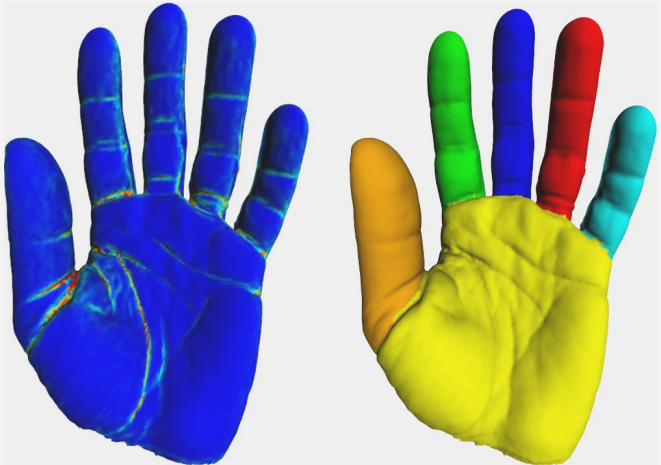
Can we segment objects without any prior?

It always seems impossible until it's done

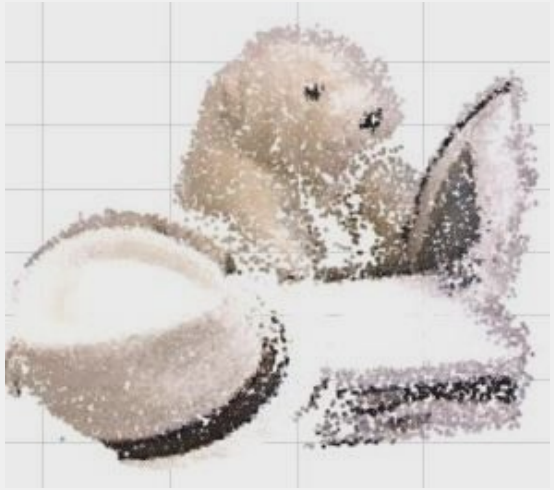
– Nelson Mandela



-Anton Mitrokhin and Chahat Deep Singh

Motivation

Why Segmentation?



- To find meaning in the image.
- Pixels are meaningless
- Extracting higher level features

Reconstructing 3D surfaces from different scans

- ICP: Iterative Closest Point (ICP)

