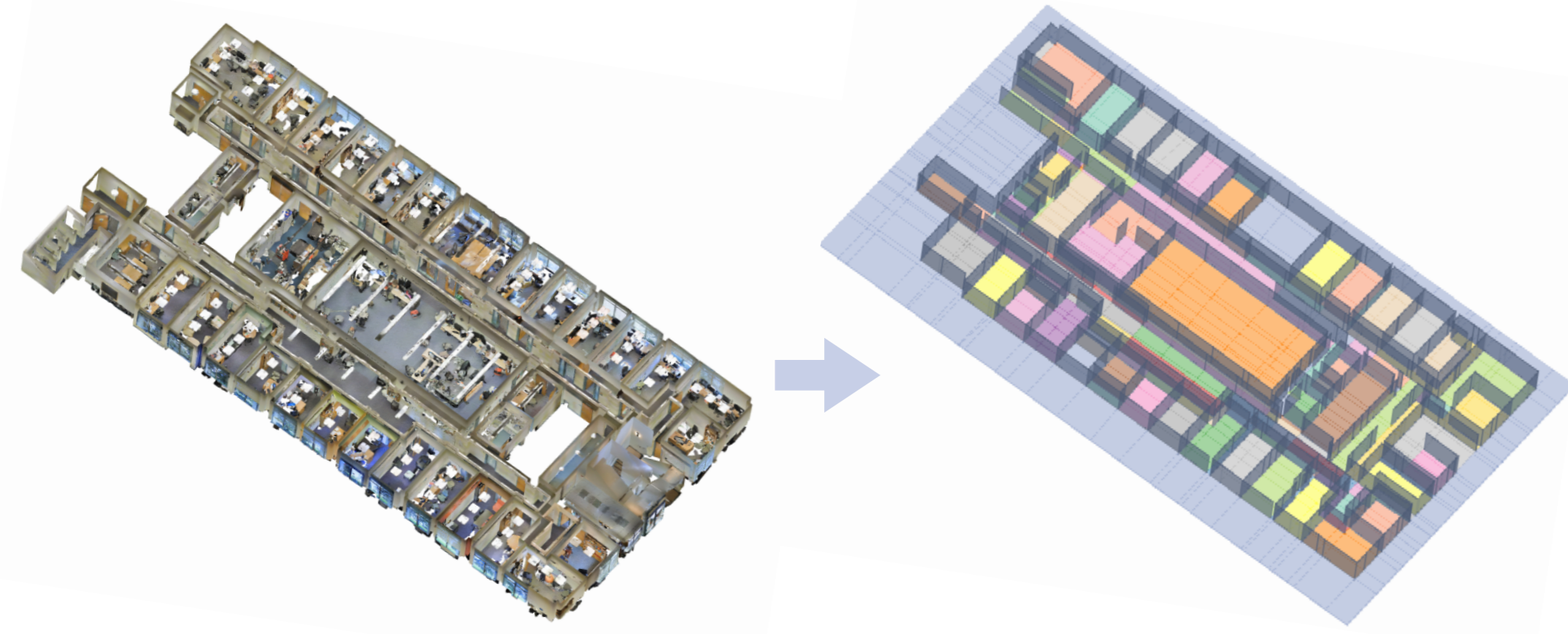


The problem

Given in input a scanned point cloud of an interior environment the aim is to automatically reconstruct its primary facility surfaces – such as floors, walls, and ceilings.



This is an essential preparatory step in many *scan2bim* applications and translates in the robust extraction of multiple planes or lines – from 3D point cloud or projected 2D points respectively.

