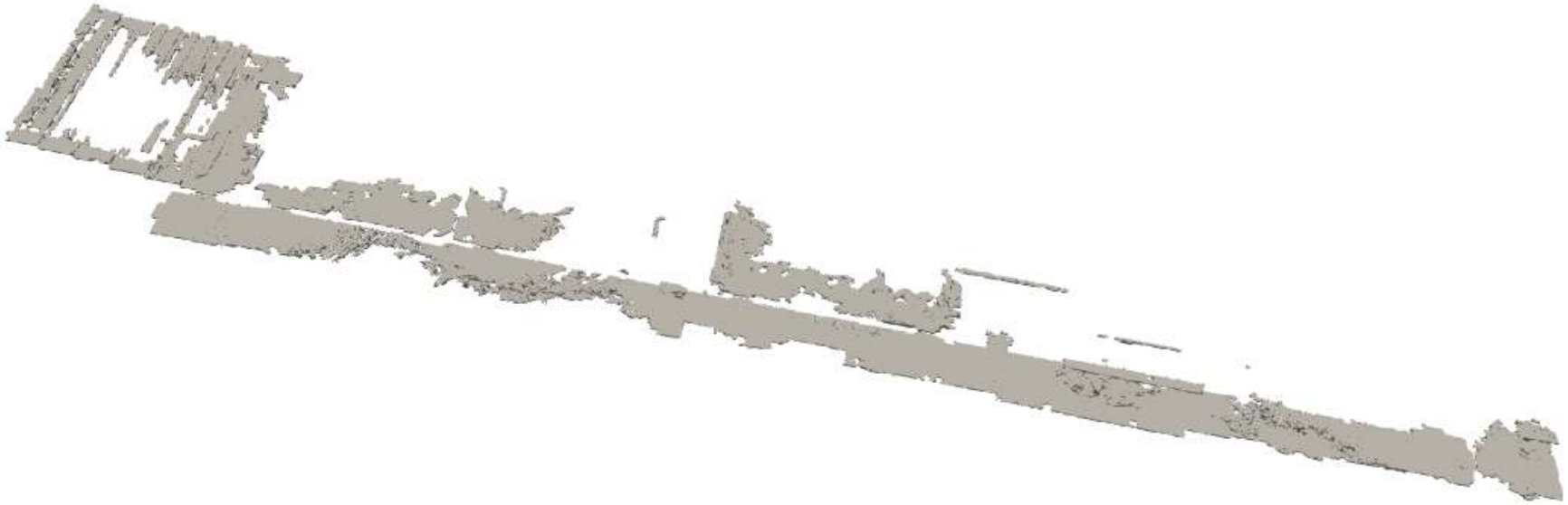




- Make use of the **trajectory**
  - Gives information on where has been walked before

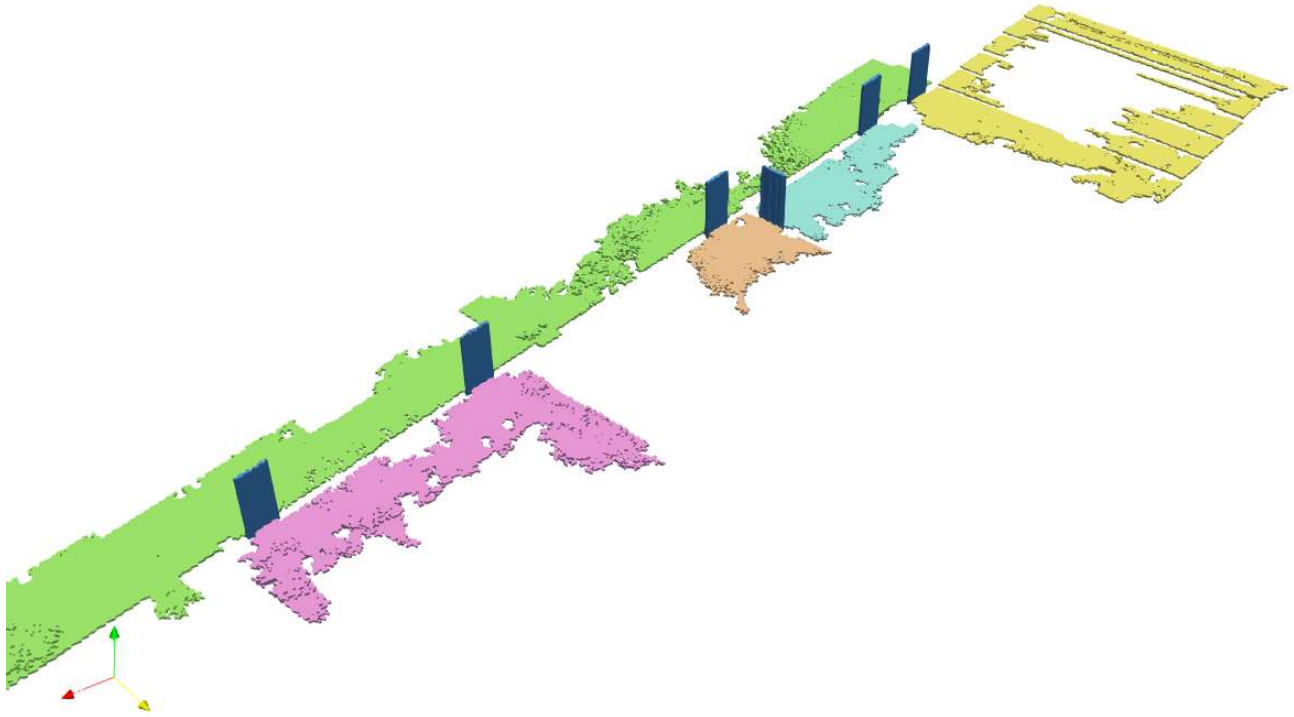
Where can we walk?