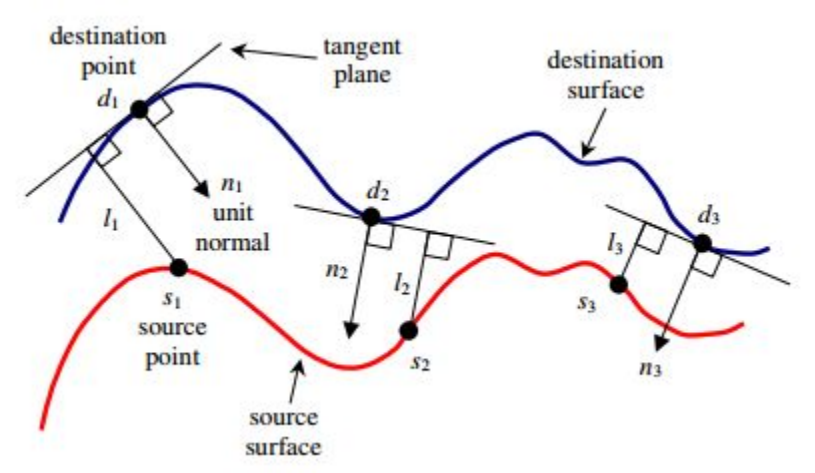
- $\textbf{min} \sum d_i$

- Minimize difference between two clouds

- Source frame is transformed to Target frame

- Local Optimization method

Linear Least Square Optimization for Point-to-Point ICP



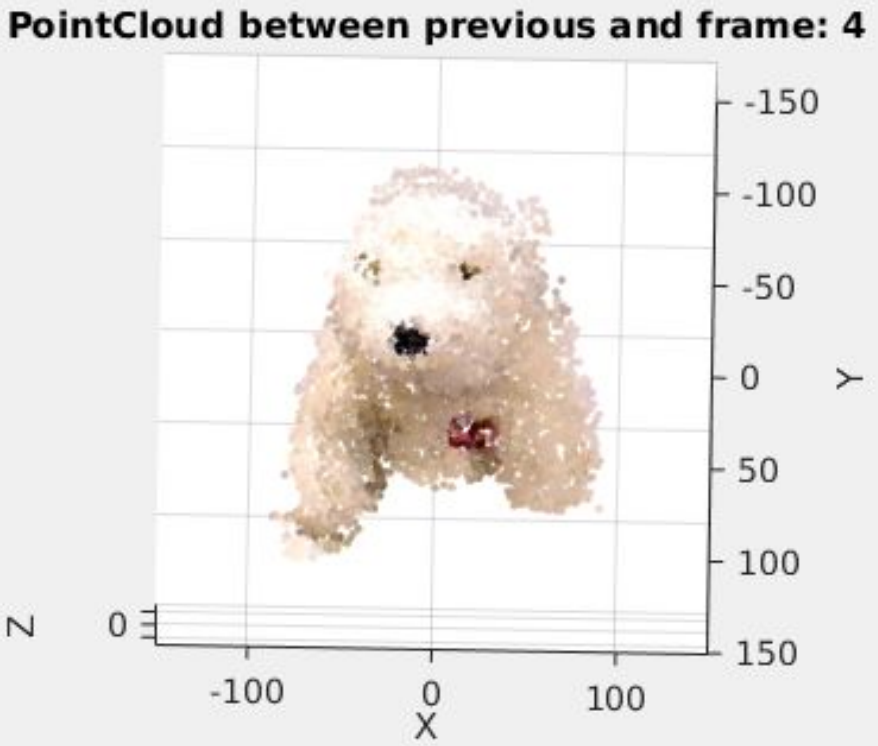
- Point-to-plane error metric converge much faster
- Over constrained Linear system

Assumptions:

- Relative Orientation is small *i.e. sin θ ≈ θ and cos θ ≈ 1.*
- Good approximation

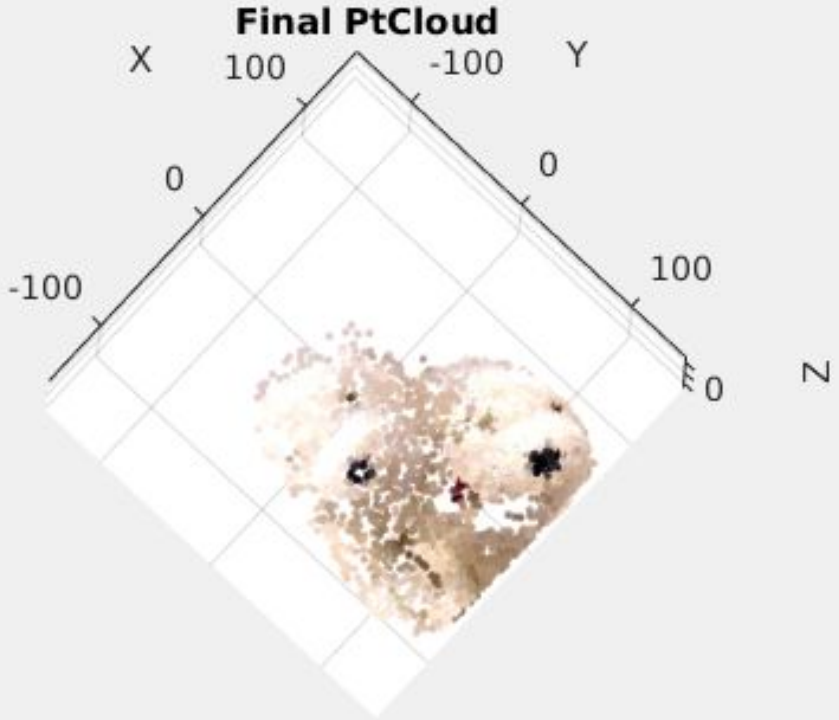
What if relative orientation is not small?

