3DSM Final results

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TU Delft 3Dgeoinfo

NWO Netherlands Organisation for Scientific Research

Hoogtebestand Rotterdam 2012

MAT in a nutshell

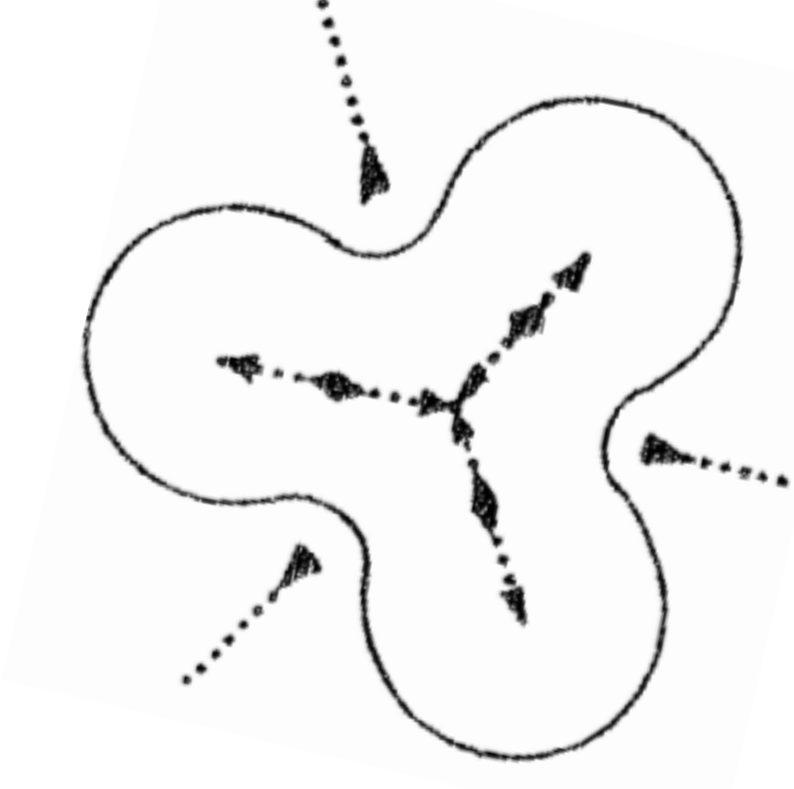


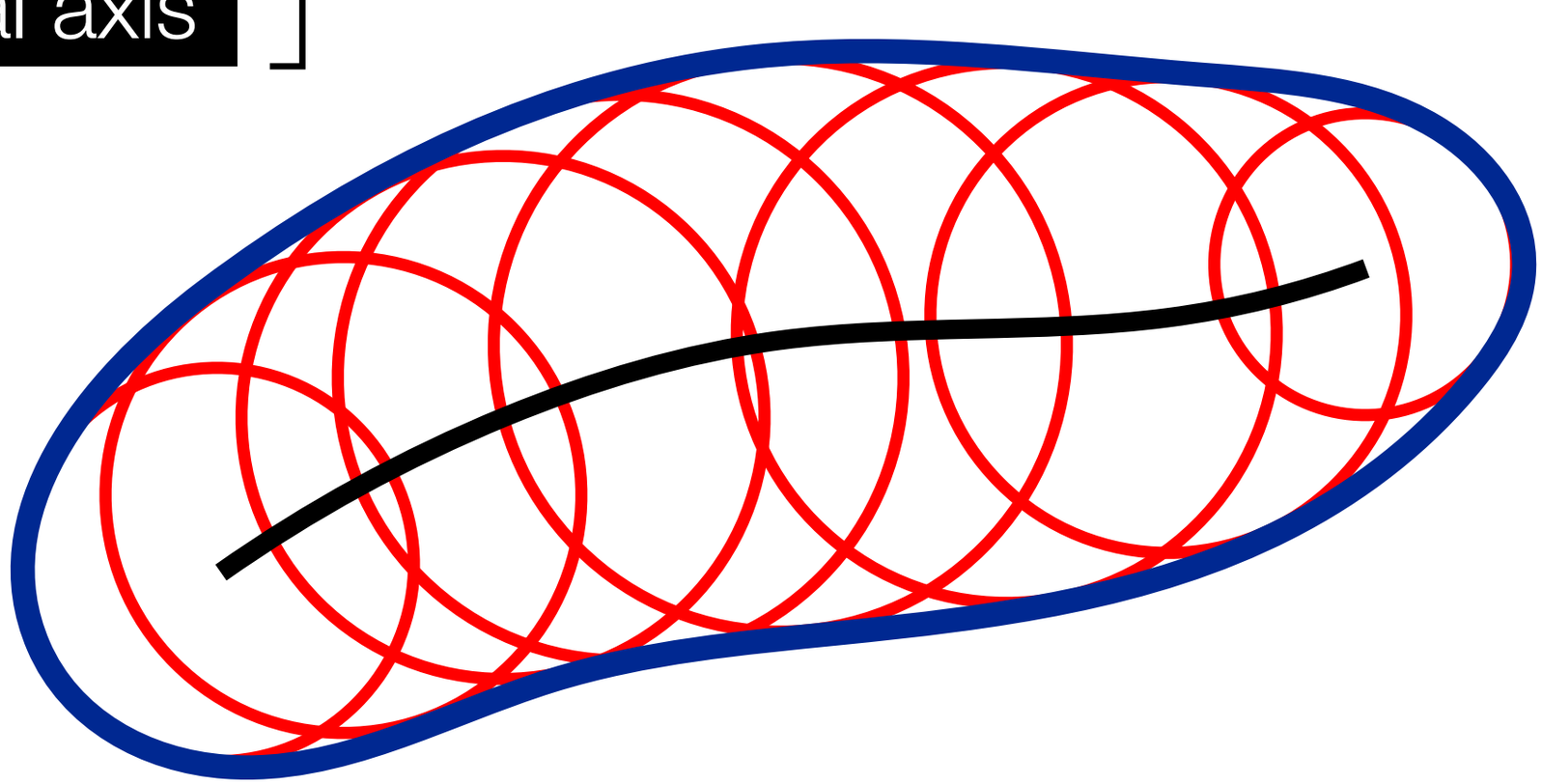
Image from *A transformation for extracting new descriptors of shape* by Harry Blum