- Retrieve walkable voxels
  - All floors, stairs, ramps, etc



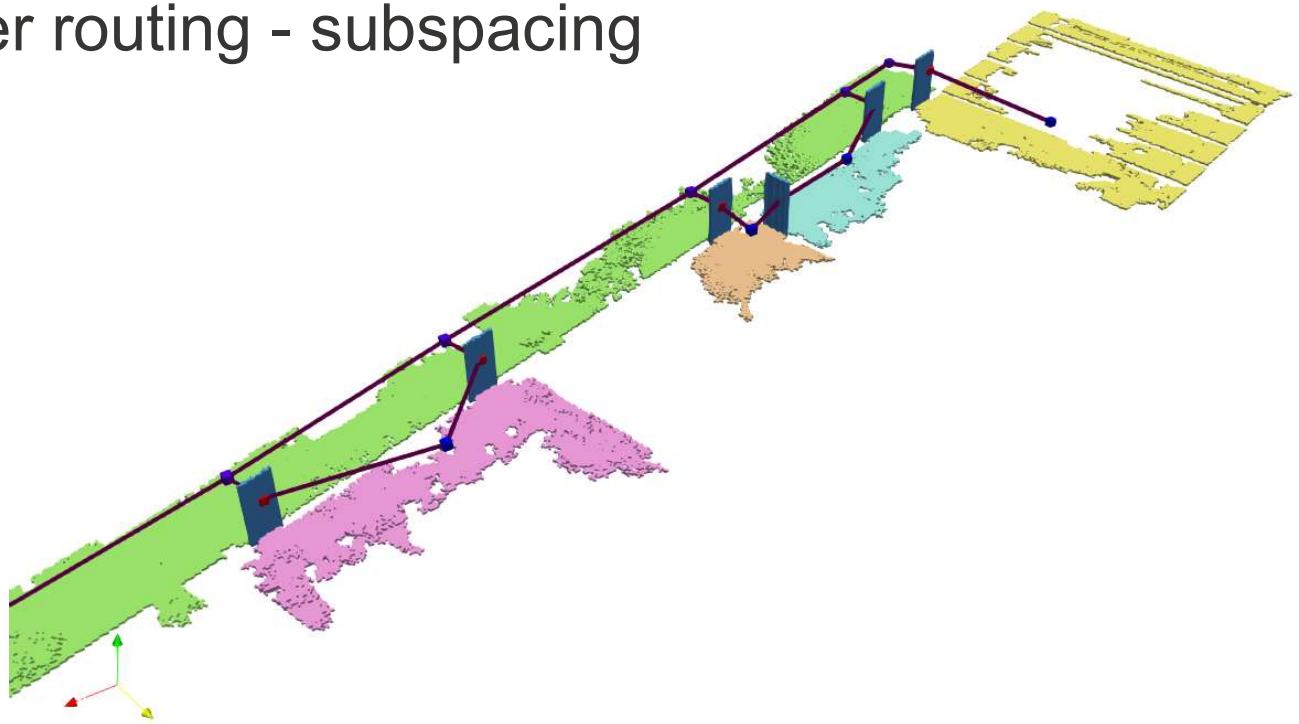
How to get a navigation network?

- Detect doors
- Divide walkable space into separate rooms



How to get a navigation network?

- Define connectivity between all spaces
- Divide hallway into smaller parts for better routing - subspacing