After ICP, you expect this→



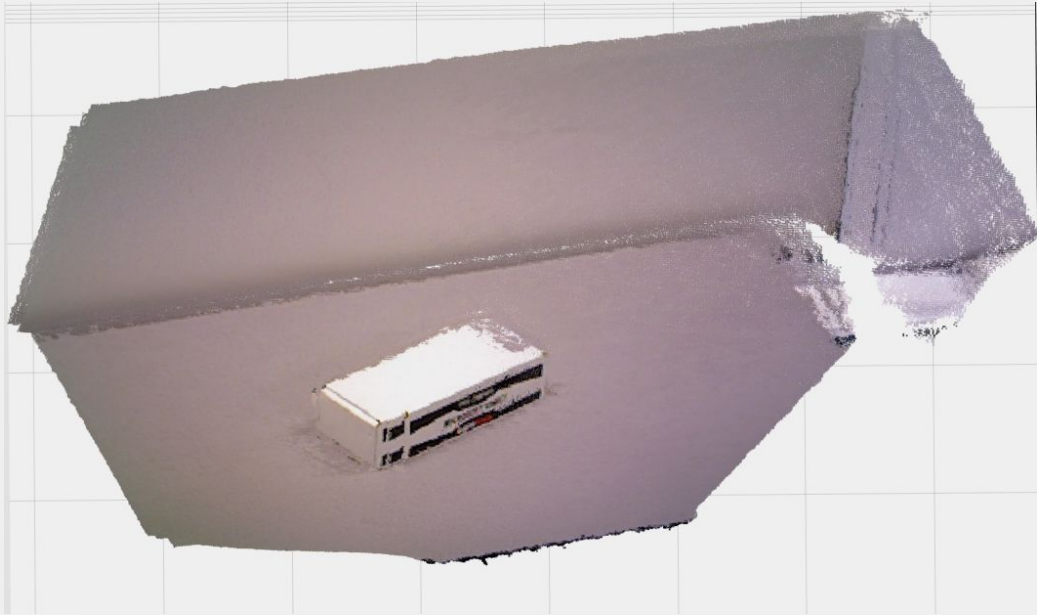
What if relative orientation is not small?

You get this →



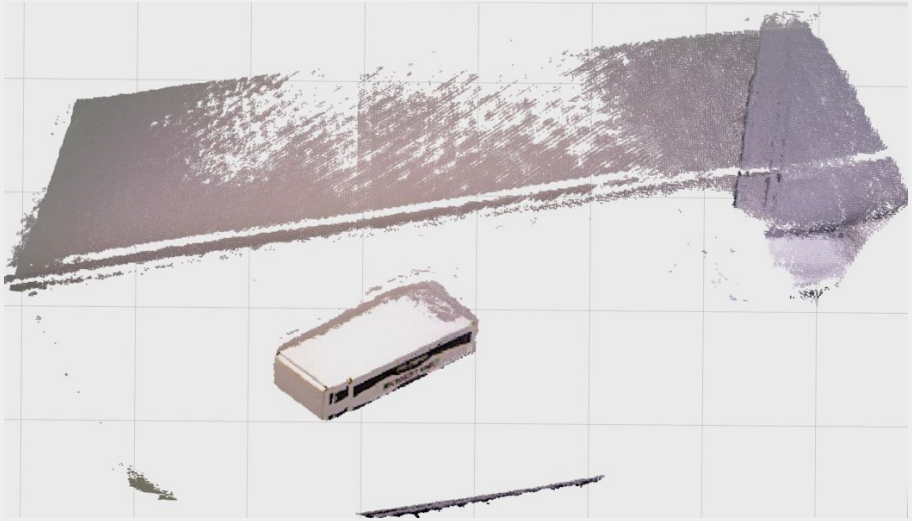
Voila! There is a two headed bear in your apartment!