Boundary representation

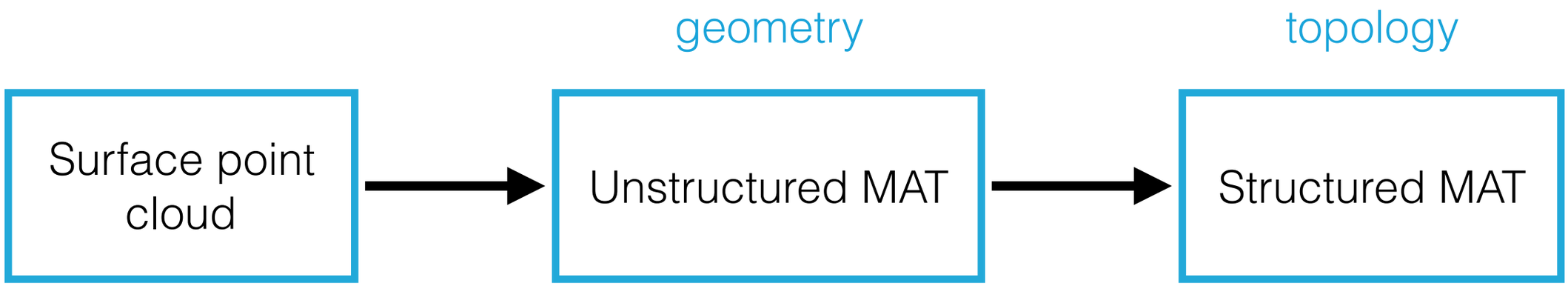
Medial balls

Medial axis

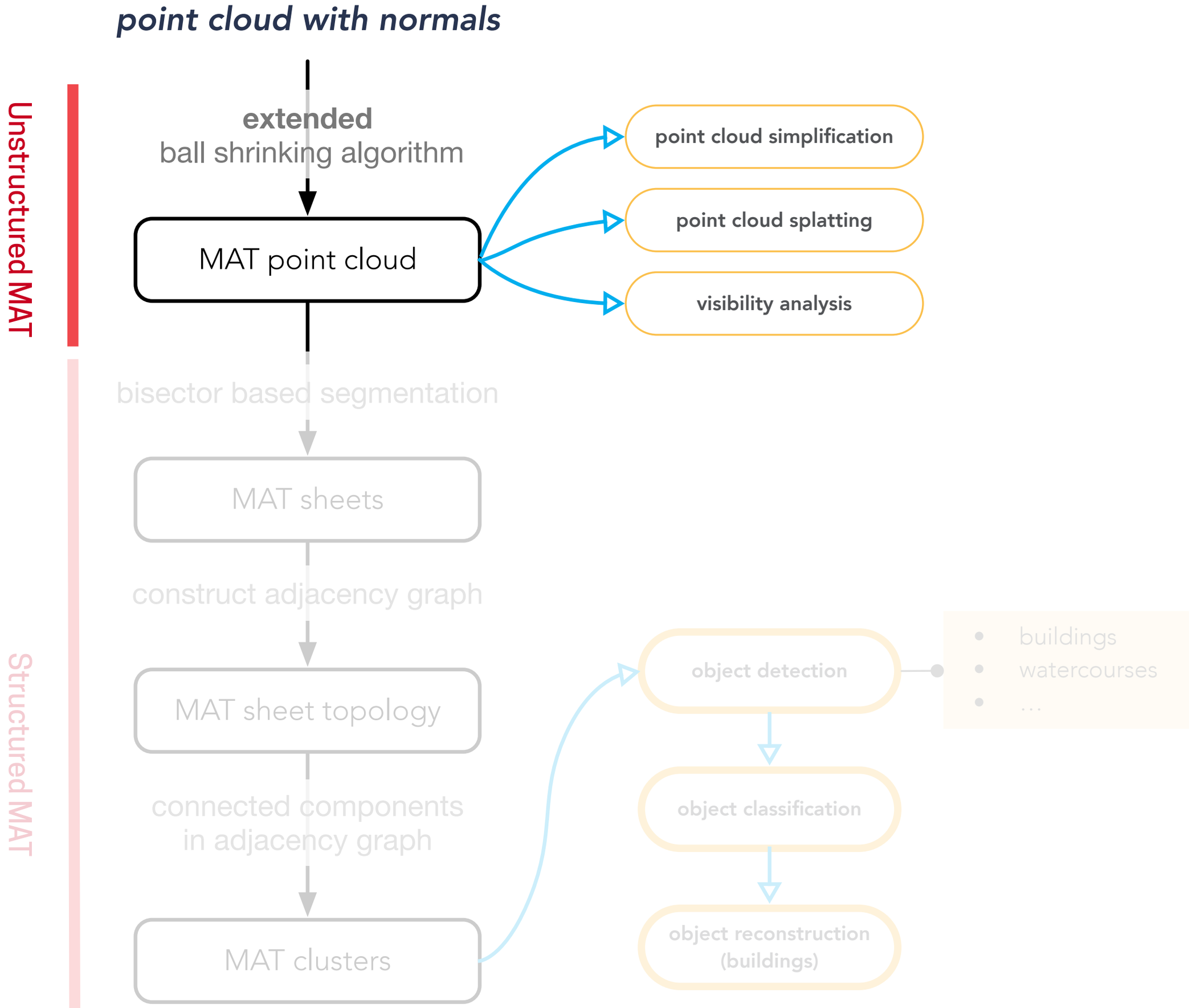
MAT



Workflow


geometry
topology
Surface point cloud
Unstructured MAT
Structured MAT

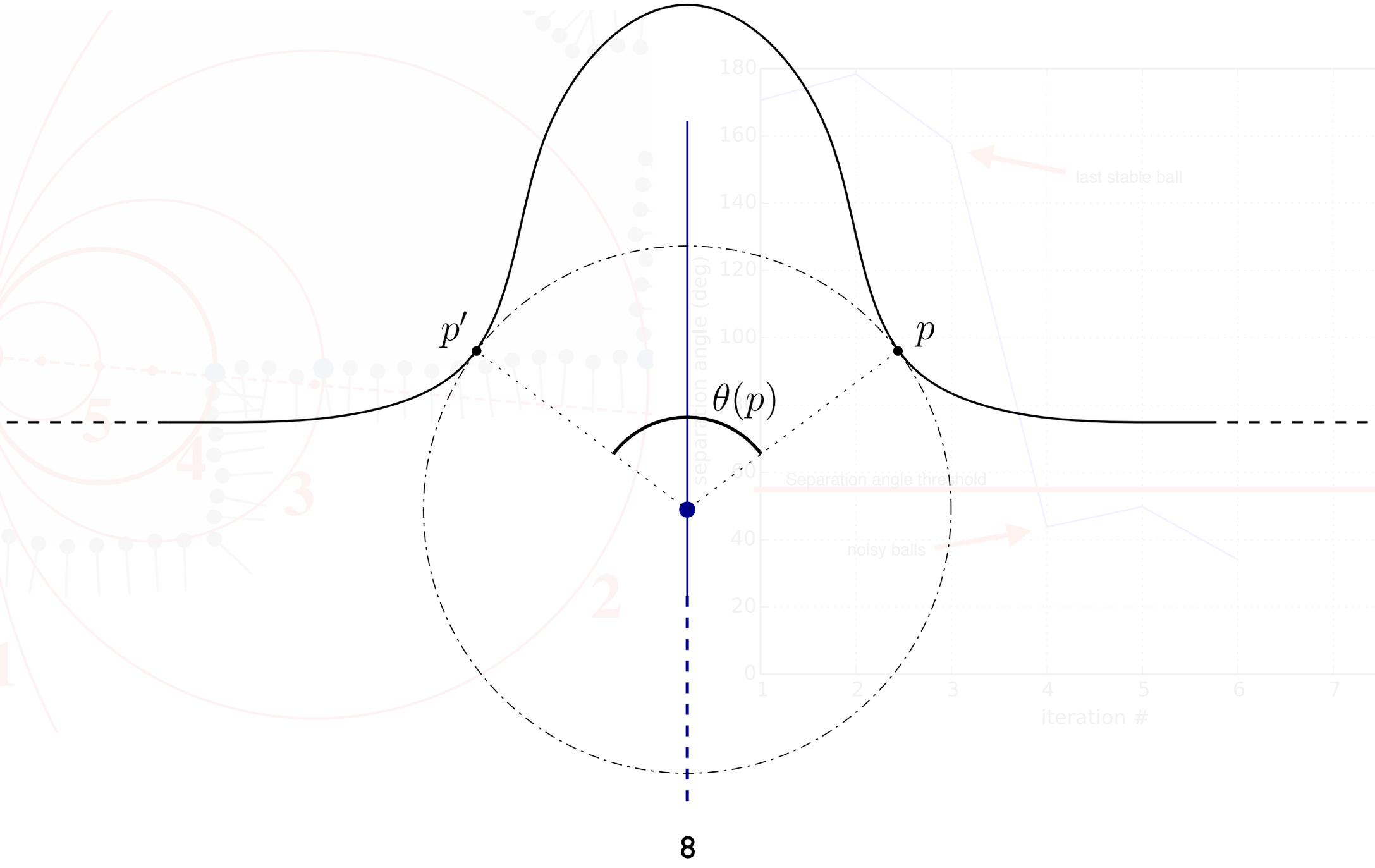
Unstructured MAT


point cloud with normals
Unstructured MAT
extended
ball shrinking algorithm
MAT point cloud
point cloud simplification
point cloud splatting
visibility analysis
bisector based segmentation
MAT sheets
construct adjacency graph
MAT sheet topology
connected components
in adjacency graph
MAT clusters
Structured MAT
object detection
buildings
watercourses
…
object classification
object reconstruction
(buildings)

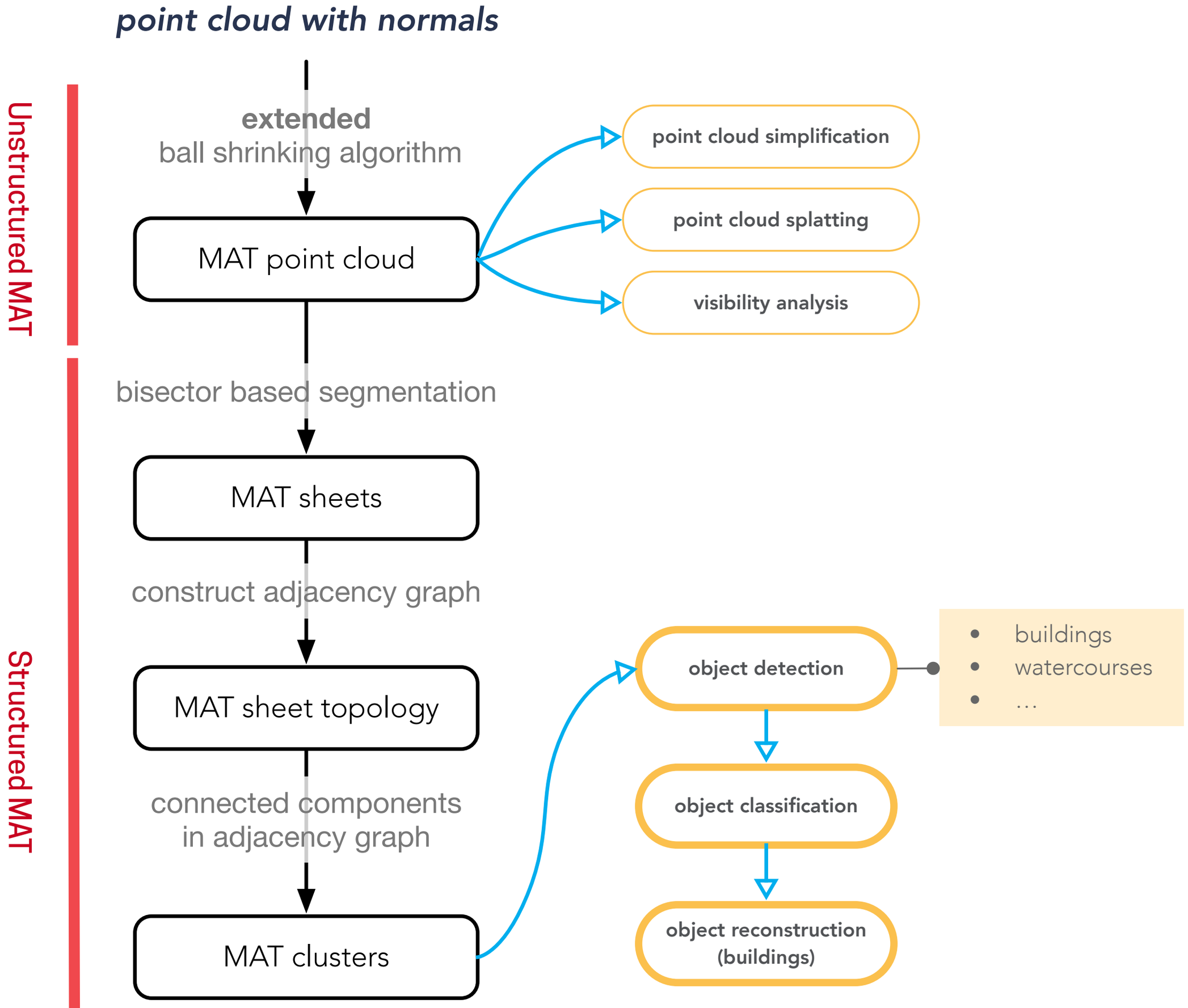
Demo

ball shrinking algorithm

Denoising heuristic



Structured MAT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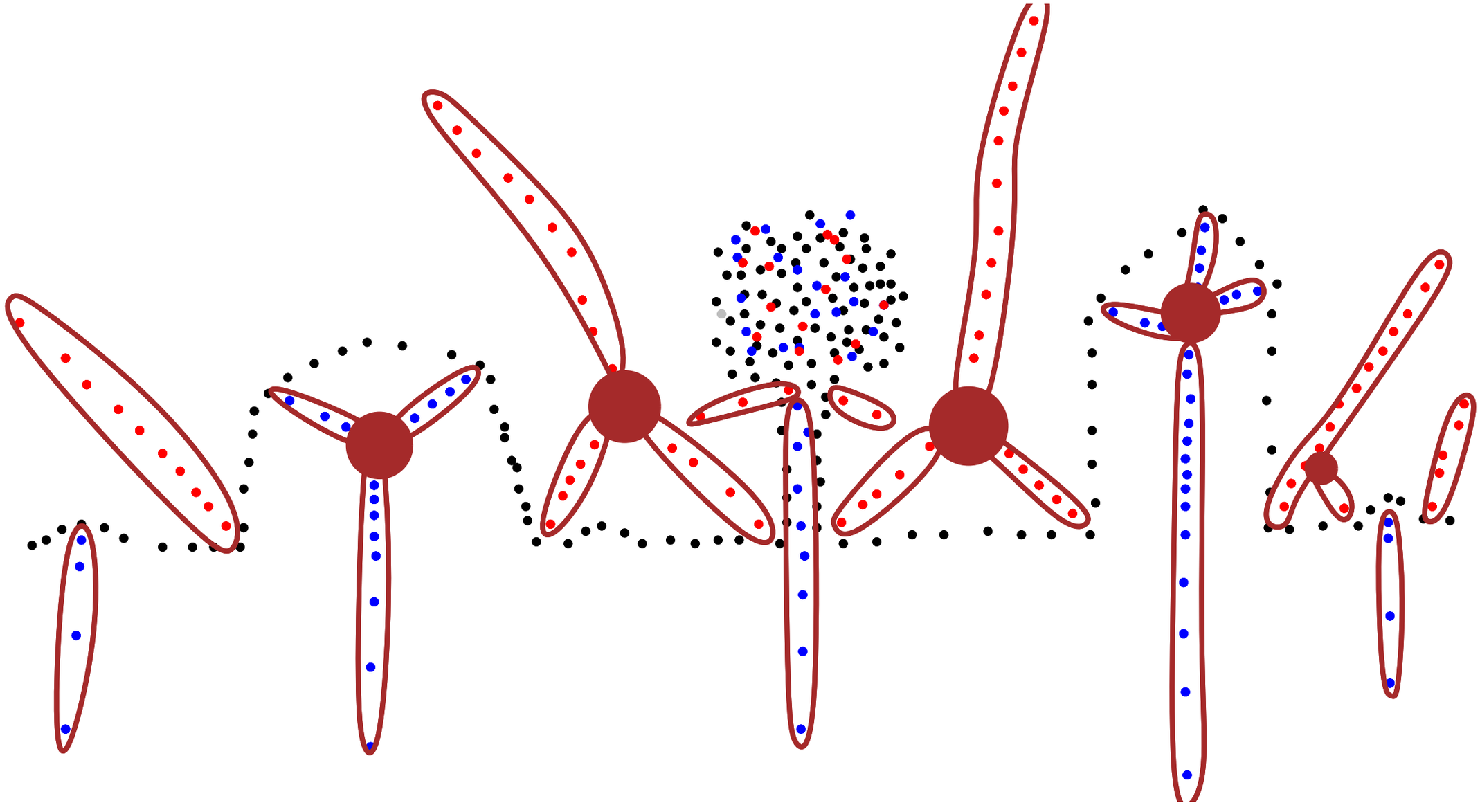
MAT topology

