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# Shape Completion with Prediction of Uncertain Regions

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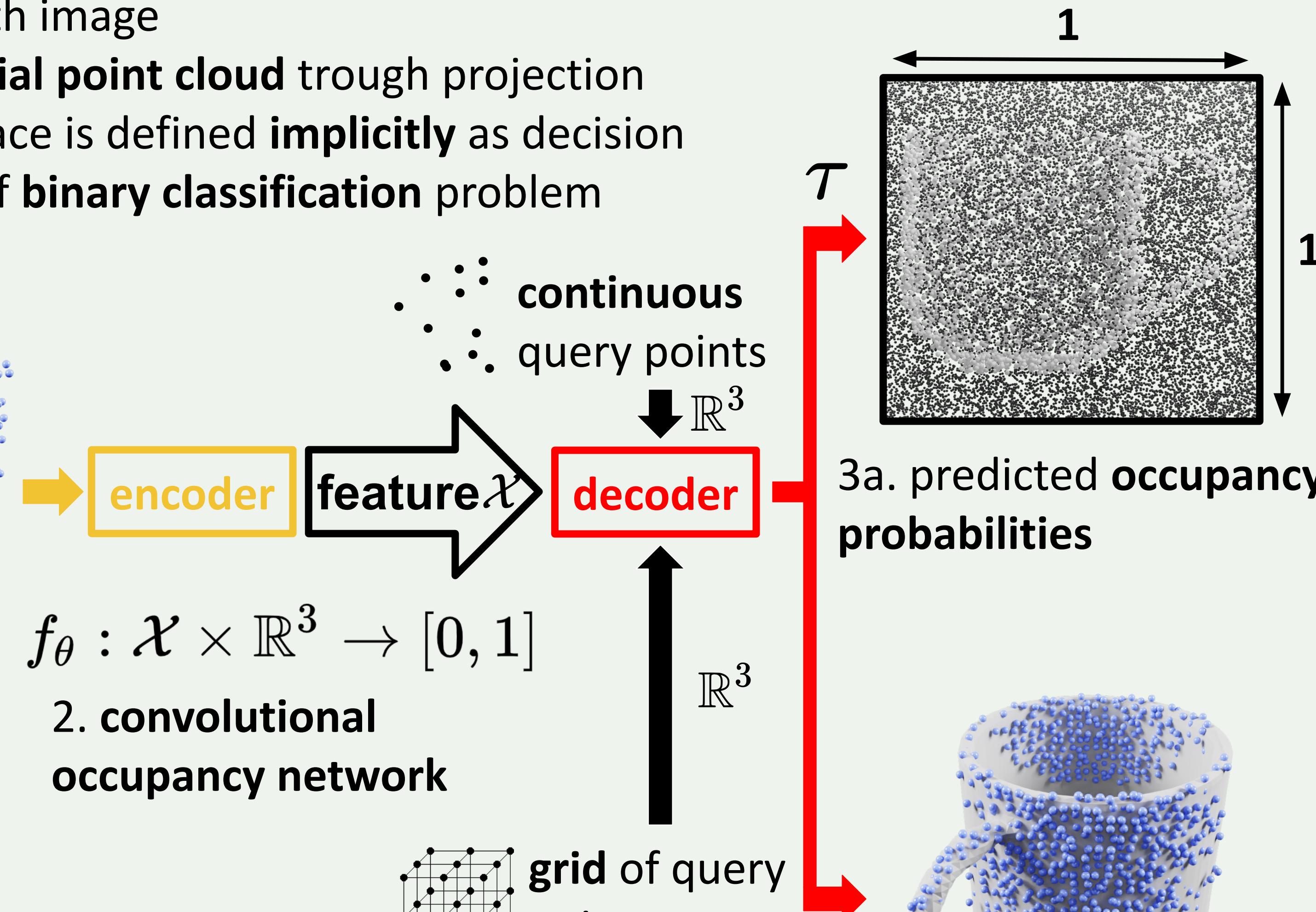
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## Shape Completion

- Prediction of full 3D geometry from a single (noisy) depth image
- Obtain **partial point cloud** through projection
- Object surface is defined **implicitly** as decision boundary of **binary classification** problem