ICP Results:



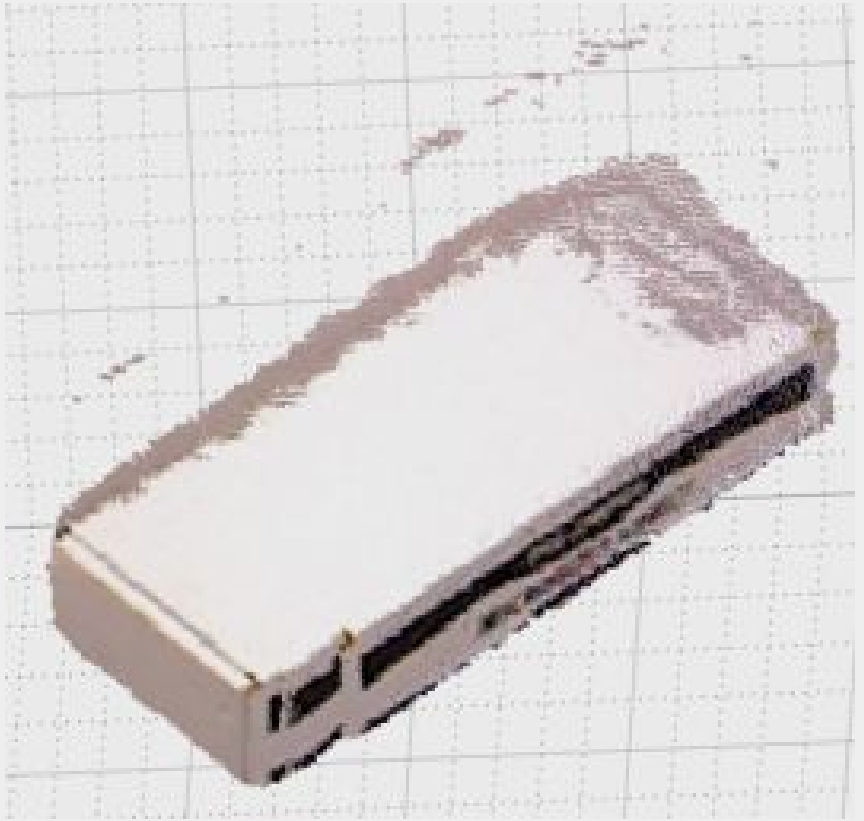
ICP Results:

Detecting Planes



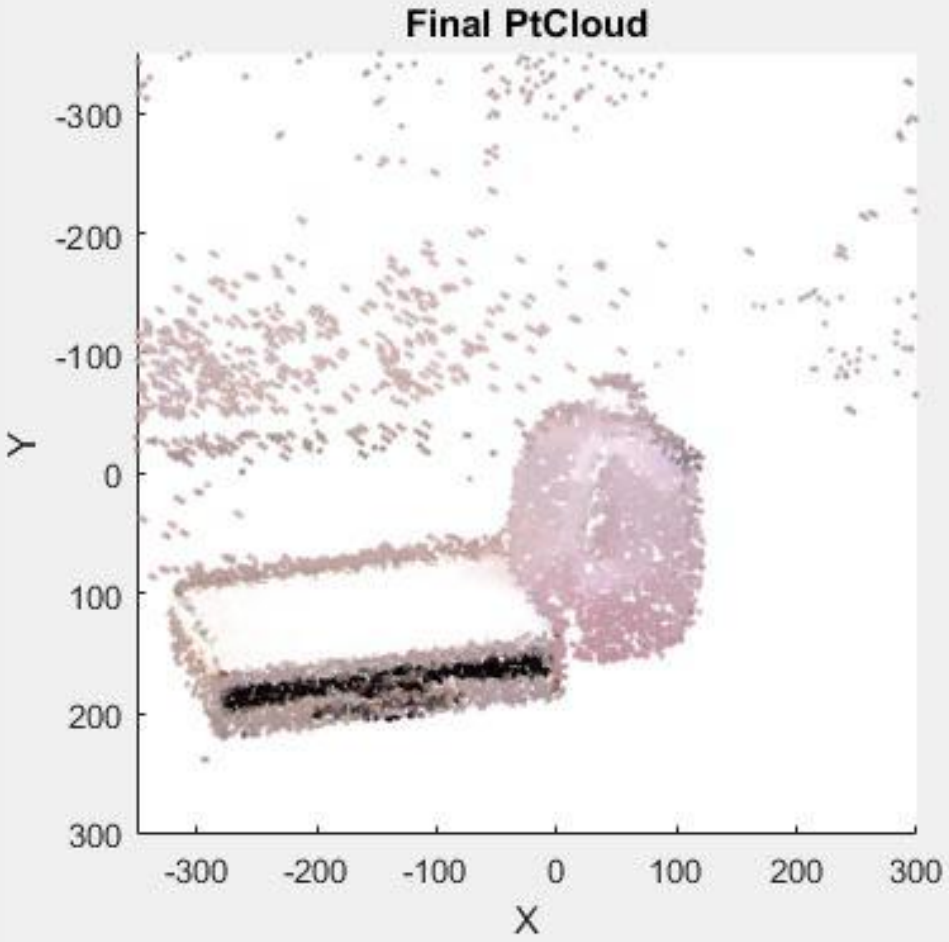
ICP Results:

Detecting Planes



ICP Results:

How to remove the noise nearby?

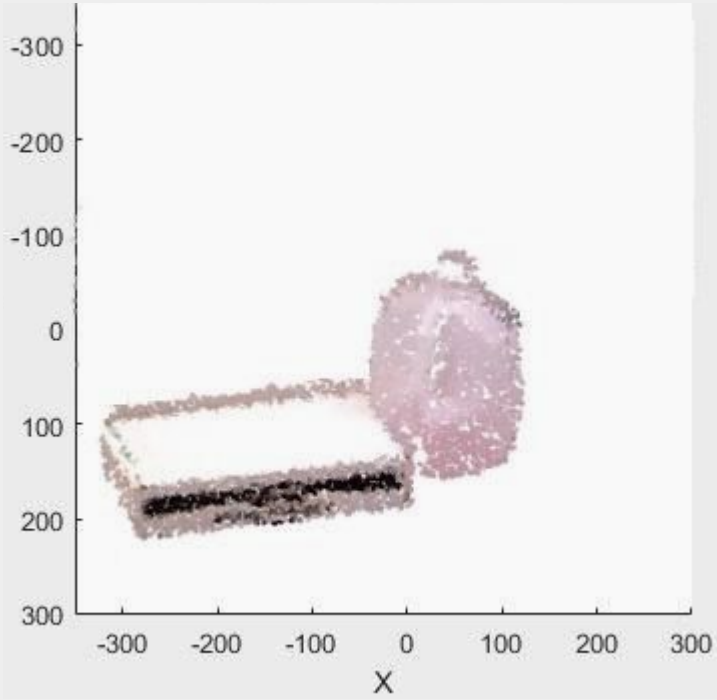


ICP Results:

Point Cloud Density!

if $\rho_{idx} < threshold$

$PtCloud(idx) = 0$



Segmentation

2D or 3D?

- How to choose?
- Should we use 2D segmentation?
- If we don’t have frames?
- Only have 3D reconstruction

Segmentation

2D?

Common Methods:

- HOG Features
- Bag of Visual Words
- Textons (building block of vision)
- K-means
- Graph-Based
- SVMs
- MRF/ CRF
- and of course….

DEEP LEARNING

Segmentation

2D?