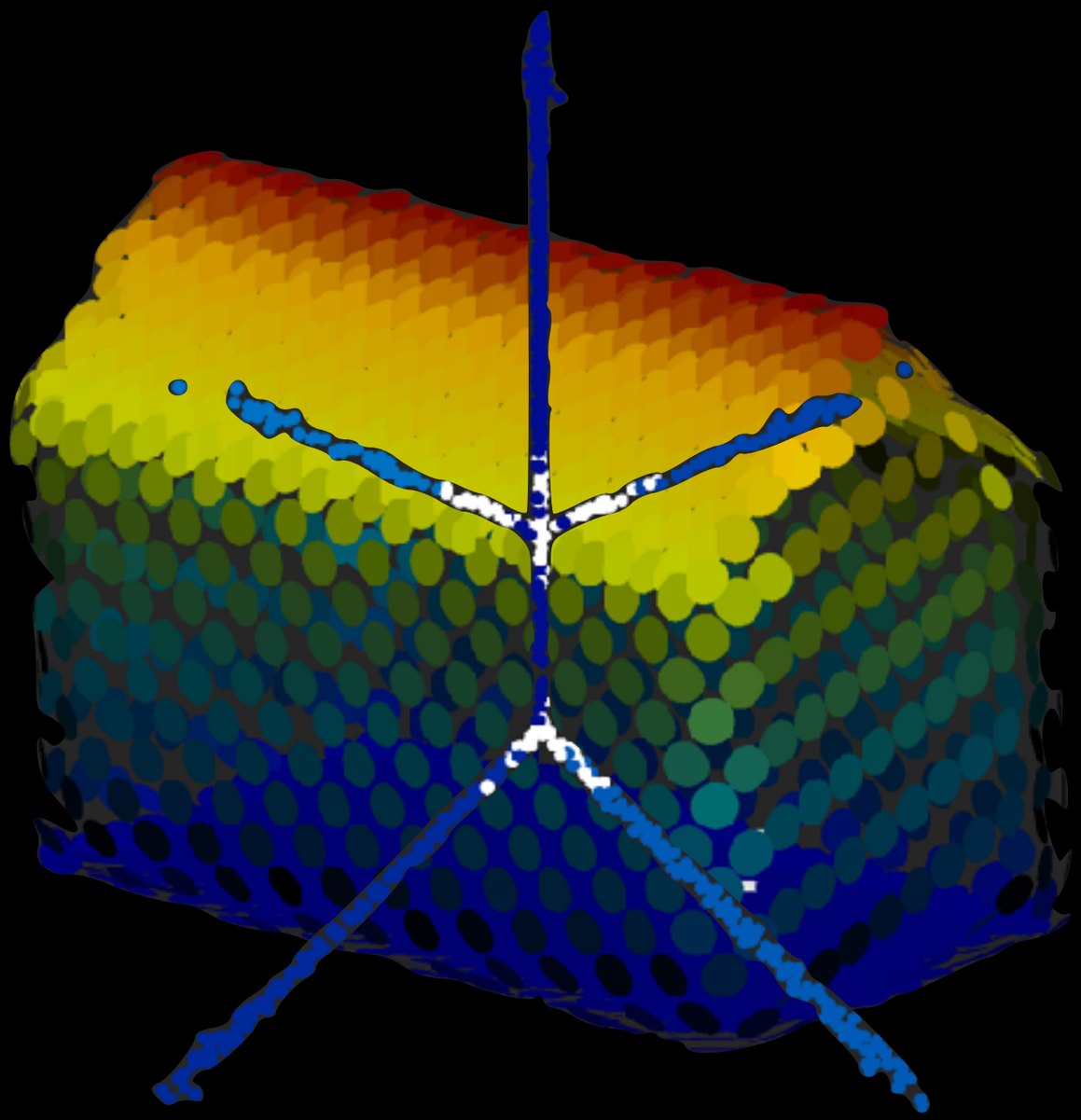


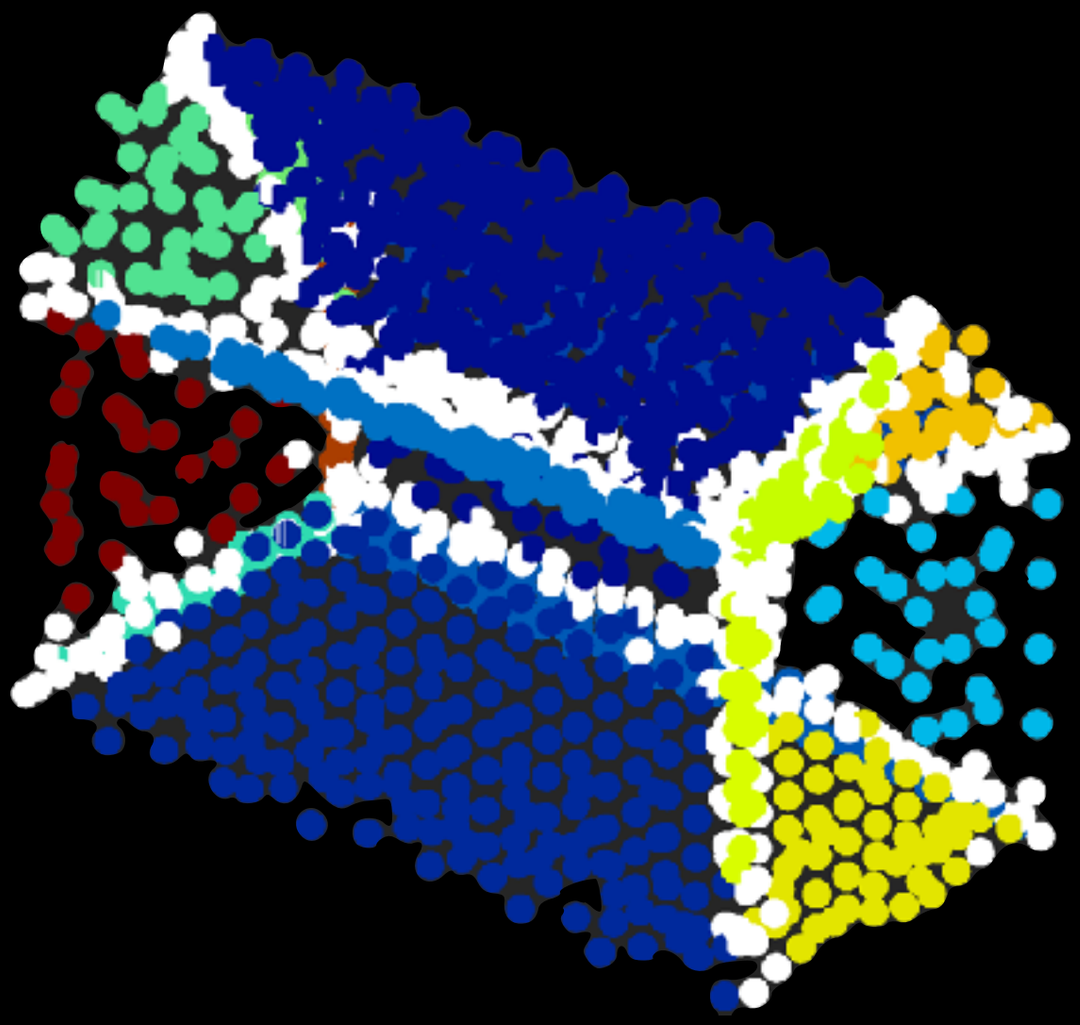
Obtaining structured MAT

1. Segmentation of MAT **sheets**
2. Find topological links between sheets
   (ie. create a **graph**)
3. Graph partitioning into **components**

MAT segmentation

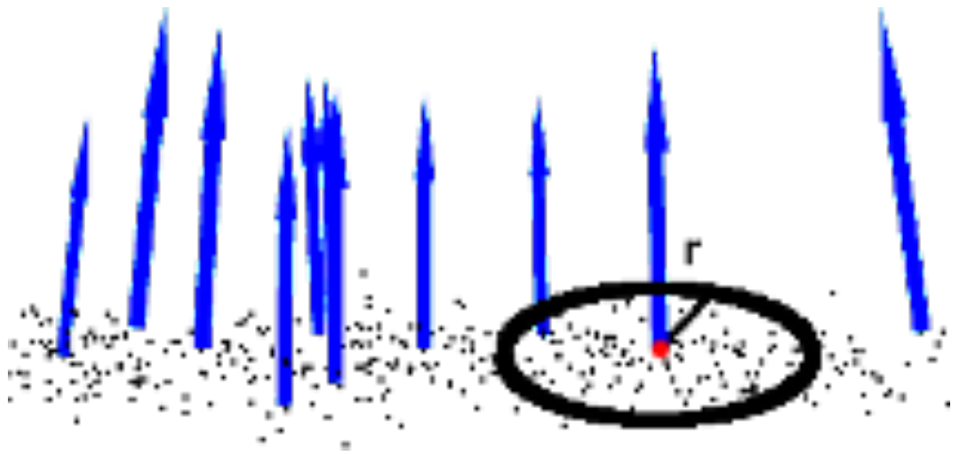
Using difference of normals (as used in e.g. PCL)