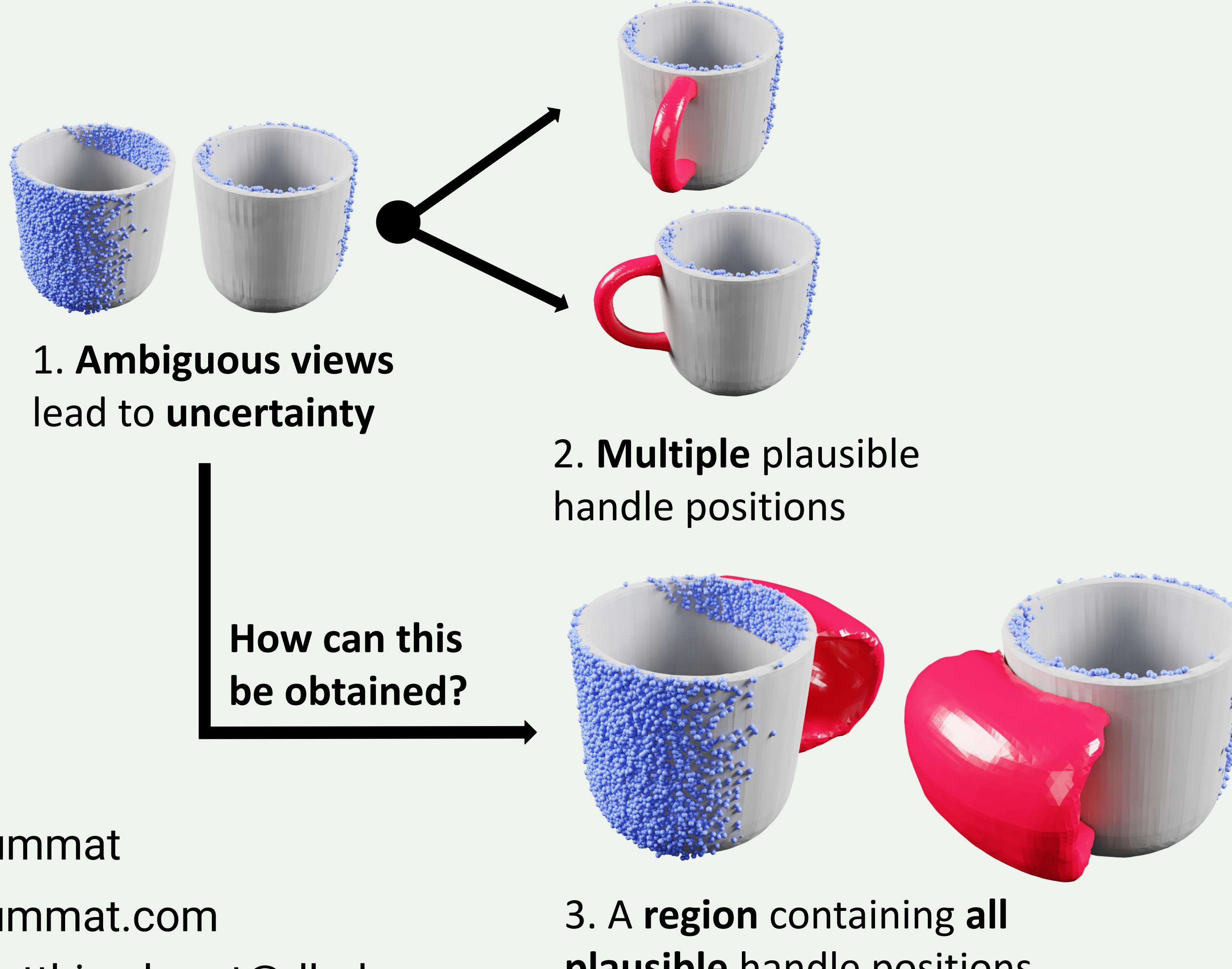


1. point cloud  
(simulation)