- Using any of the methods,
  i) Segment in 2D
  ii) Reconstruct the segmented region in 3D

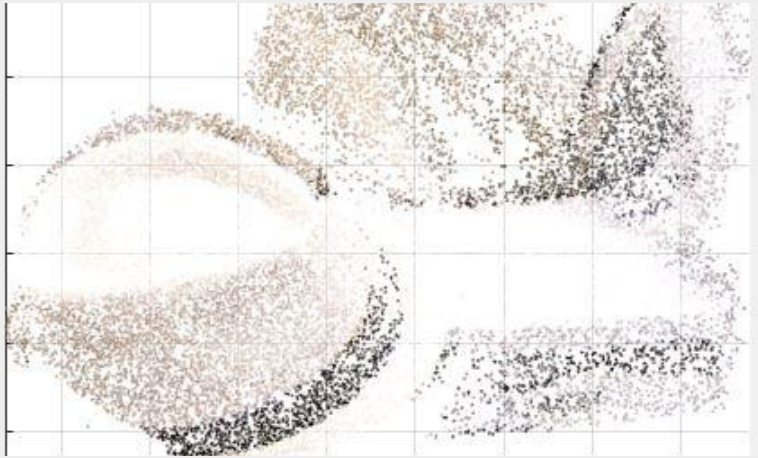
Segmentation

3D?

-Depth Discrepancy between two objects

Segmentation

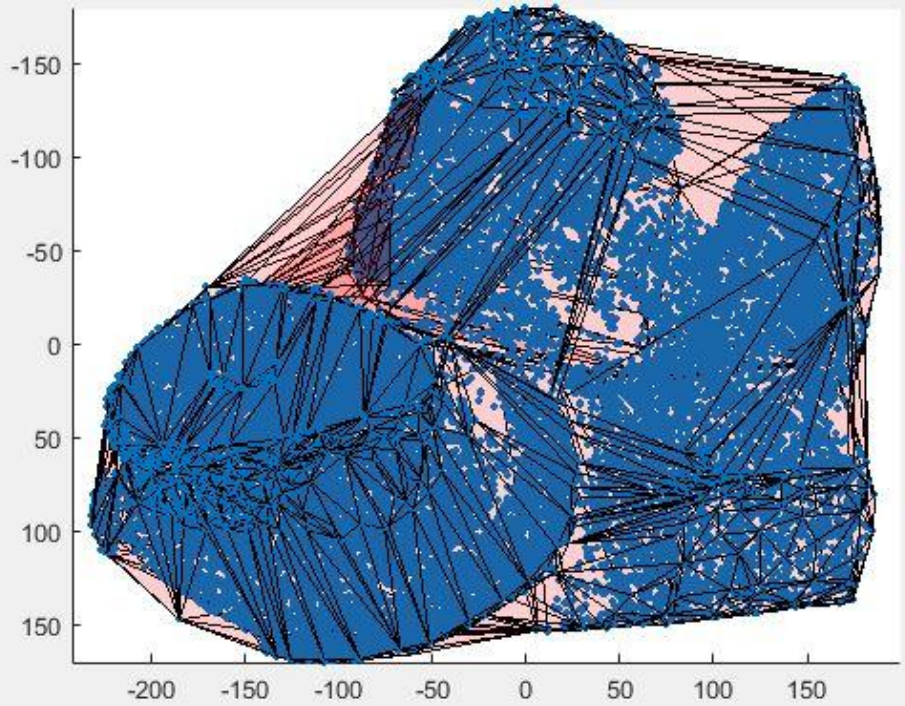
3D?