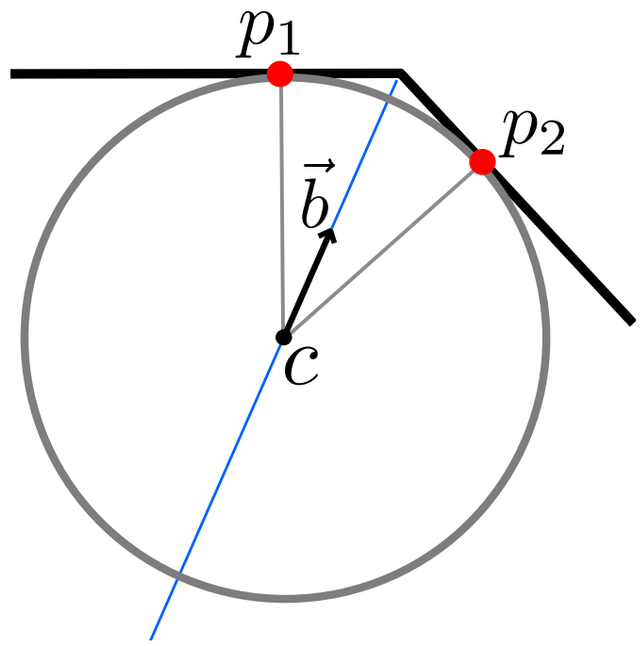


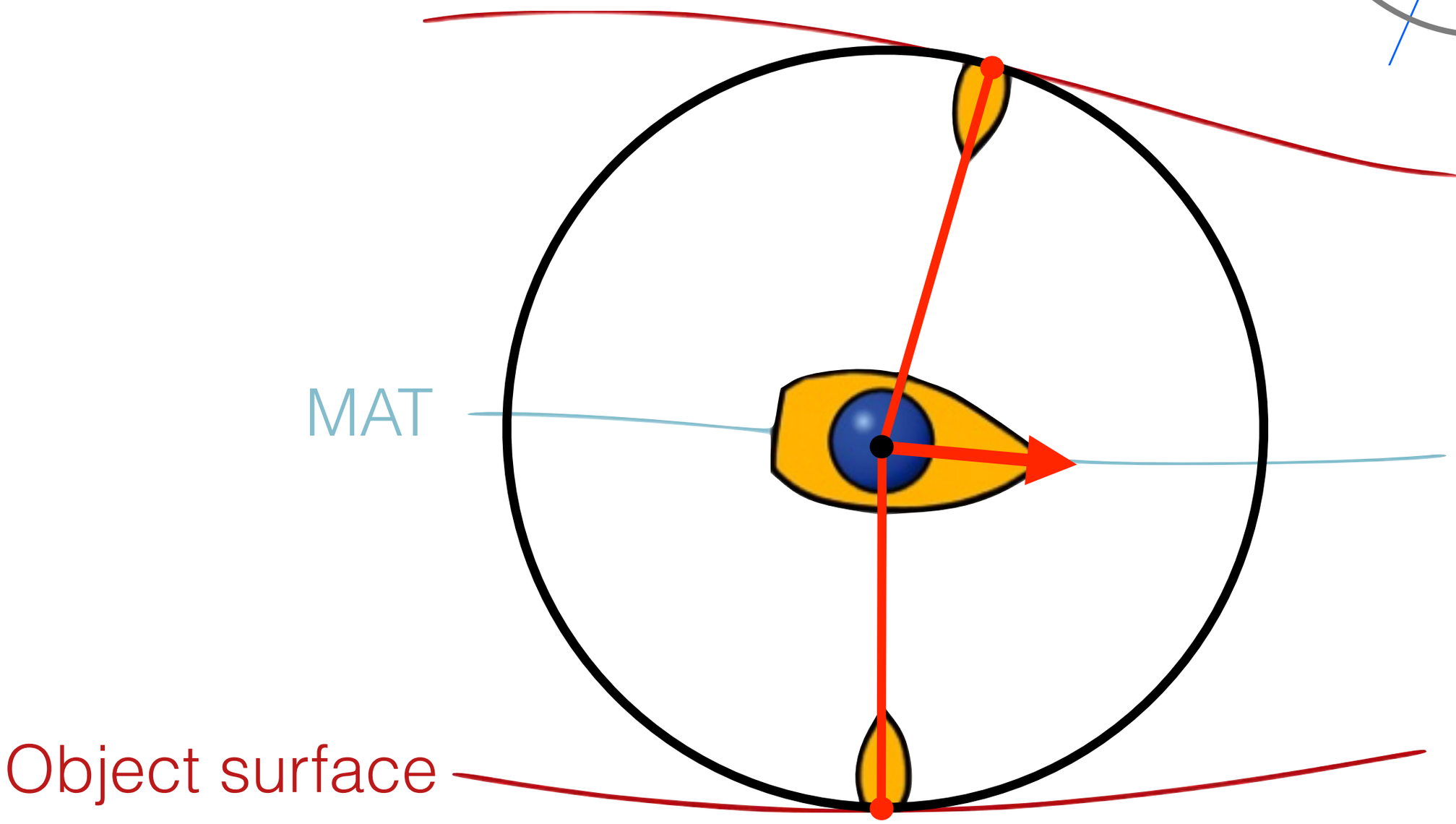
MAT segmentation

difference
of normals

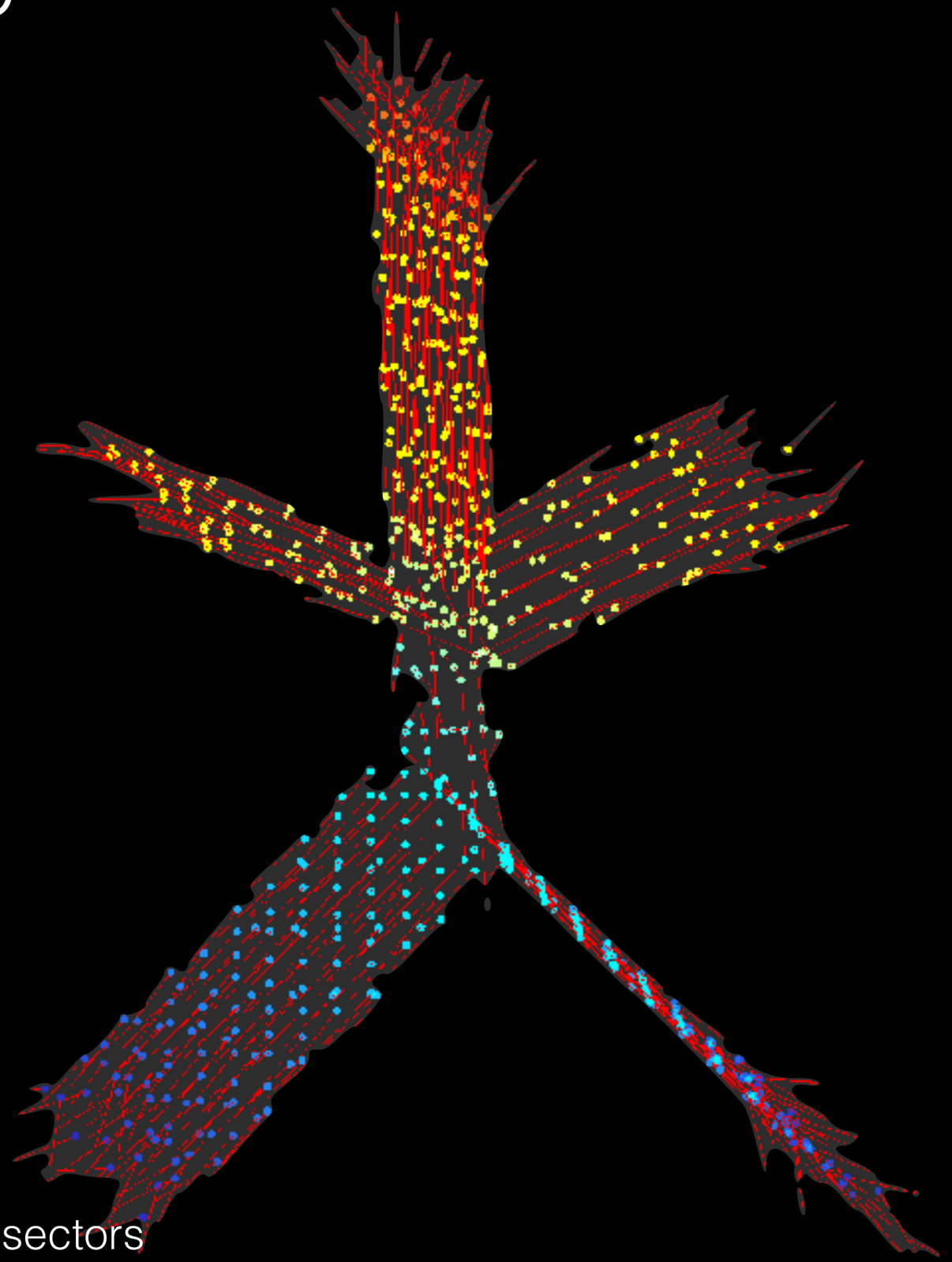


MAT segmentation





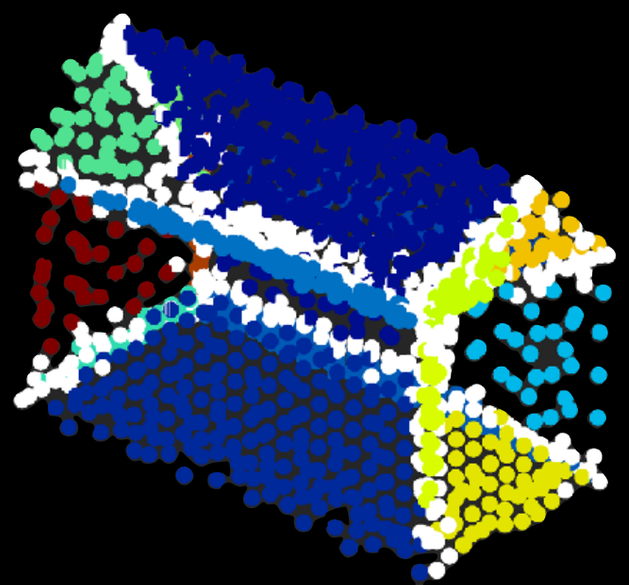
MAT segmentation

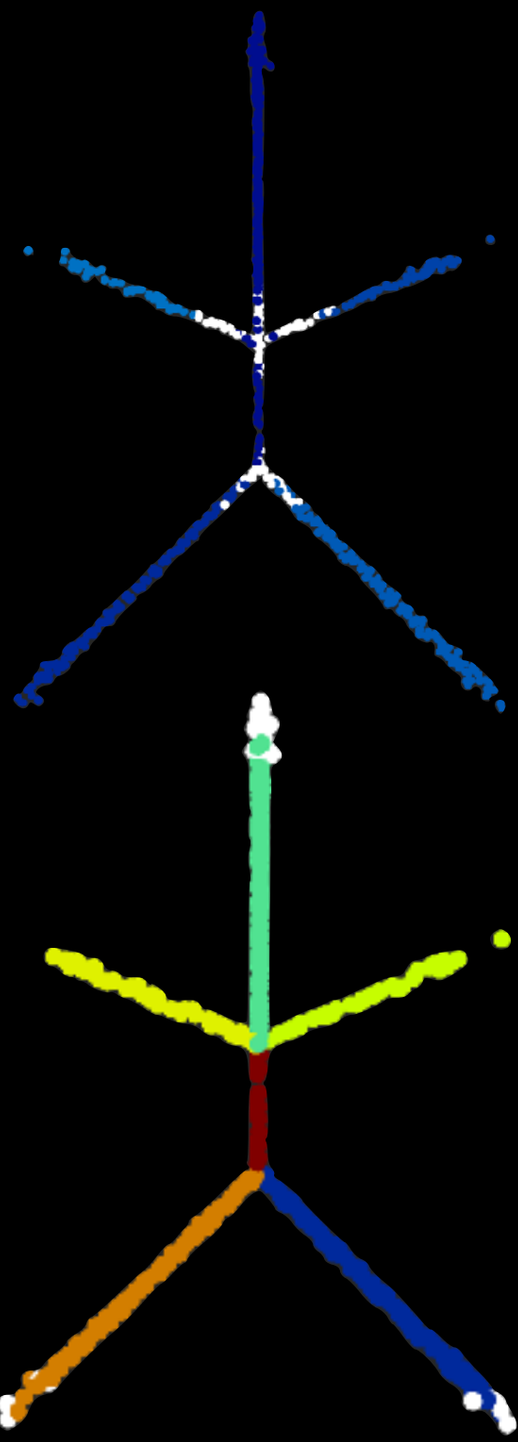


Red lines are Medial Bisectors

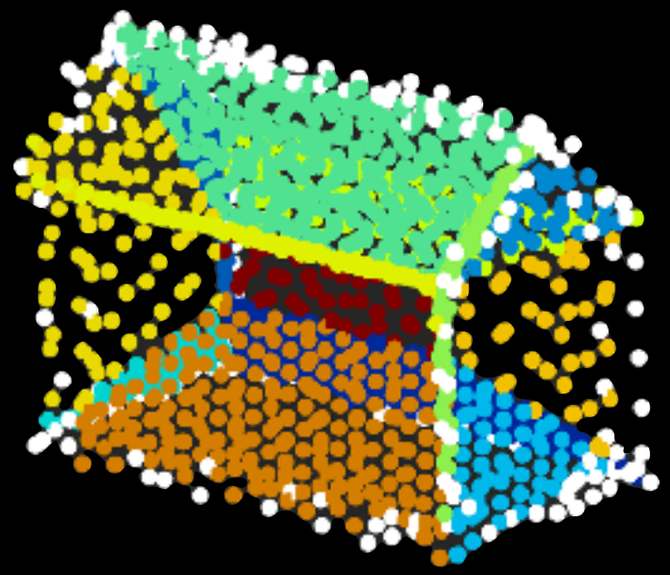
MAT segmentation

difference
of normals



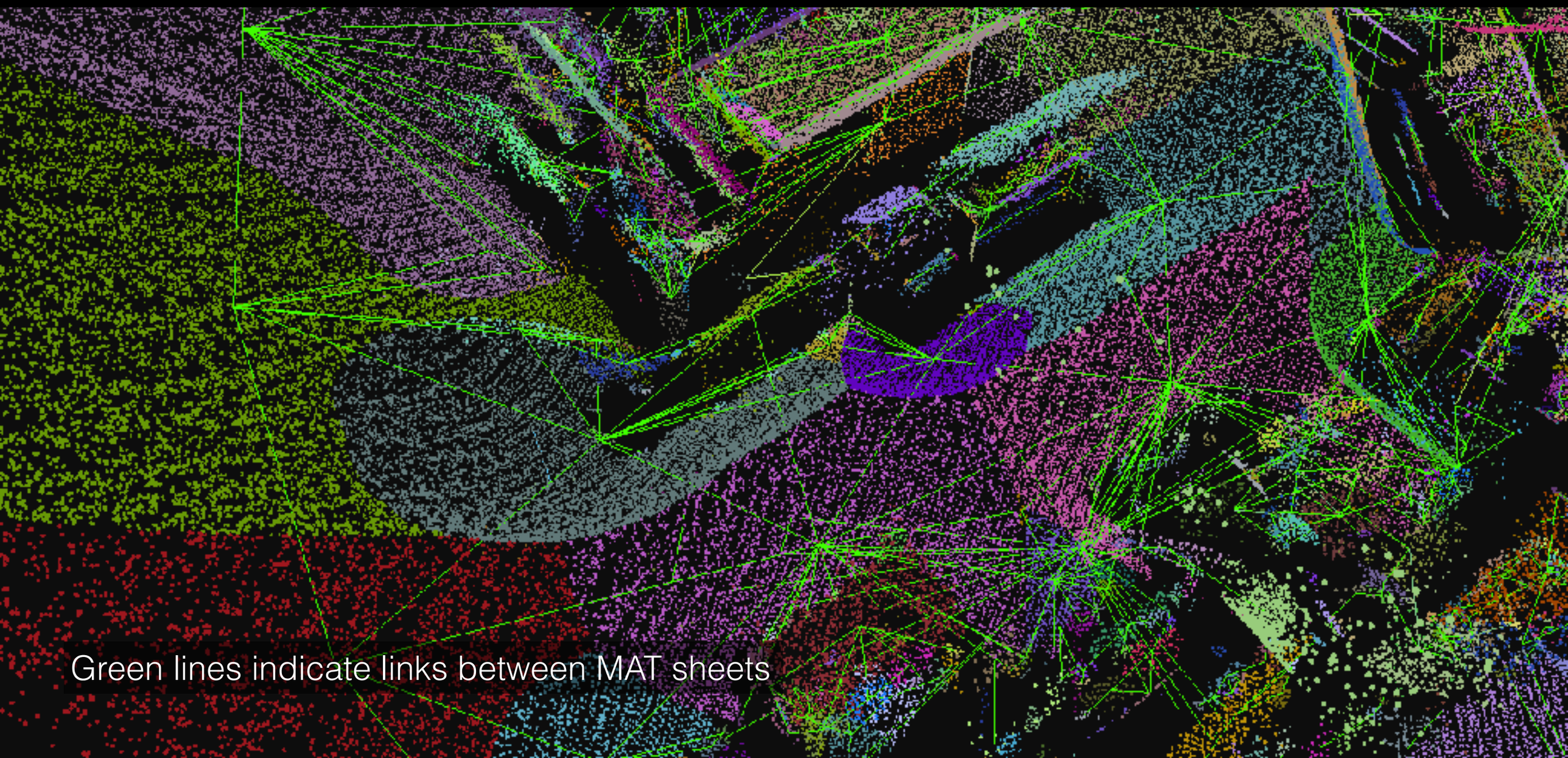