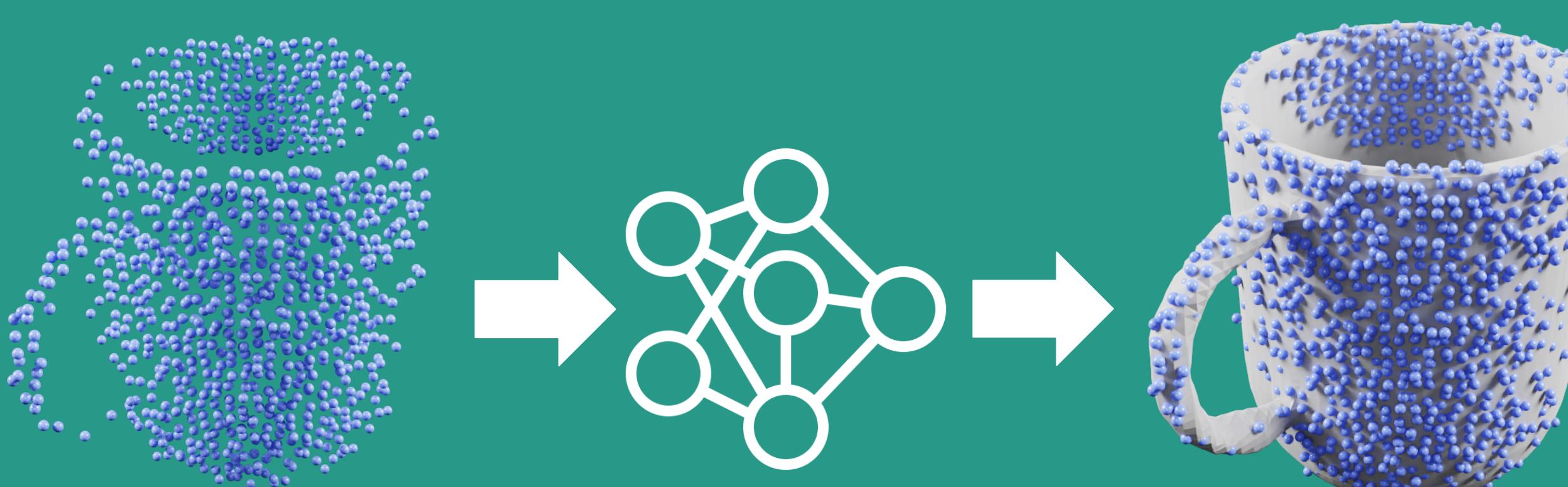
[1] Mescheder et al.: Occupancy Networks: Learning 3D Reconstruction in Function Space  
[2] Peng et al.: Convolutional Occupancy Networks