-Depth Discrepancy between two objects

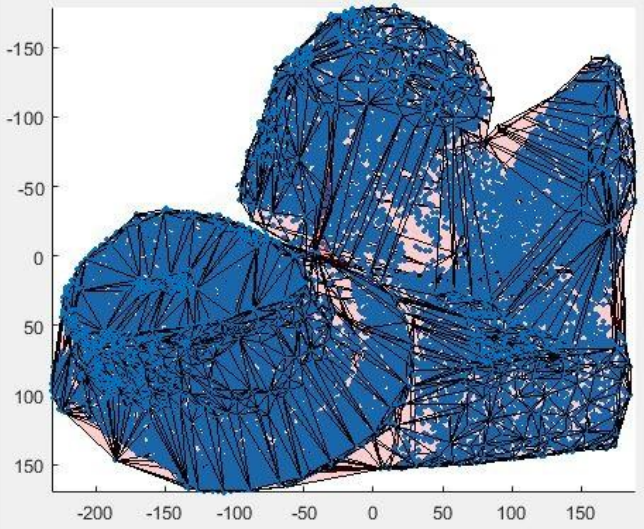
Method 2

Convex Hull

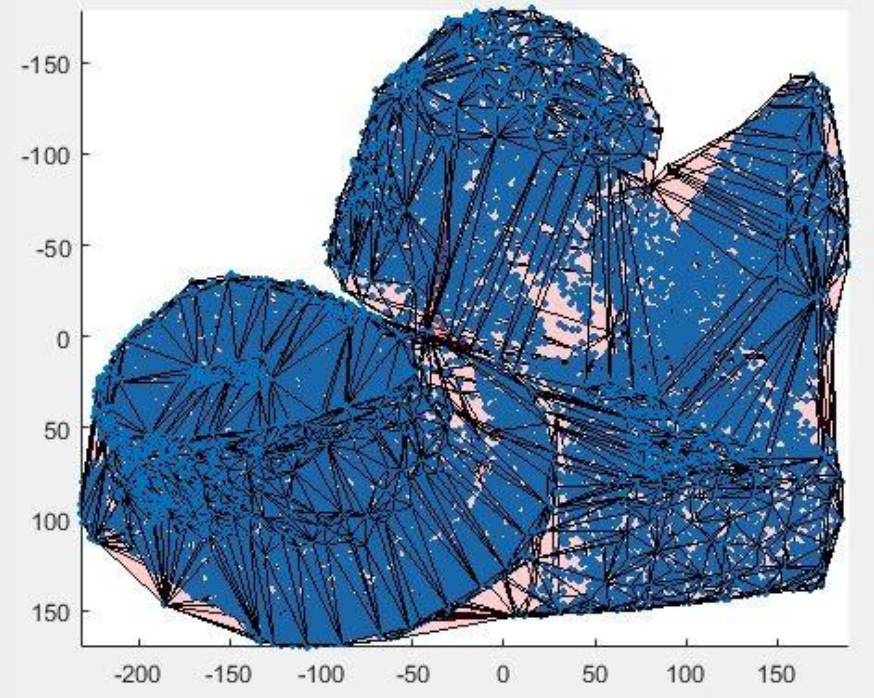


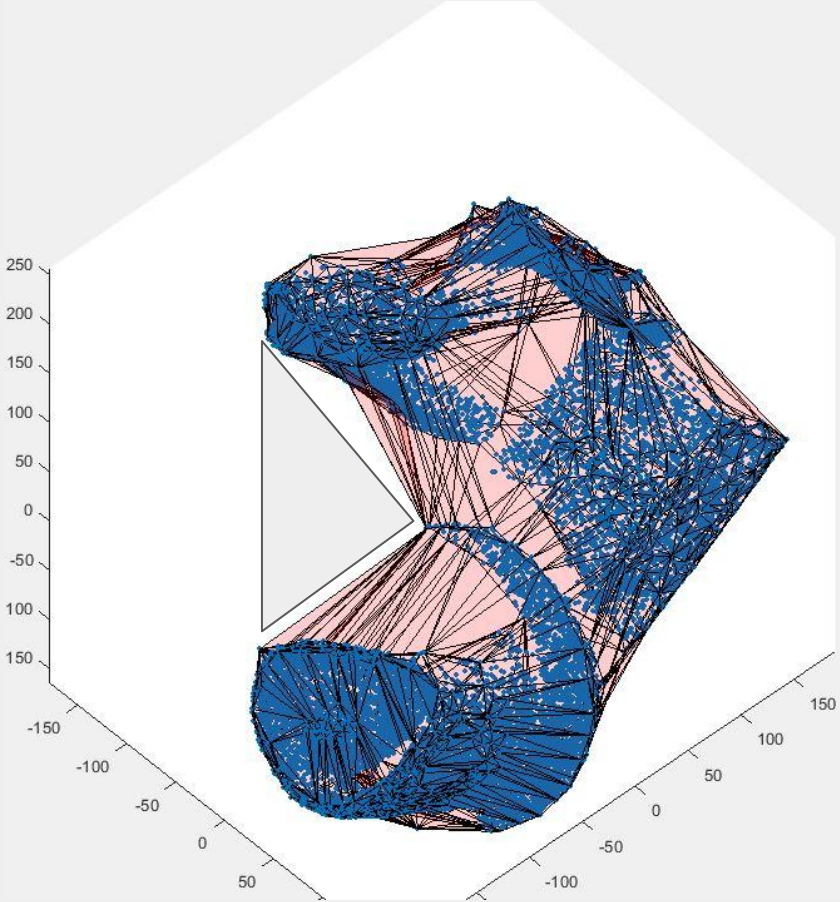
Now, take draw a boundary:

triangulation with
edge_length < threshold



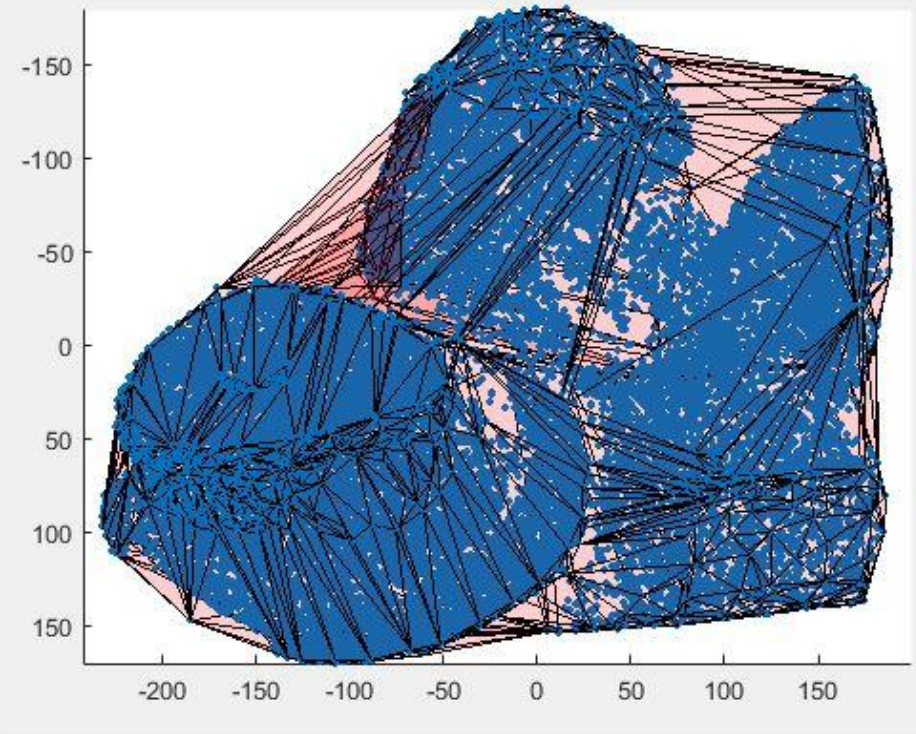
Convex - Hull


-150
-100
-50
0
50
100
150
-200
-150
-100
-50
0
50
100
150


250
200
150
100
50
0
-50
100
150
-150
-100
-50
0
50
150
100
50
0
-50
-100

Method 3

Go-ICP or Multi-scale EM-ICP



- Scale Invariant
- ICP between Single and Multi Object scene !
- Find the similarity between single and objects in multiple scene!

Semantic Mapping:

- Based on Size:
  - Total number of pixels of each object
  - Which has has the maximum volume?
- Dominating colors?
- Which object can fit the Sphere of maximum radius?
- Given the complete structure of each object, one can ask **WHICH Object is tilted the most w.r.t the table**??

-Based on look-up table.

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733 ROCKS !!!!

Any questions?

THANK YOU