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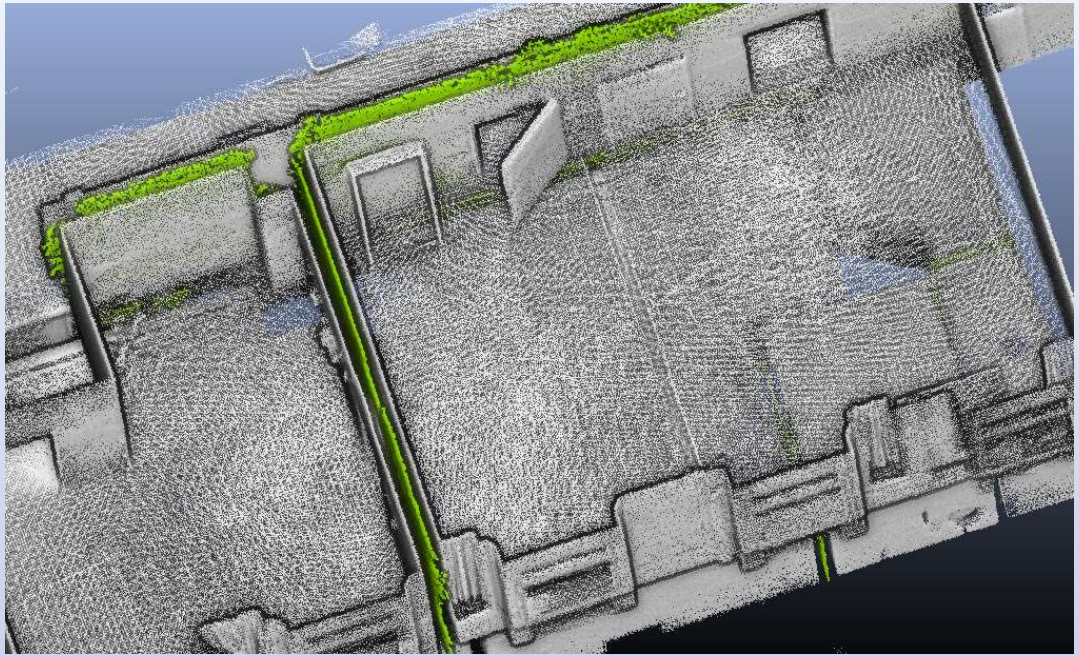
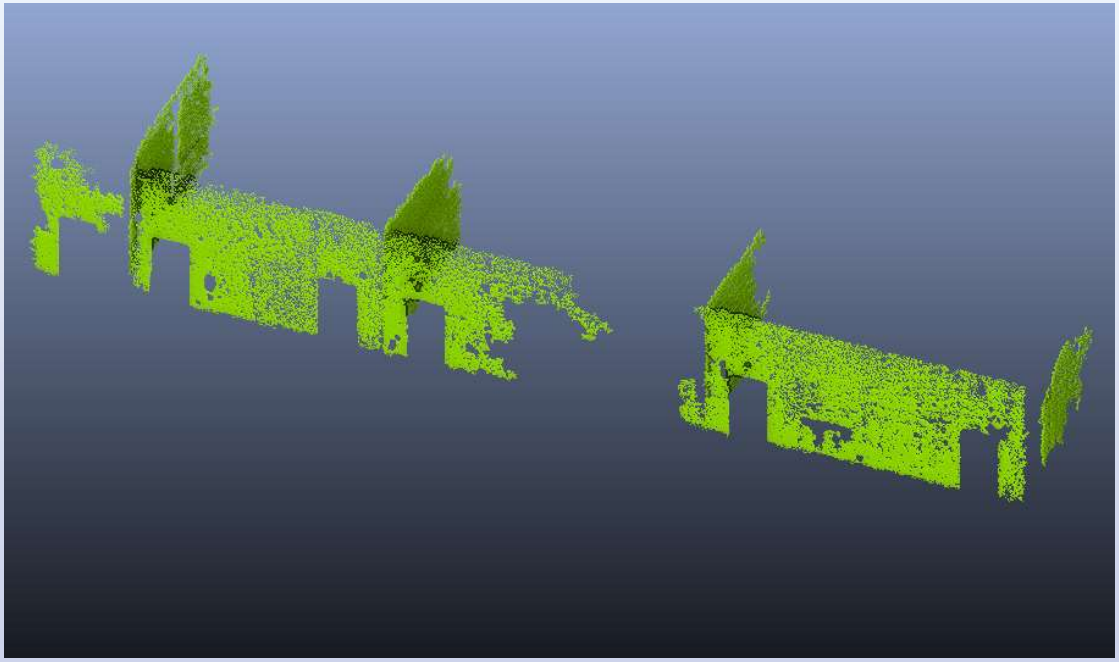
Medial wall sheets

- MAT Medial Axis Transform





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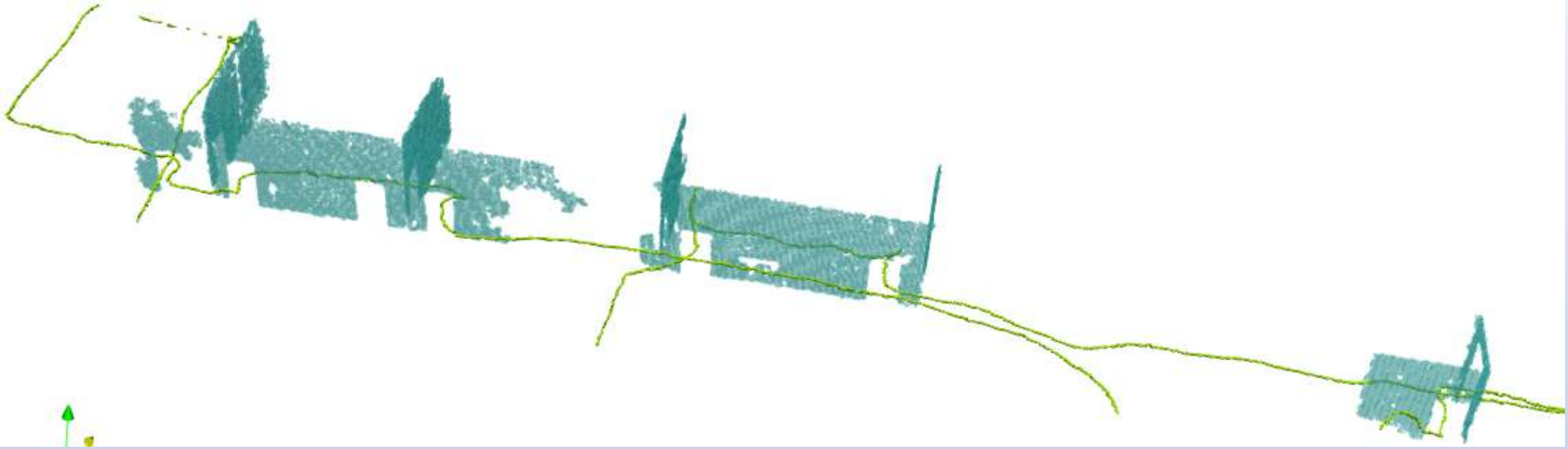
Door detection using 3D MAT sheet voxels