difference
of bisectors



Different colors mean different segments (medial sheets)
White means no segment

MAT segmentation



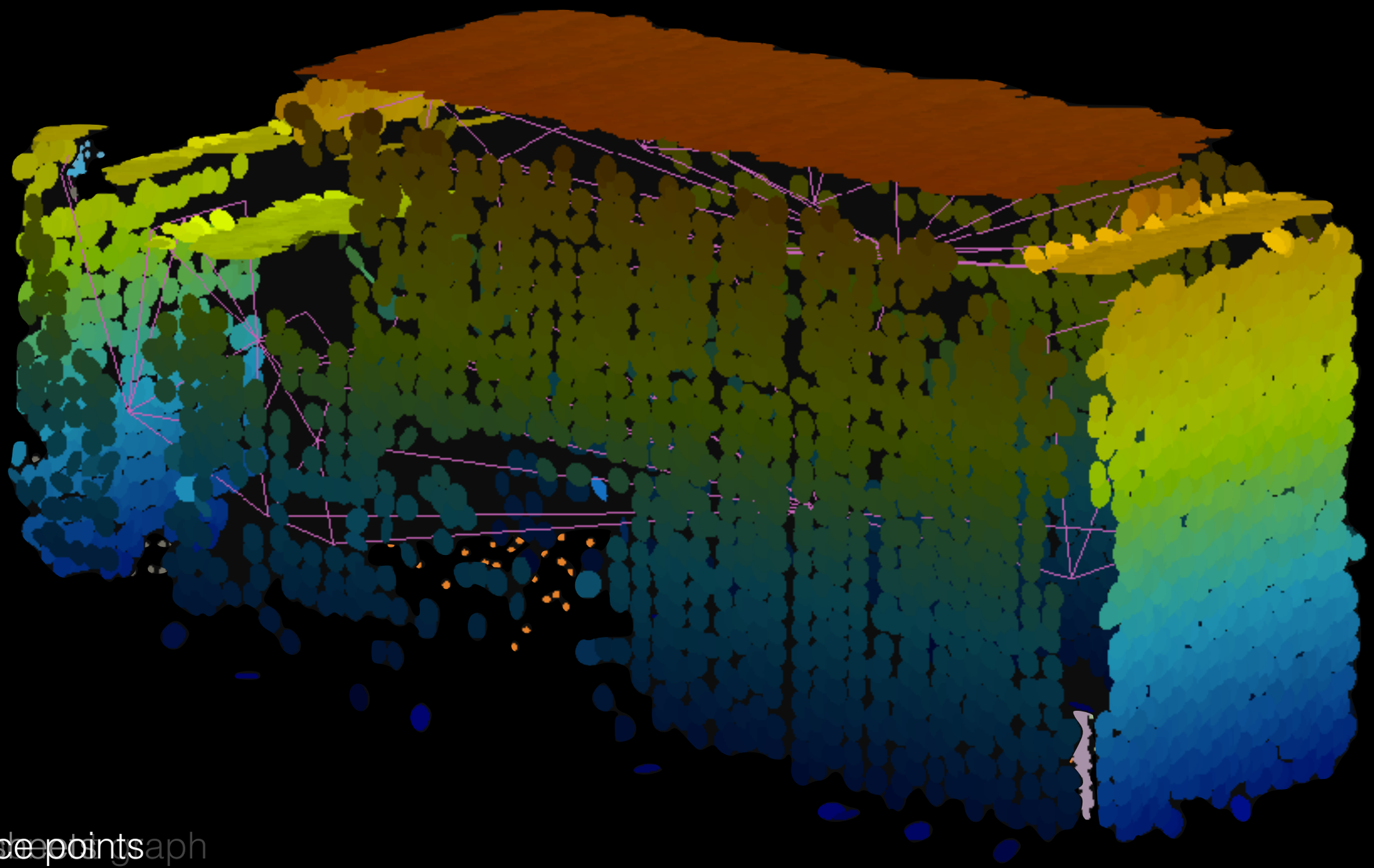
Green lines indicate links between MAT sheets

Connected components

Each component has a random color

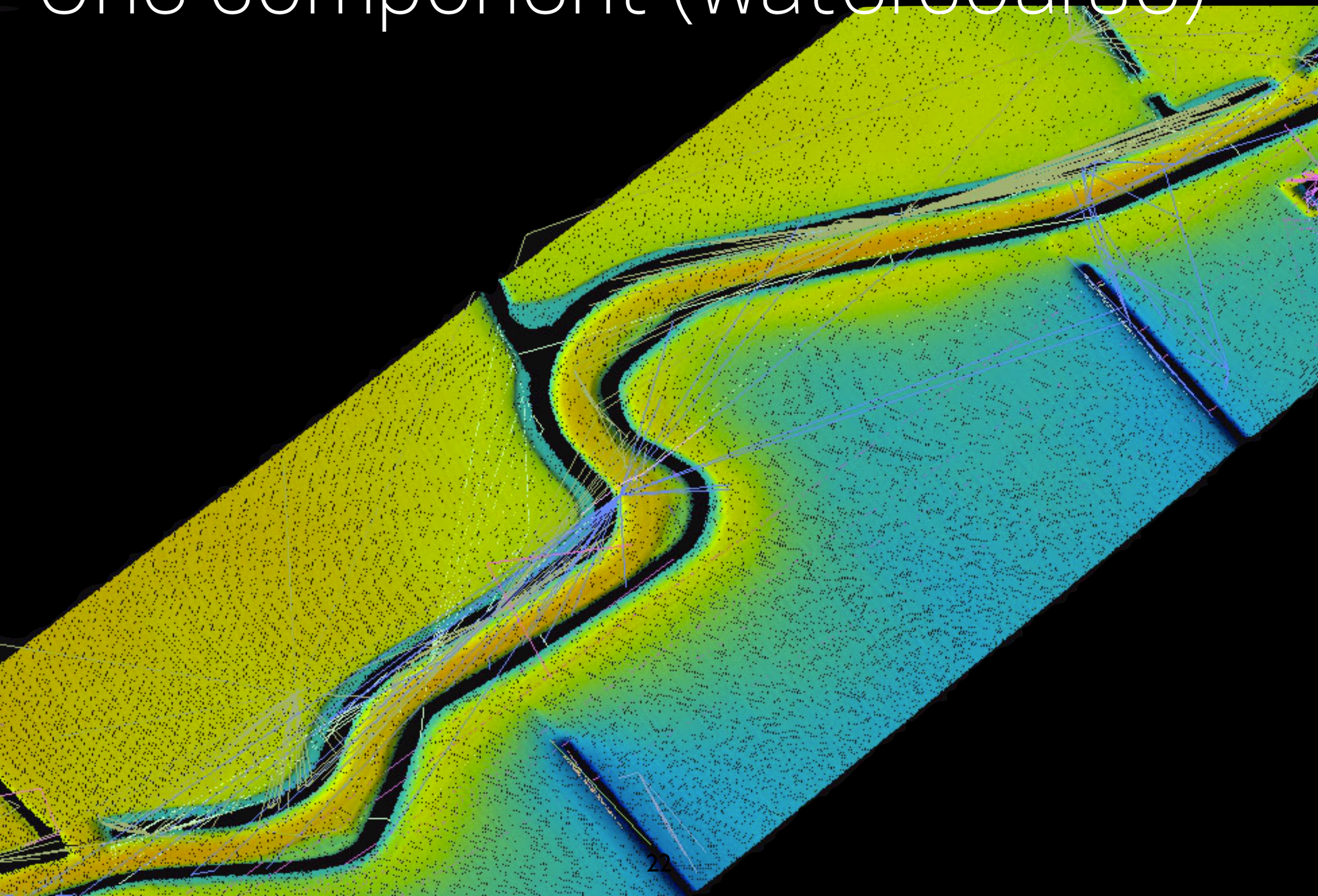
Overlay with surface points

One component (urban)

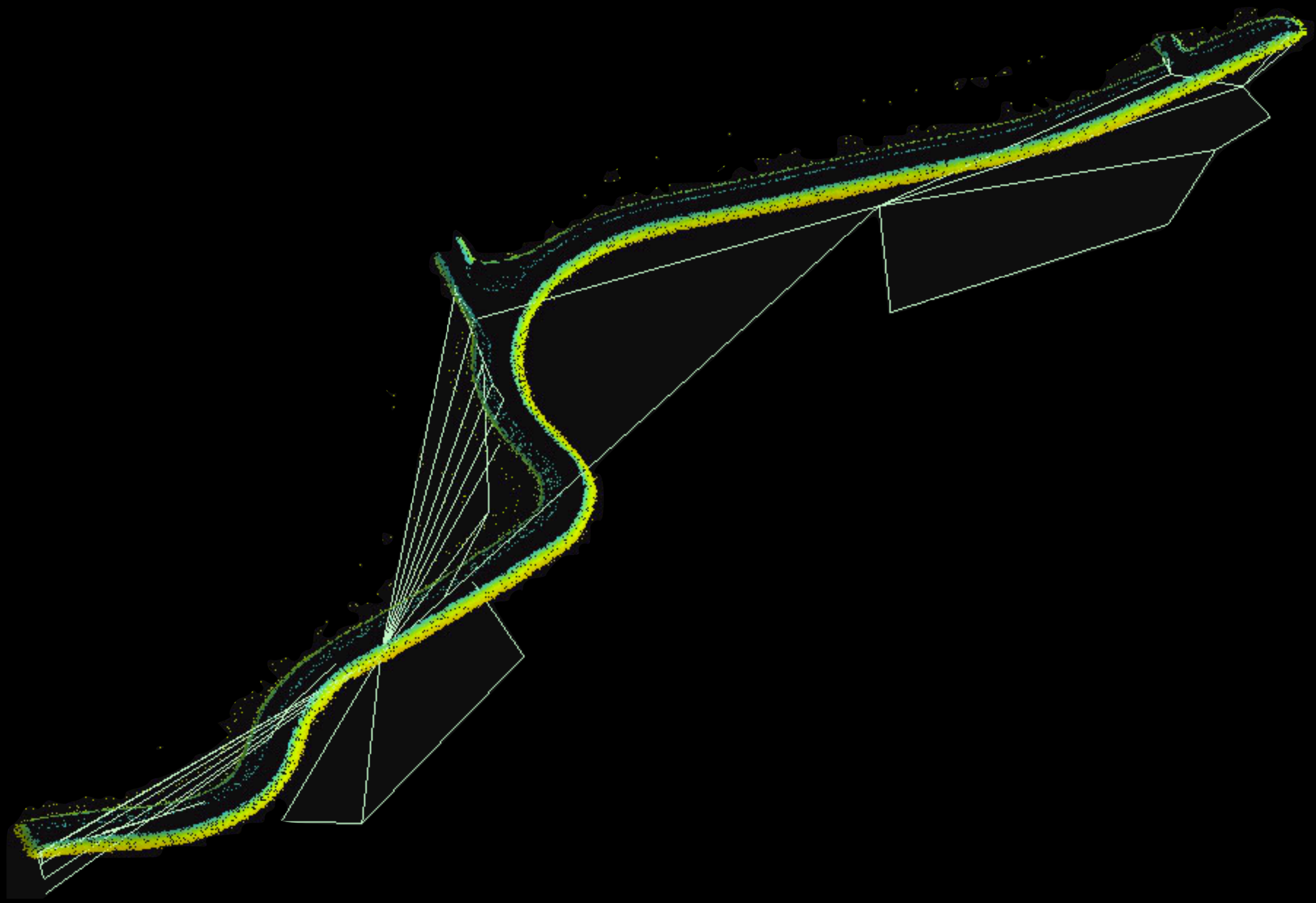


Surface points

One component (watercourse)