## Uncertain Regions



## Overview

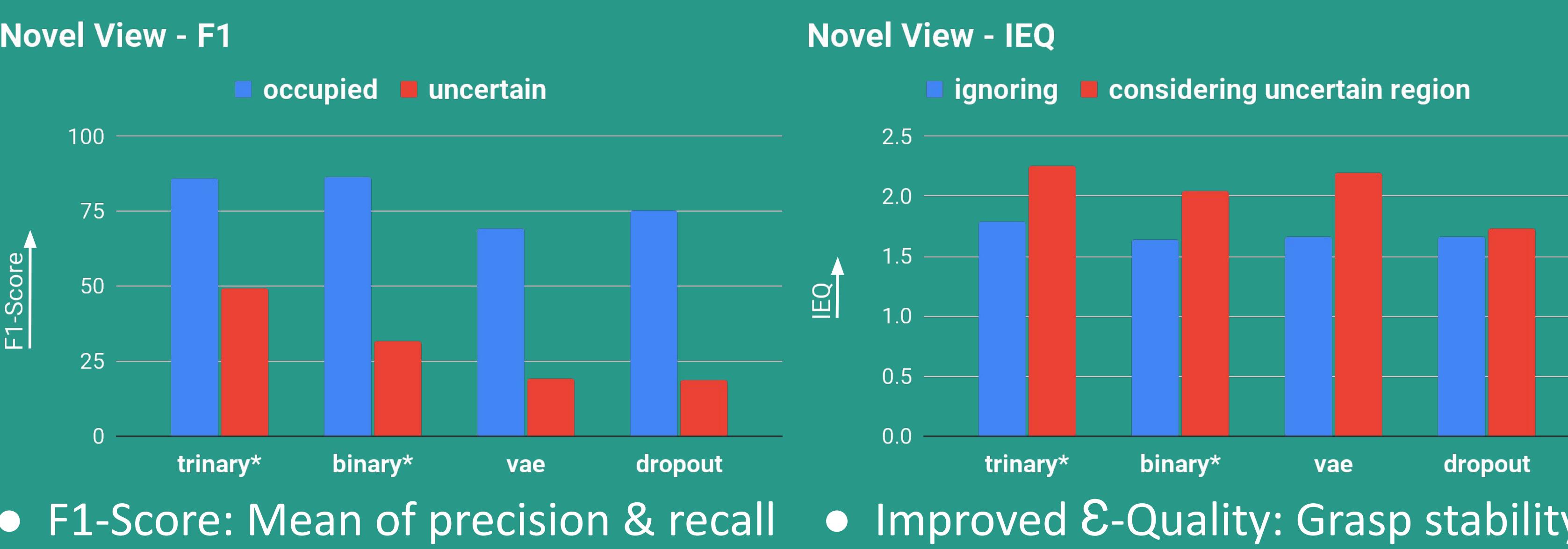
### A Shape Completion



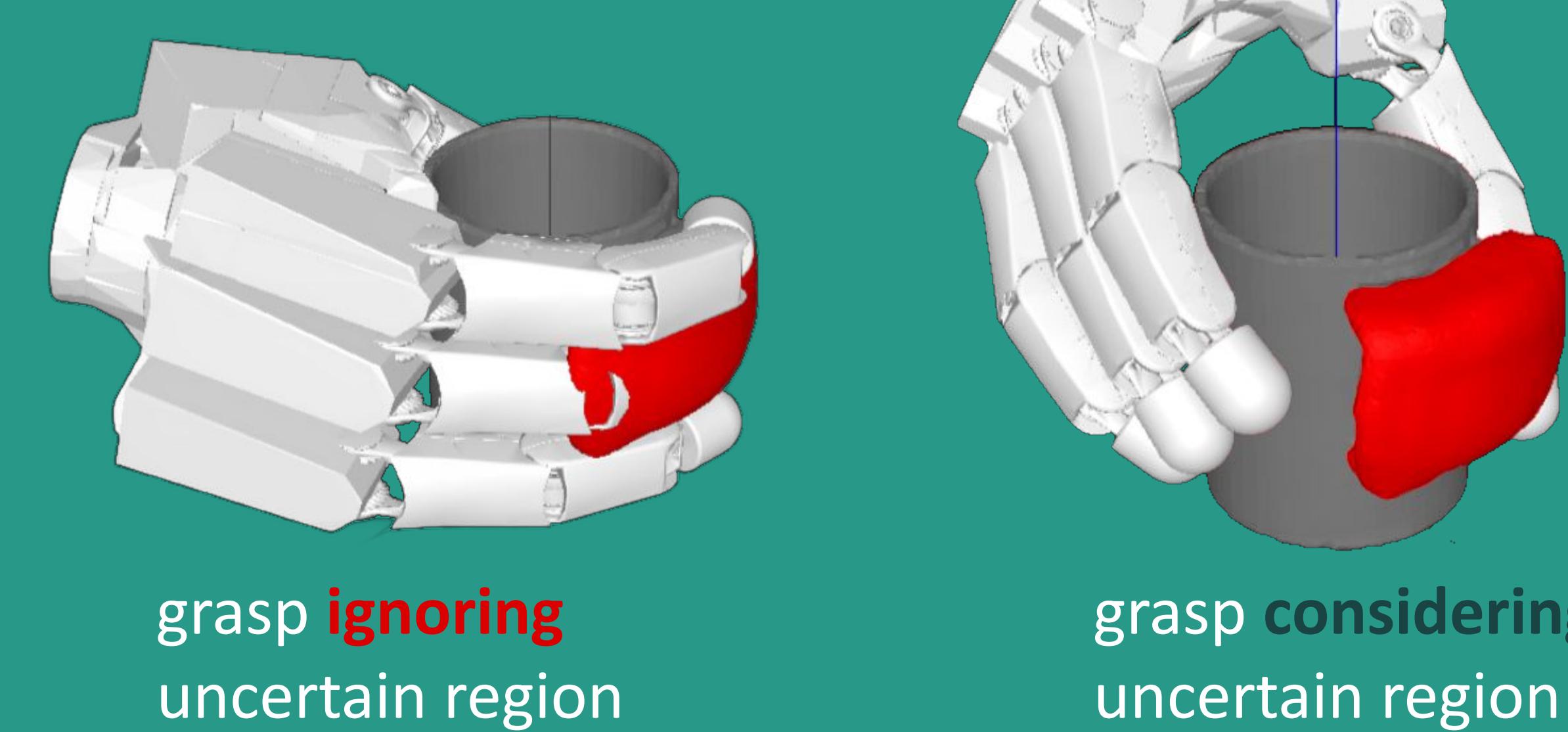
### B Prediction of Uncertain Regions



### C Results



### D Downstream Applications



## Approach 1: Gradient

### 1 Additional threshold

- Naively adding an additional threshold blocks occupied space

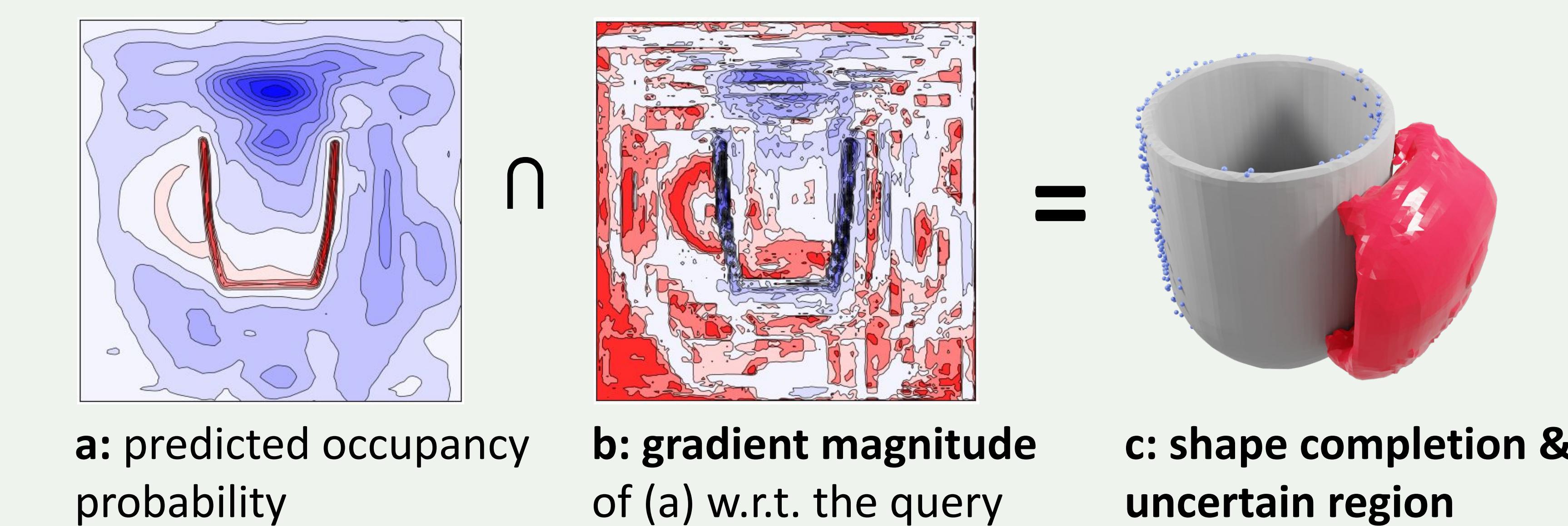
ground truth

predicted occupied  
 $\tau_{\text{occ}} = 0.5$

predicted uncertain  
 $\tau_{\text{min}} < \tau \leq \tau_{\text{max}}$

### 2 With gradient thresholding

- Uncertain region as intersection of occupancy at low certainty and magnitude of the gradient of predicted occupancy probability



$$\forall q \in \mathcal{Q} : \|\nabla_q \sum_{i=1}^N \hat{y}_i\| < \frac{1}{|\mathcal{Q}|} \sum_{q \in \mathcal{Q}} \|\nabla_q \sum_{i=1}^N \hat{y}_i\|$$

## Approach 2: Third Label

- Transform problem from **binary** to **trinary** classification
- Extract ground truth **labels** through **similarity measure** of **multiple views** from different **object orientations**