- Together with trajectory



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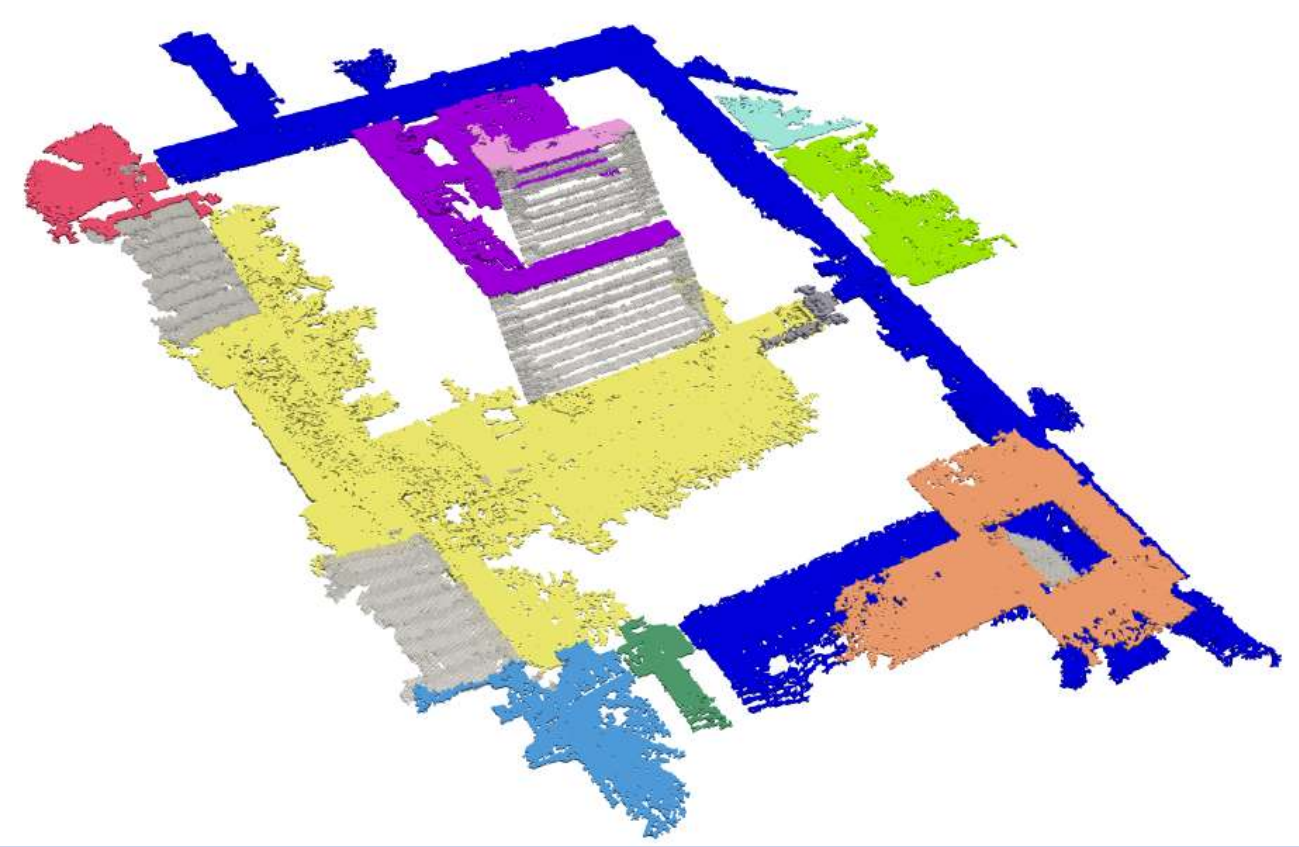
Creating separate indoor spaces



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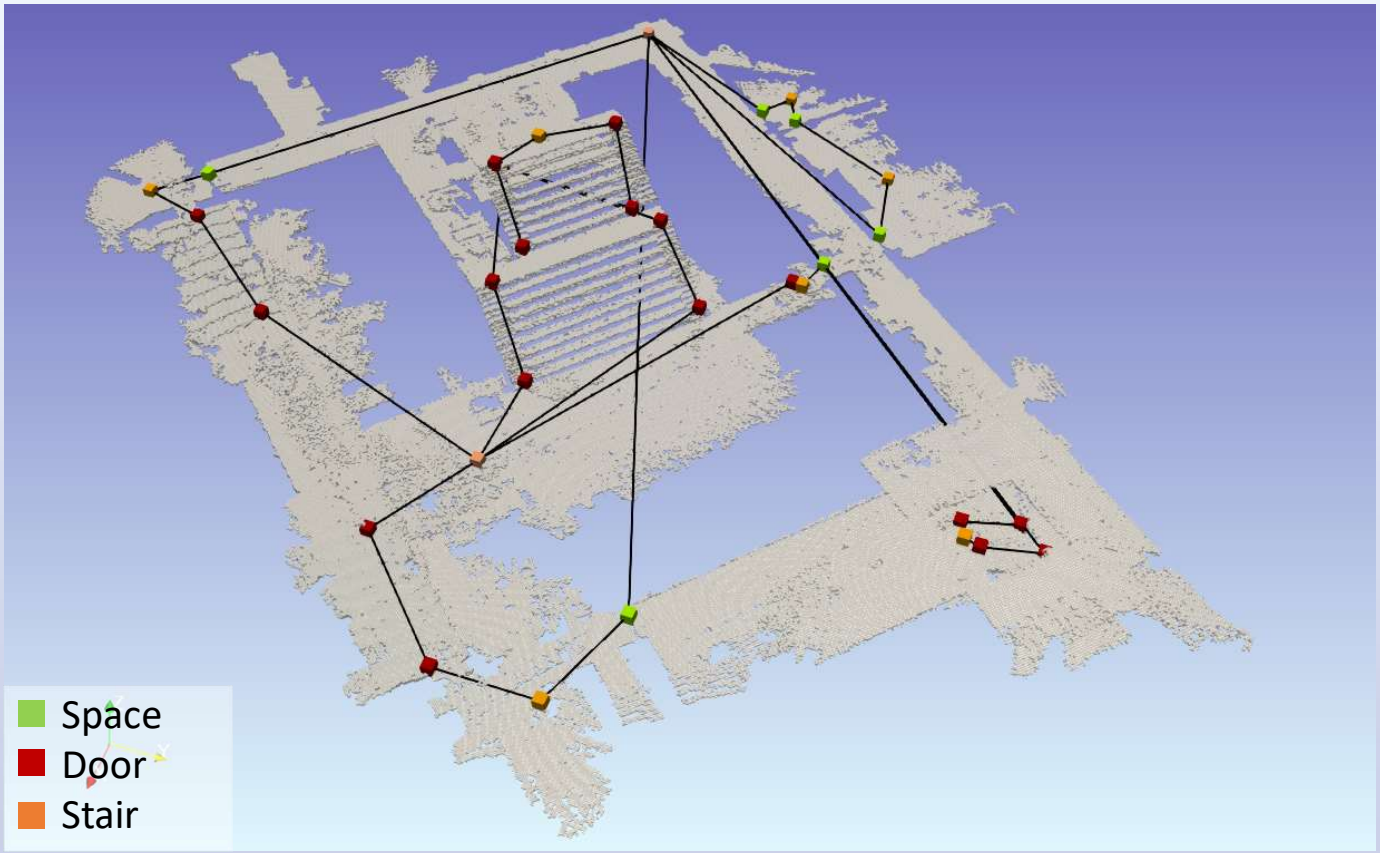
Connectivity graph