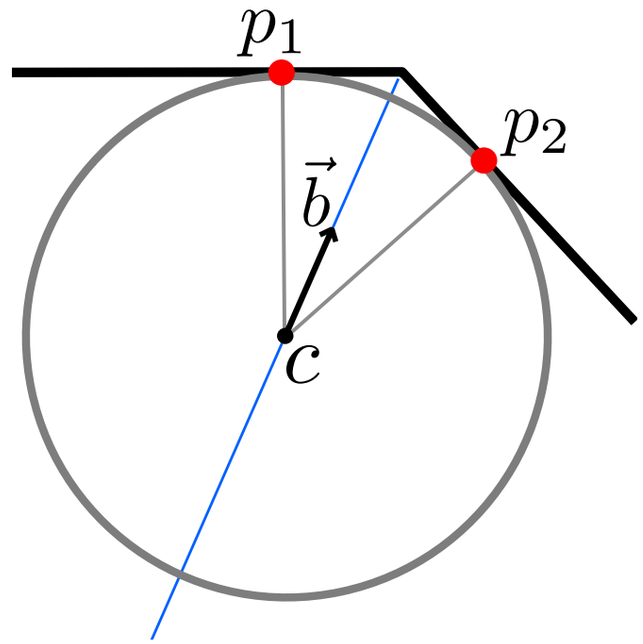


One component (watercourse)

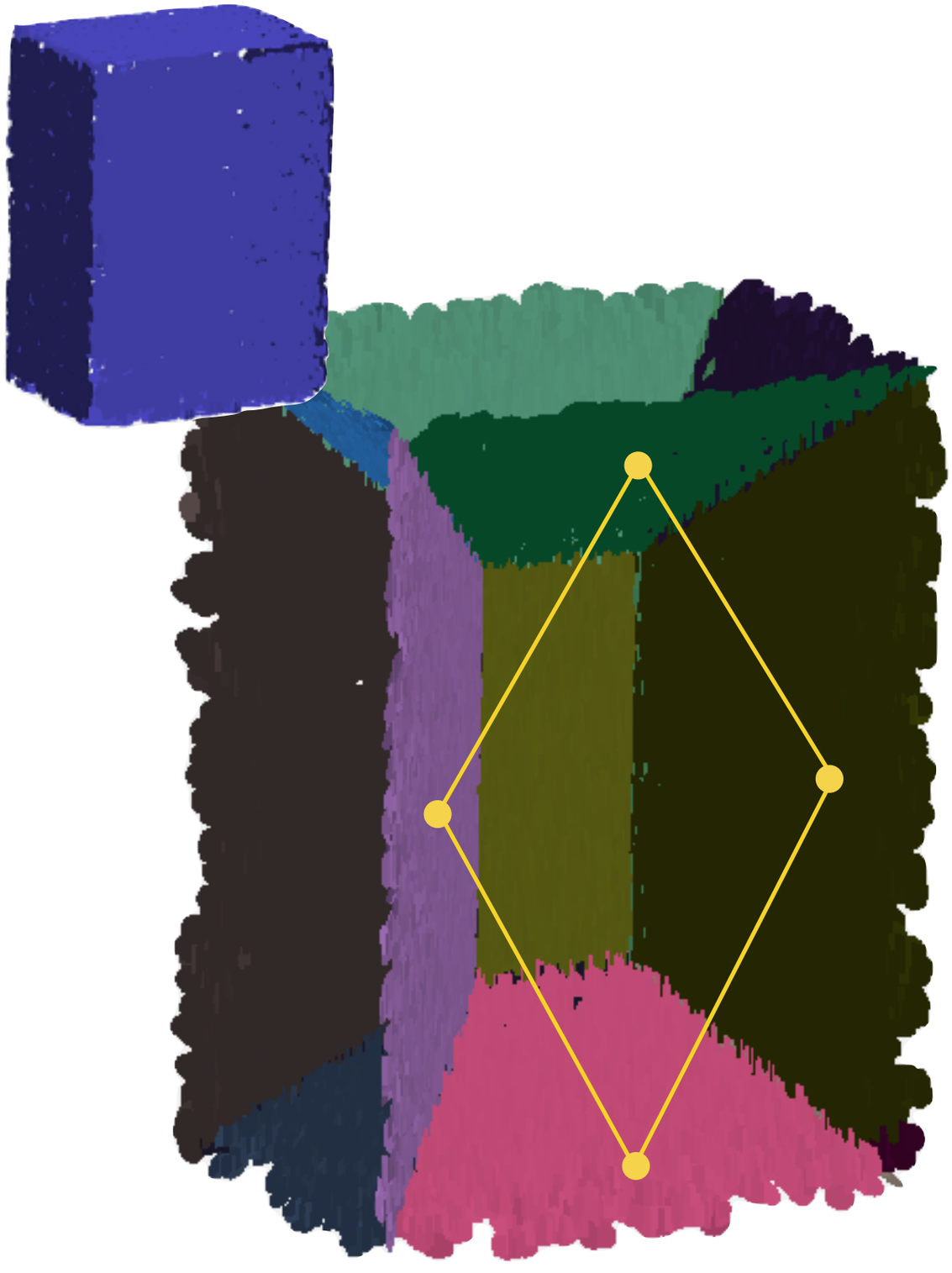


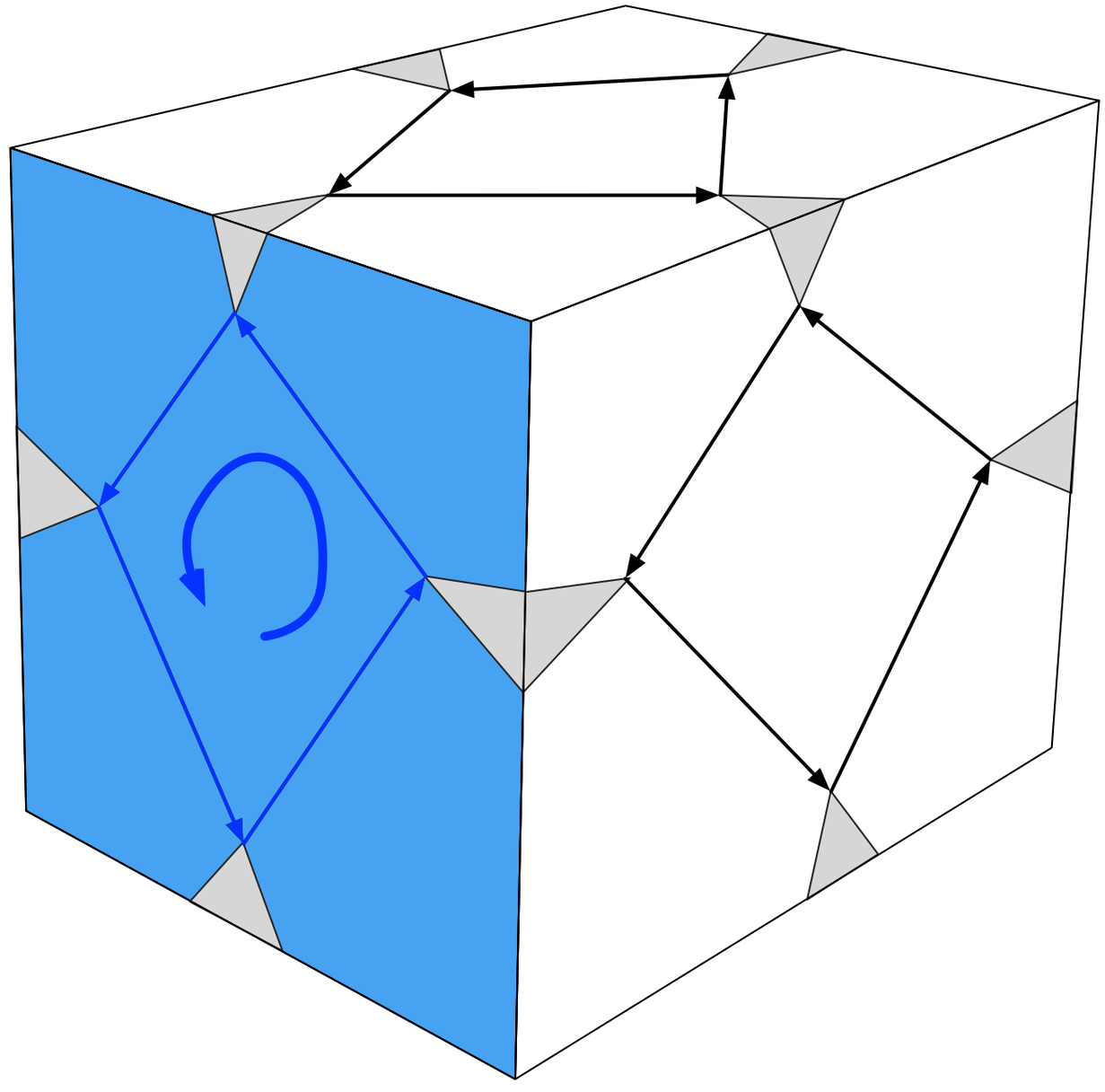
Cluster classification

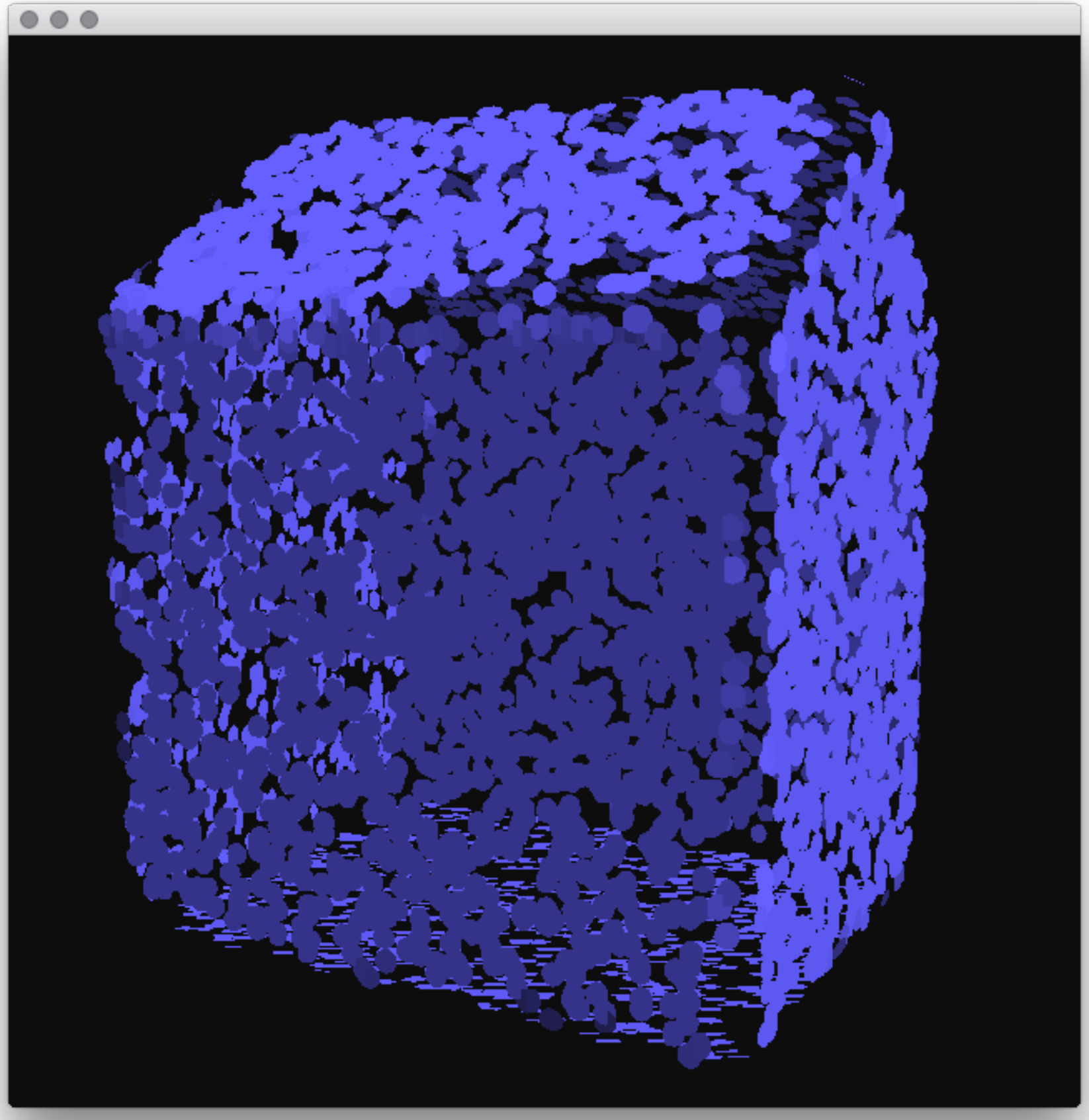
- based on aggregated ball metrics
  - currently simple thresholding
- I classify
  - interior and exterior MAT clusters
  - building clusters