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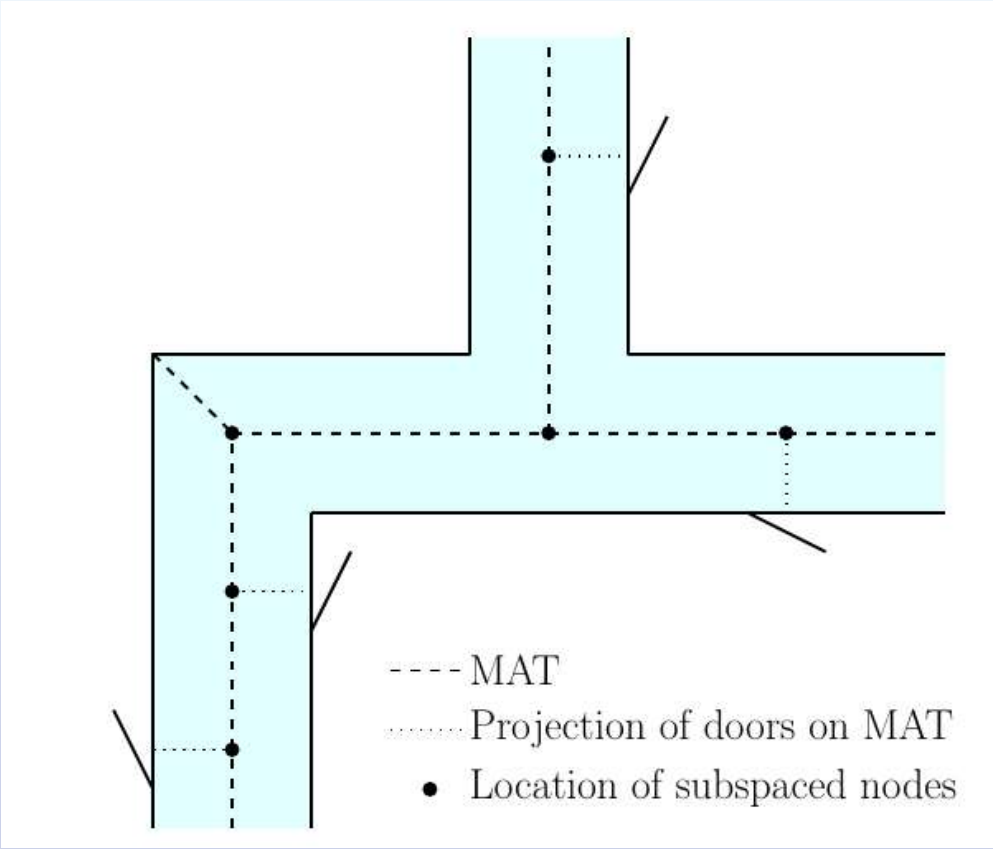
Subspacing corridor with MAT



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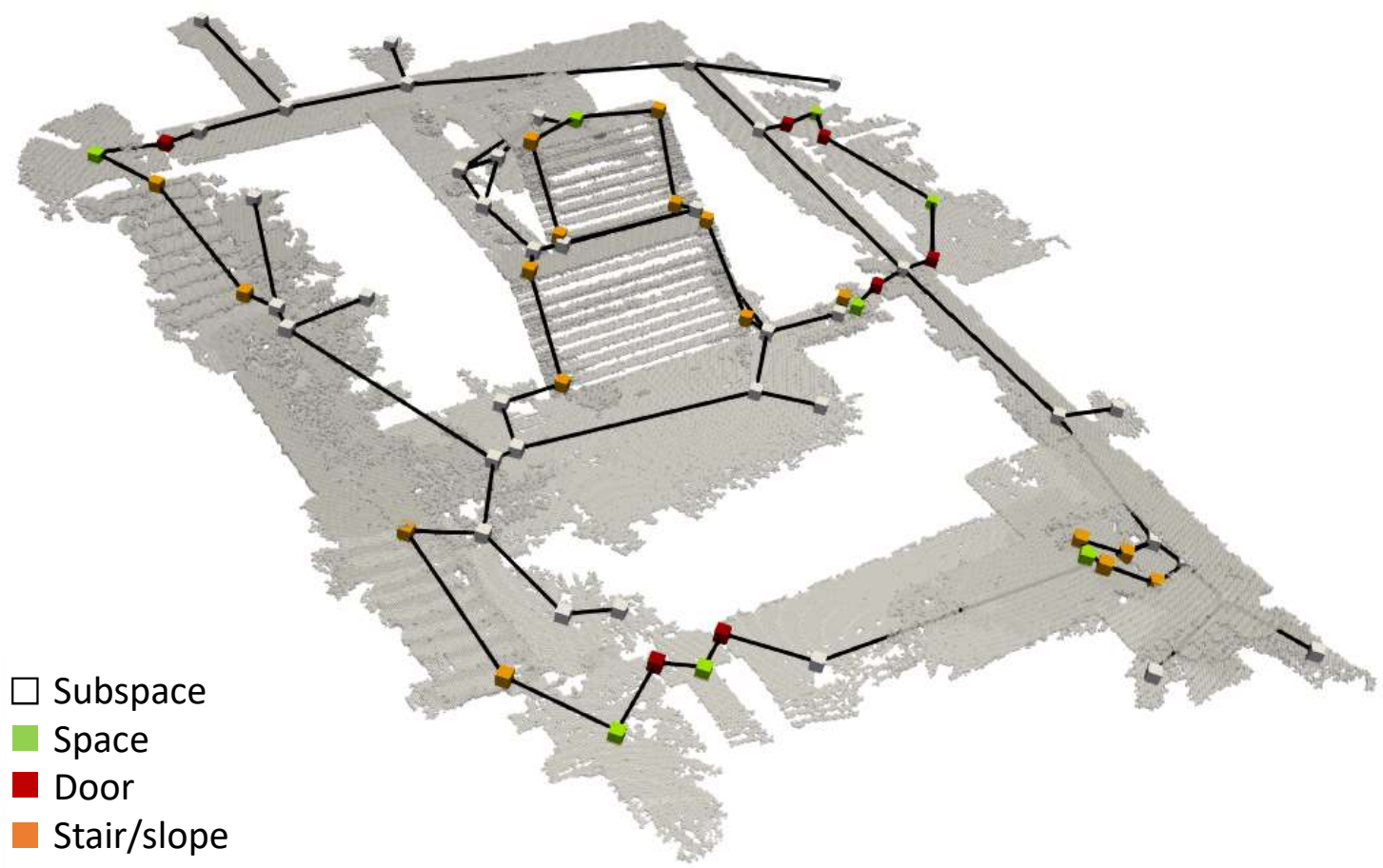
Result of subspacing



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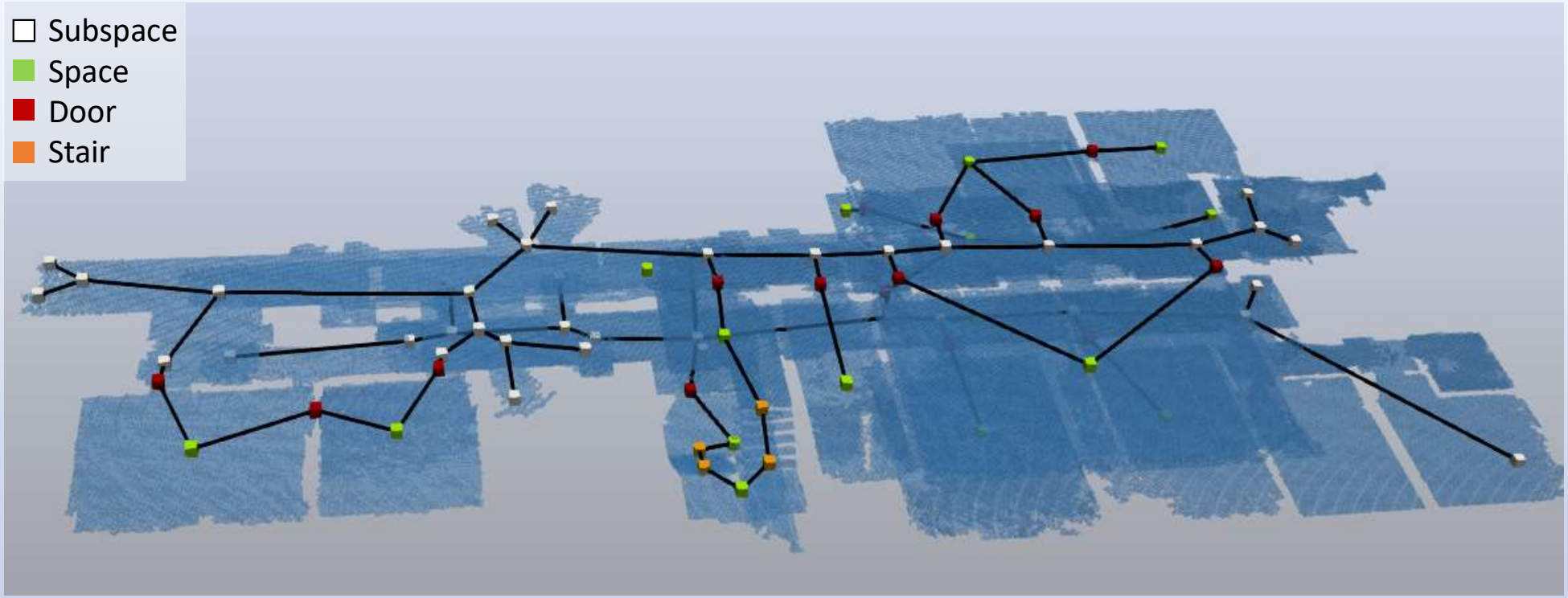
Results on test point cloud