Object reconstruction 1







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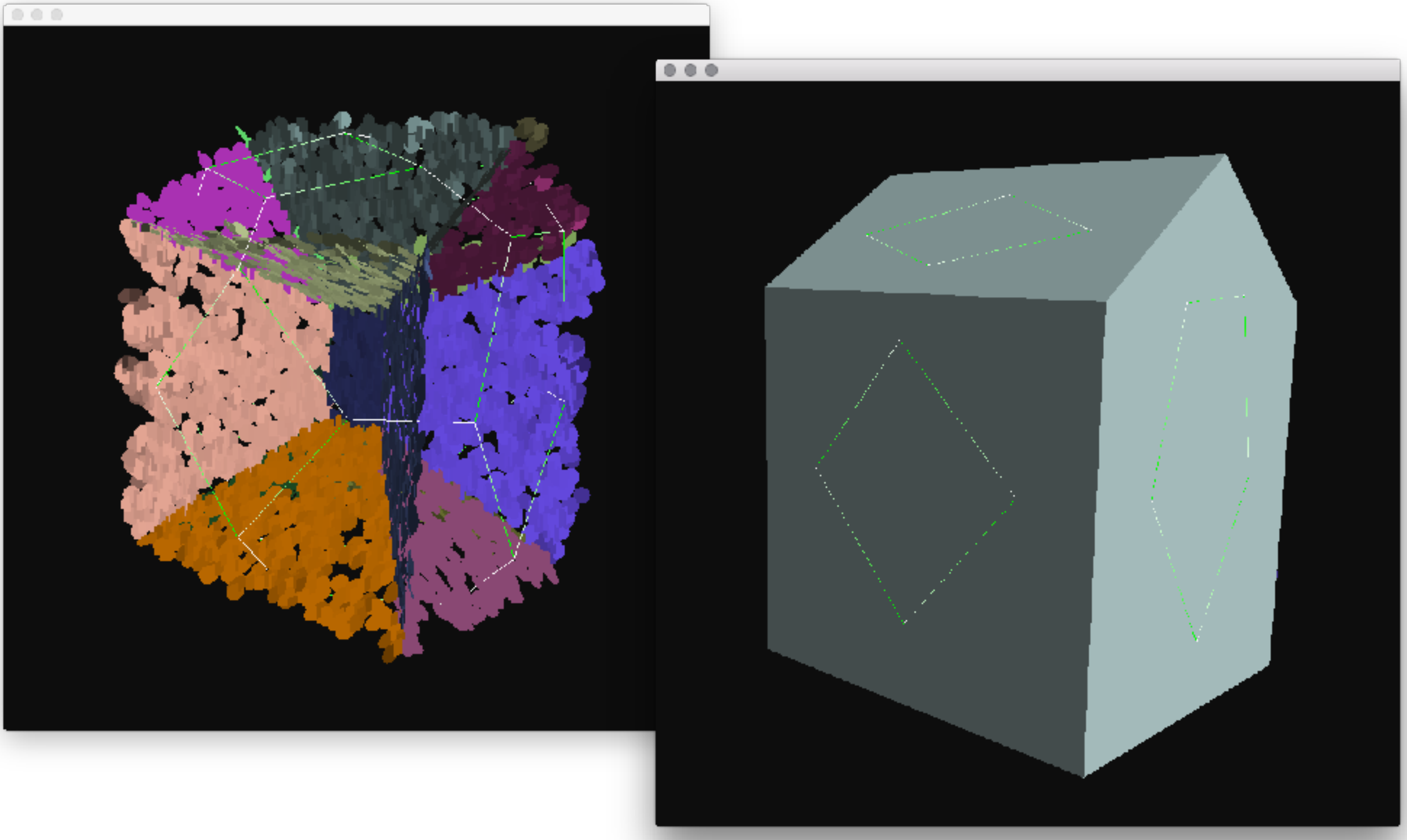
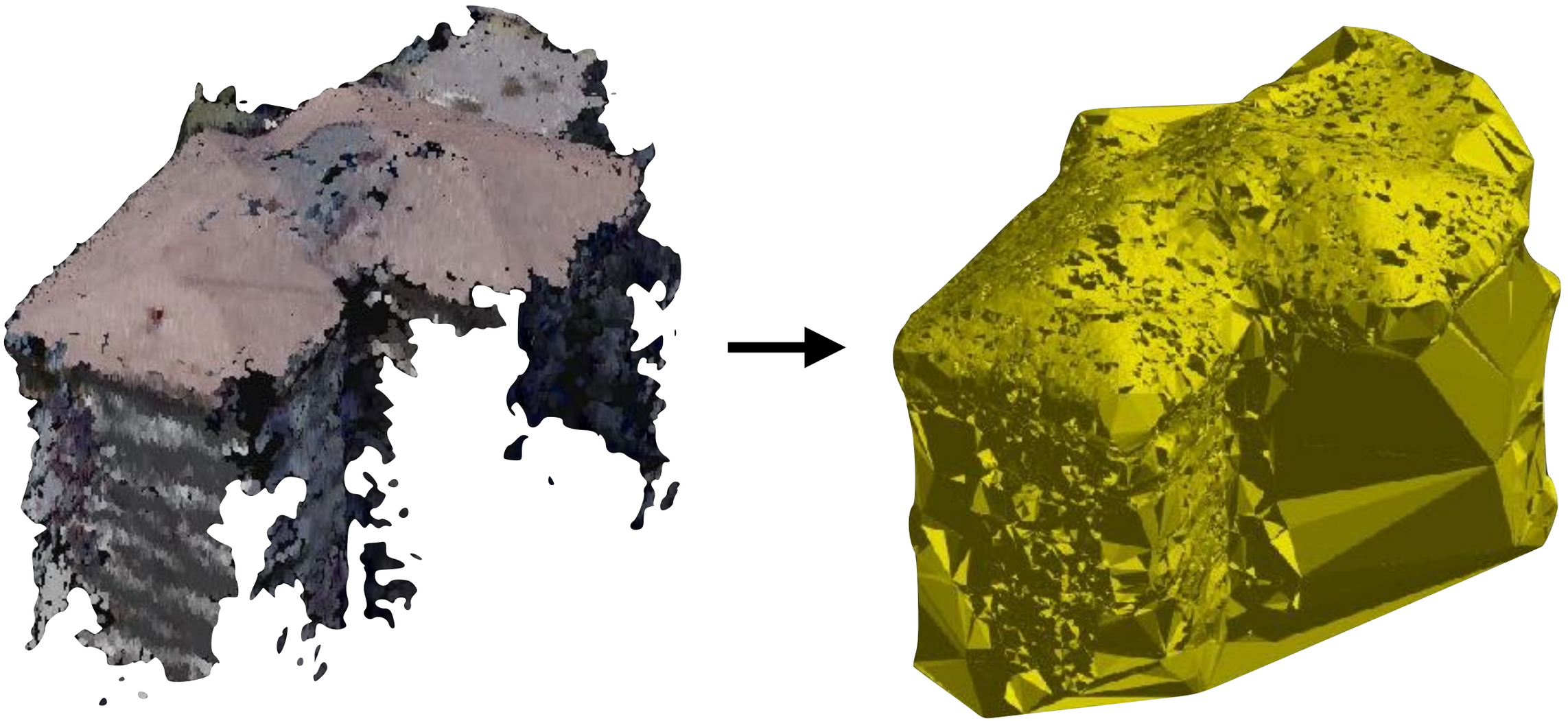