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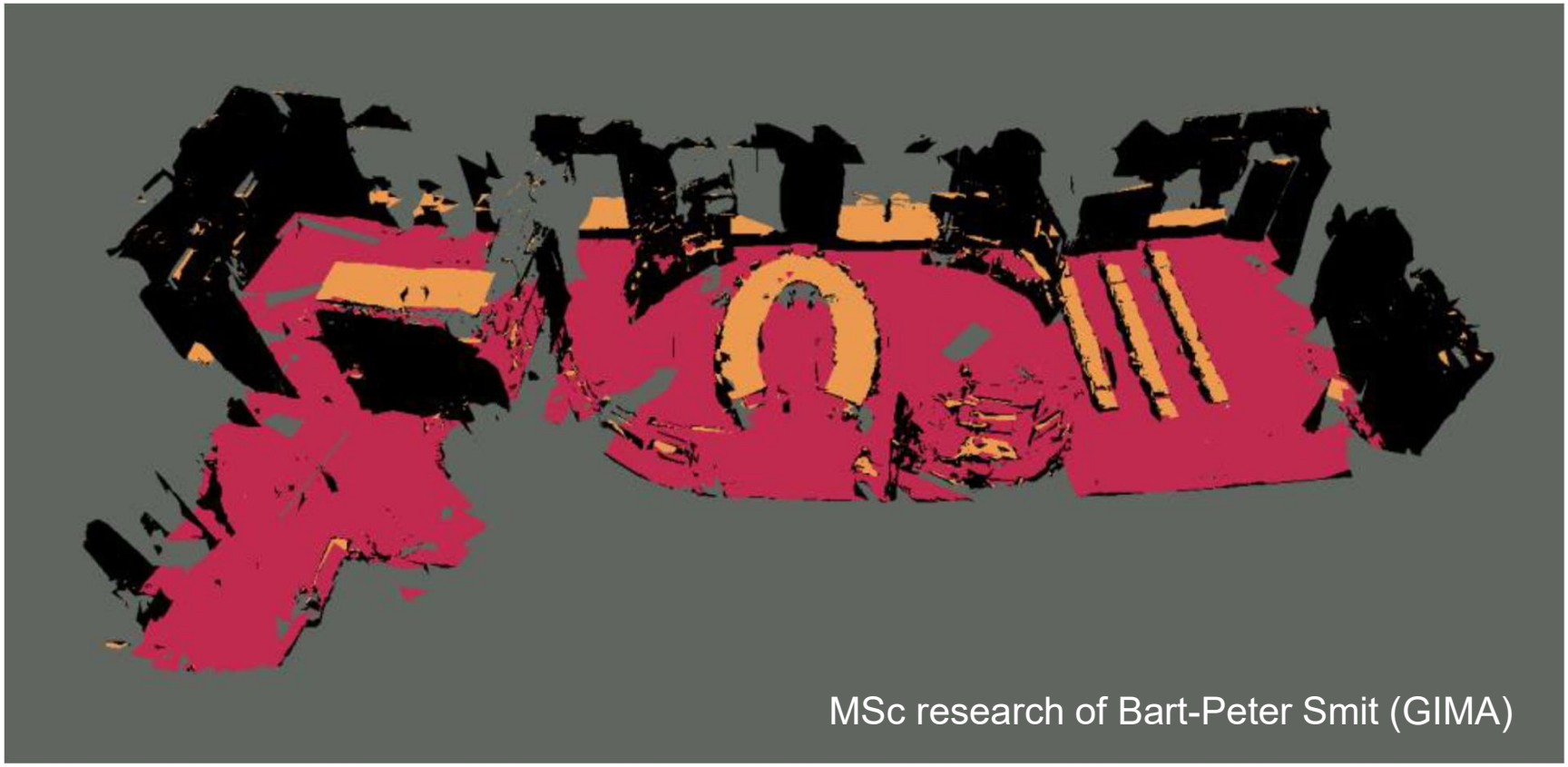
Many future challenges!

- Will we be in need of stored datasets?
- Complex indoor environments with micro navigation

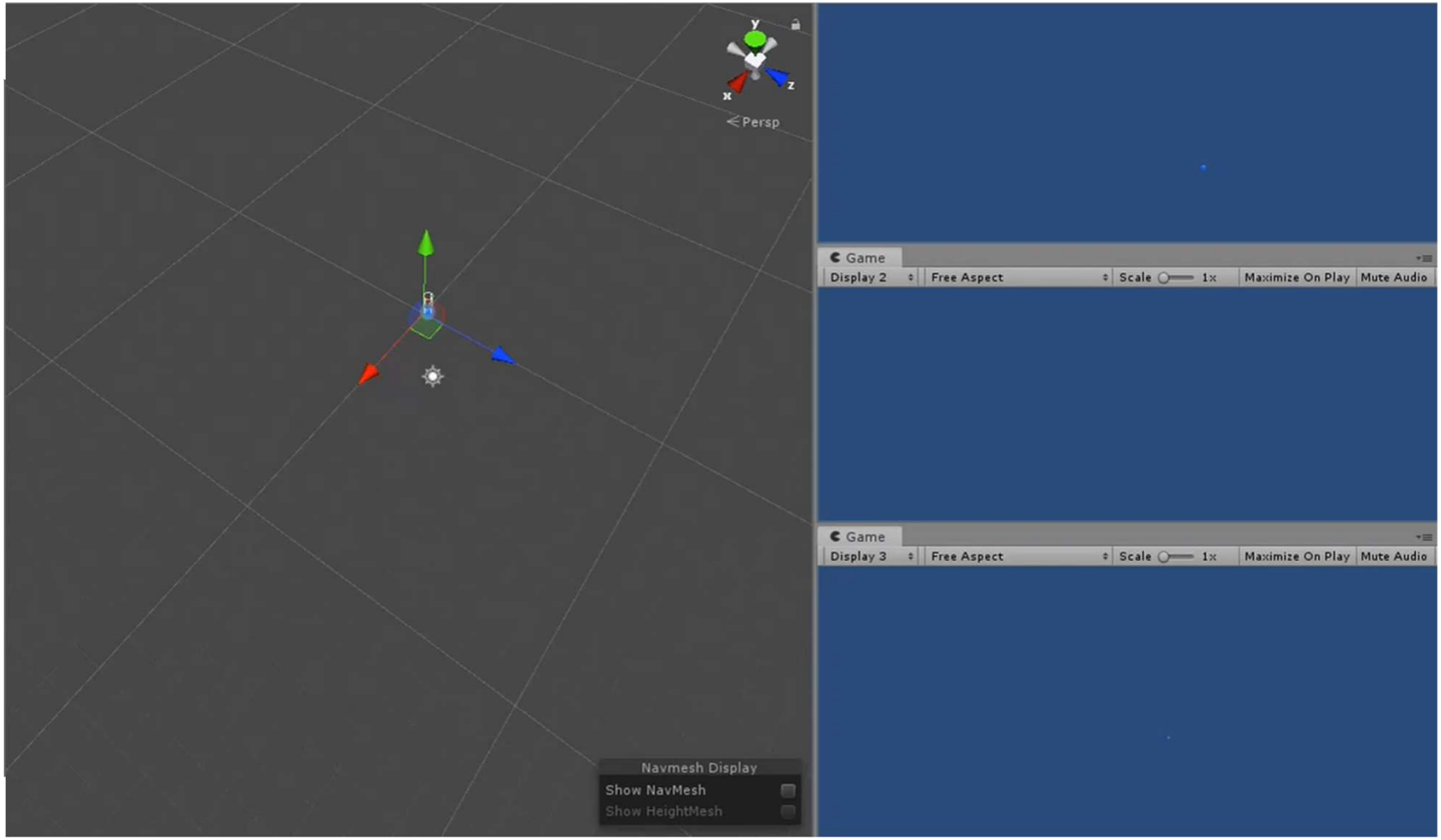
Scanning, sharing and using it directly

Creating Remote 3D Indoor First Responder Situation Awareness in Real-Time using SLAM



Scanning, sharing and using it directly

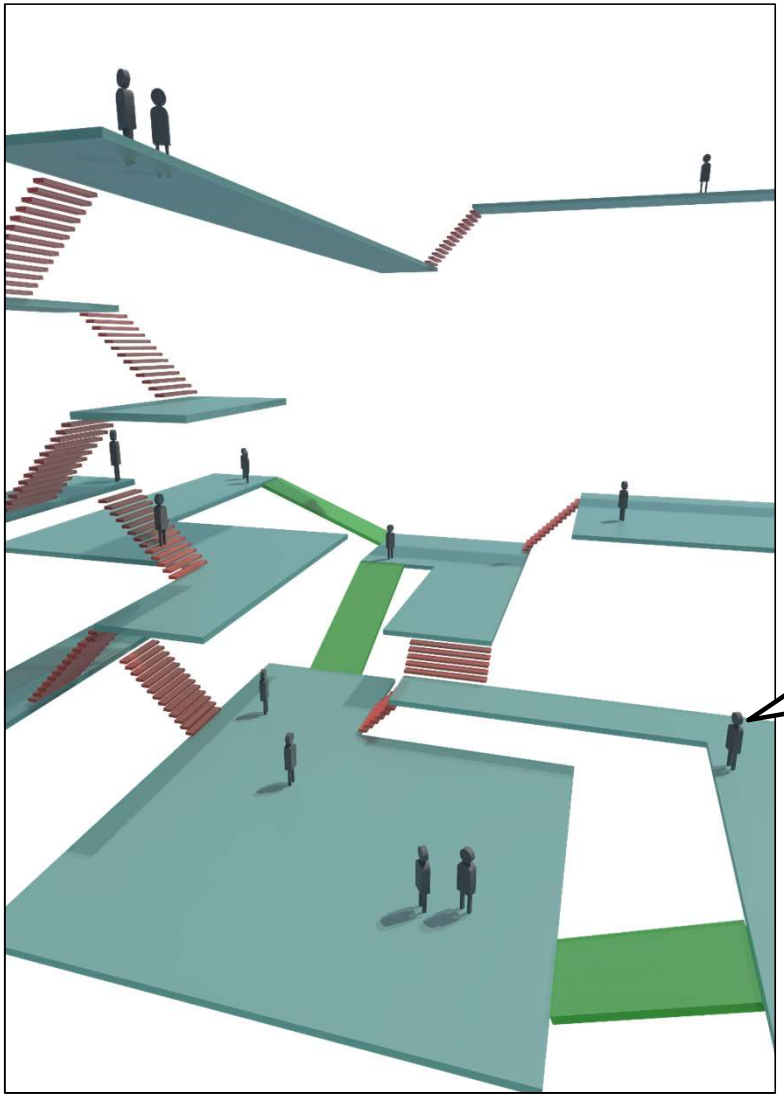
Creating Remote 3D Indoor First Responder Situation Awareness in Real-Time using SLAM



Future research

- Glas detection
- 3D Indoor visualisations for operations (from outdoor to indoor and directly indoor)
- Collaborative scanning

- Demo Rotterdam
  (if time left)



Thank you
for your attention!

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