Object reconstruction 2

1. Tetrahedralise surface points + interior MAT points
2. only keep tetras with an interior MAT point



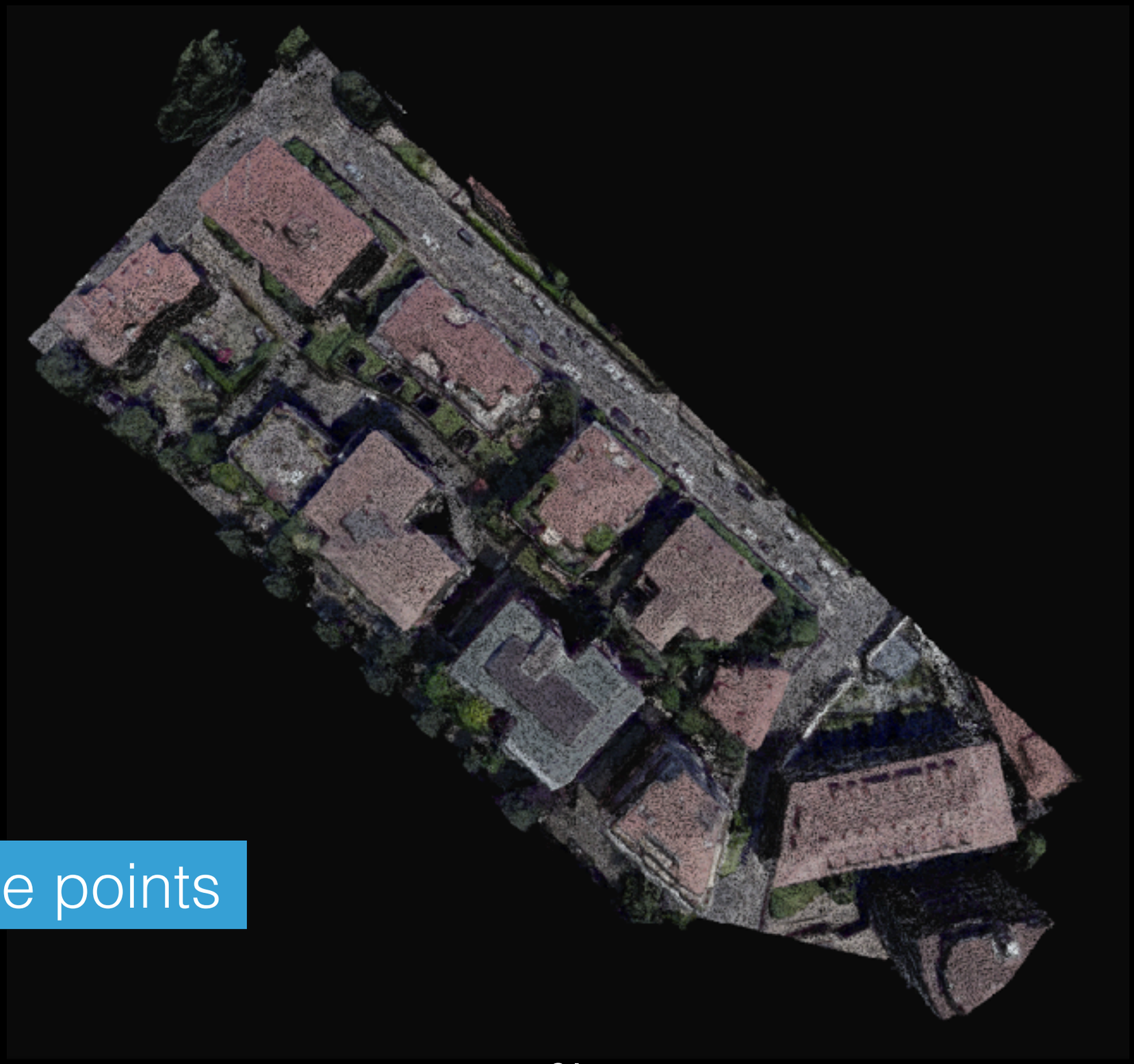
Demo

Structured MAT

Unstructured MAT

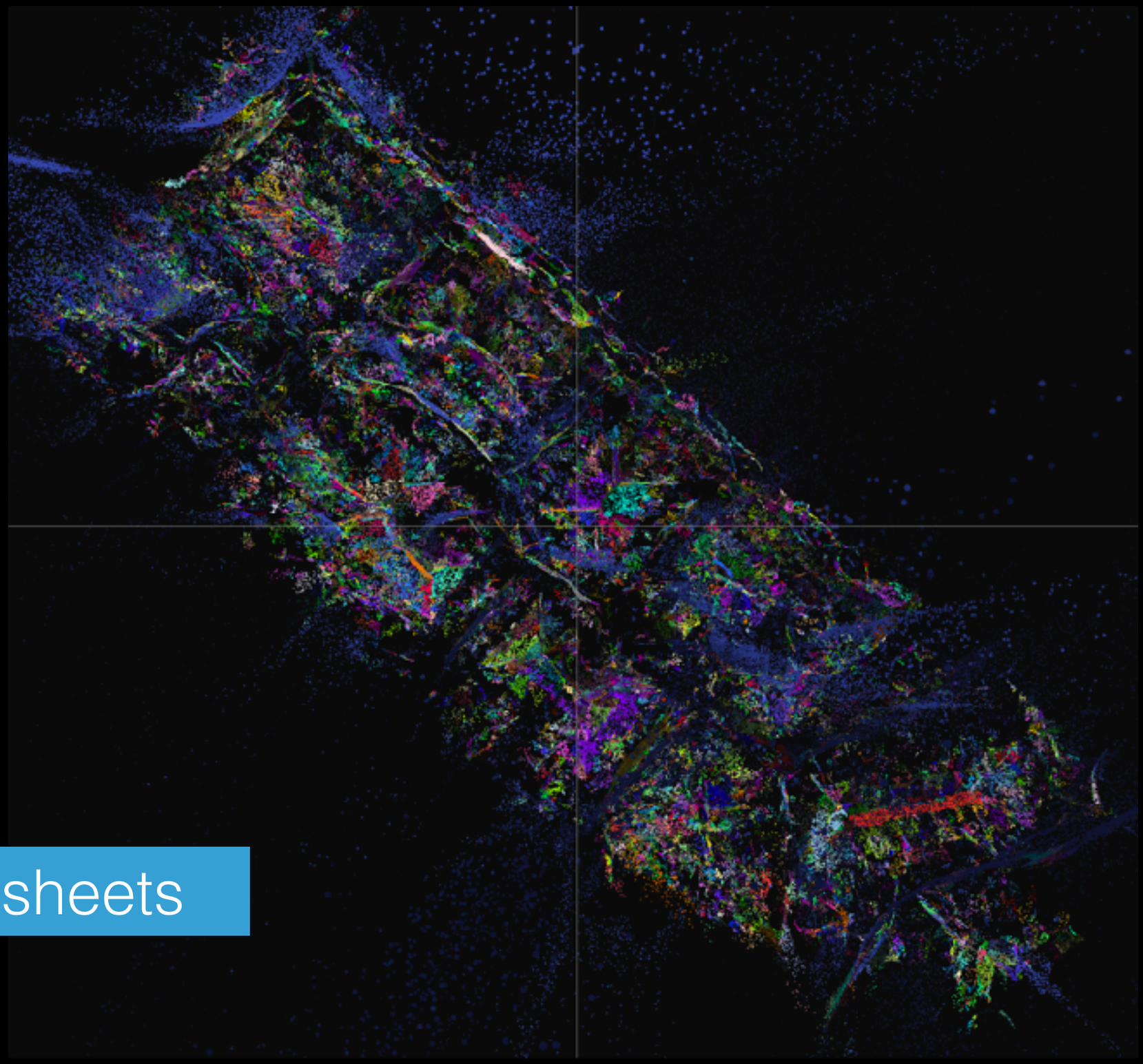
Object detection & classification

Building detection + classification



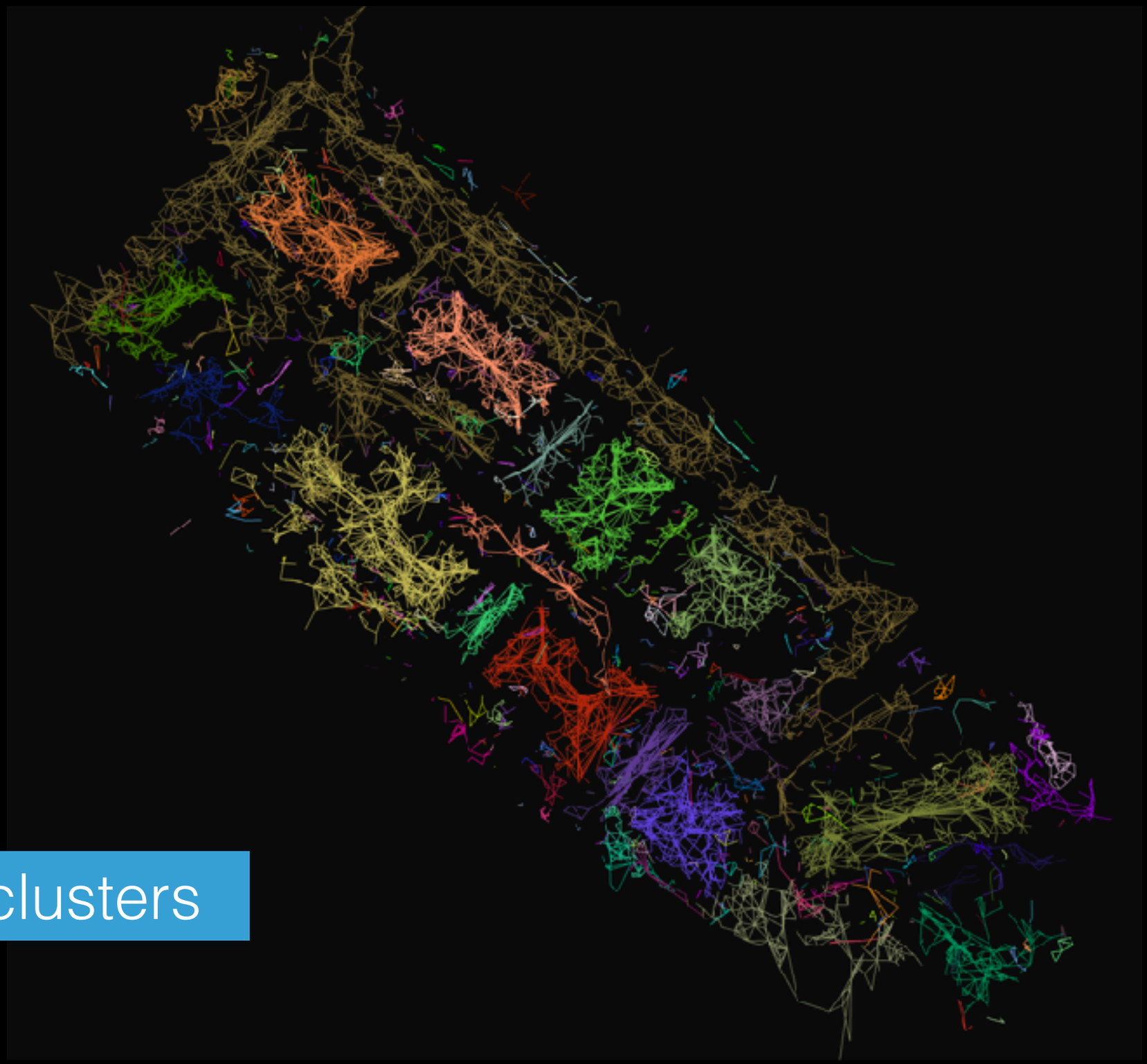
Surface points

Building detection + classification



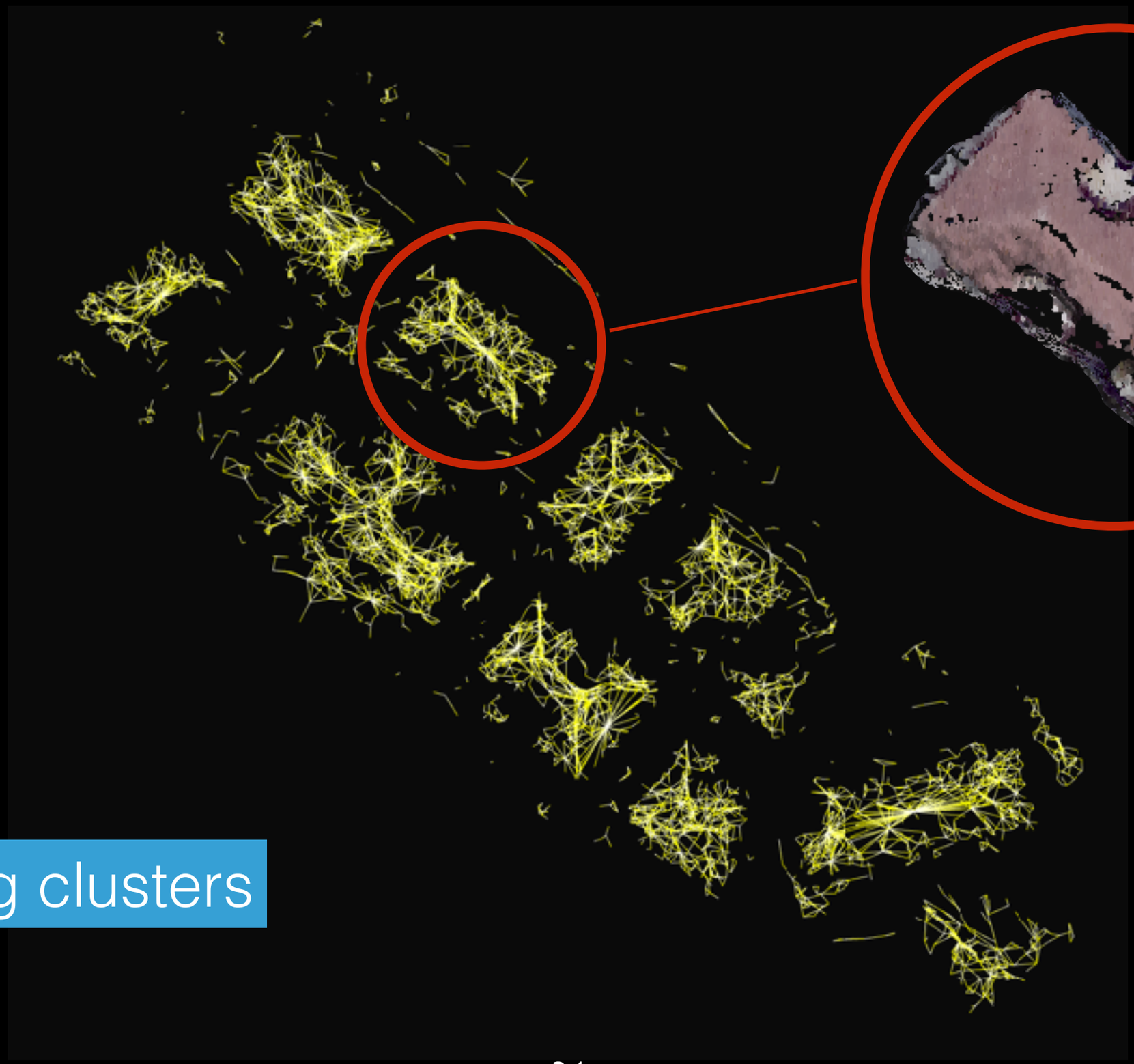
MAT sheets

Building detection + classification



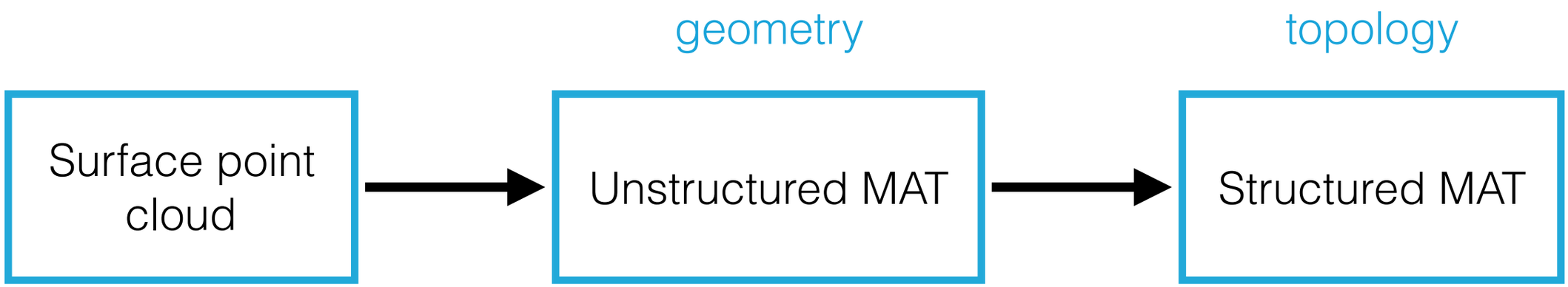
MAT clusters

Building detection + classification



Building clusters

Workflow



1. visibility
2. simplification
3. visualisation

1. detection
2. classification
3. reconstruction

Conclusions

- Yes, MAT is an effective tool for DSM point cloud modelling
  - both for LiDAR and dense matching clouds
- Most promising applications in structured MAT
  - object detection/classification/reconstruction

Future work

- further improve denoise heuristic
- object detection/classification
  - use e.g. machine Learning + additional data sources
- object reconstruction
  - using optimisation of 3D discrete arrangements
- unexplored small ideas:
  - normal improvement
  - breakline detection

Thank you!

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