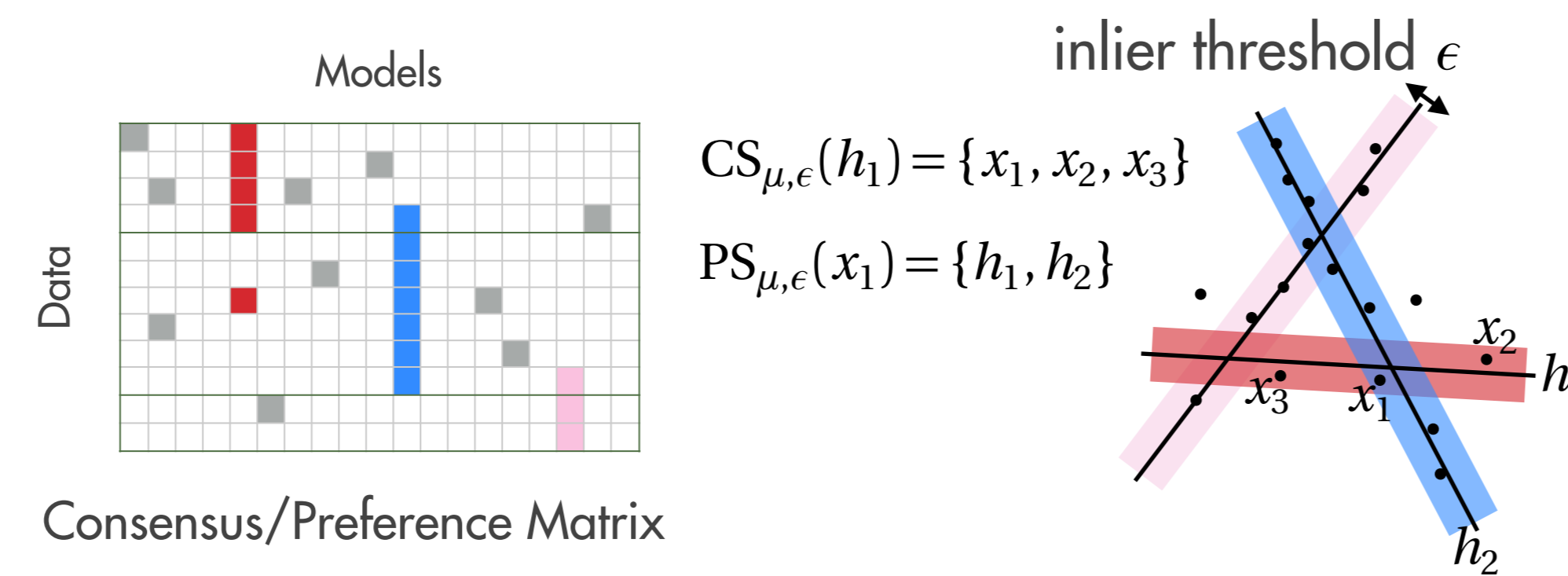
Challenges



J-linkage

Represents data as preferences granted to a set of random provisional models.

Clusters of points belonging to the same model are constructed in the preference space in a bottom-up fashion by linkage clustering using the Jaccard distance between preference sets.



- The preference set of a cluster is the intersection of the preference sets of the points belonging to it
- At each step clusters with the closest Jaccard distance are merged
- Clusters are merged until their preference set are disjoint

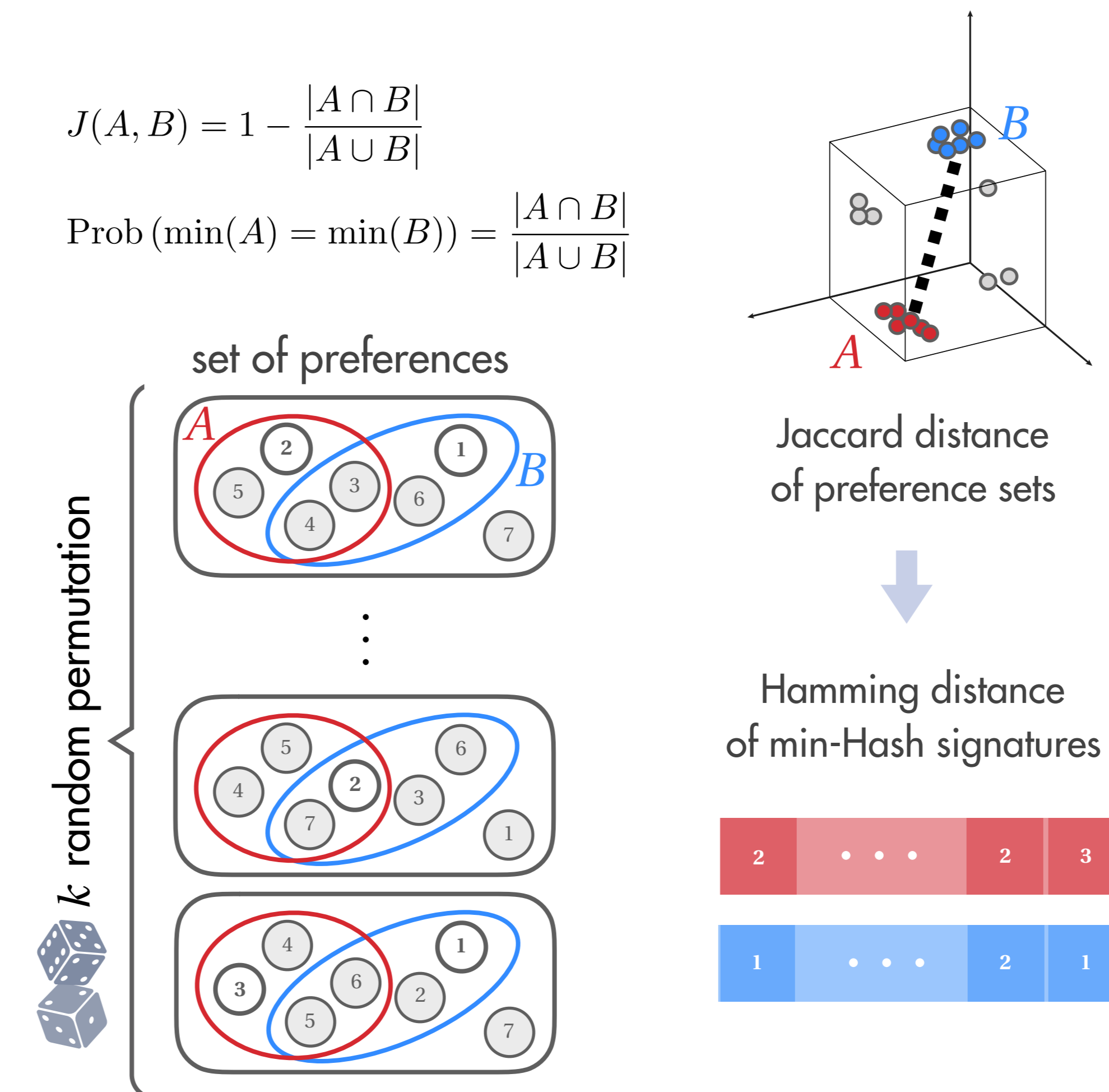
The number of structures is automatically estimated, the main input parameter, the inlier threshold, is an educated guess naturally related to the desired model resolution.

Min-Hash

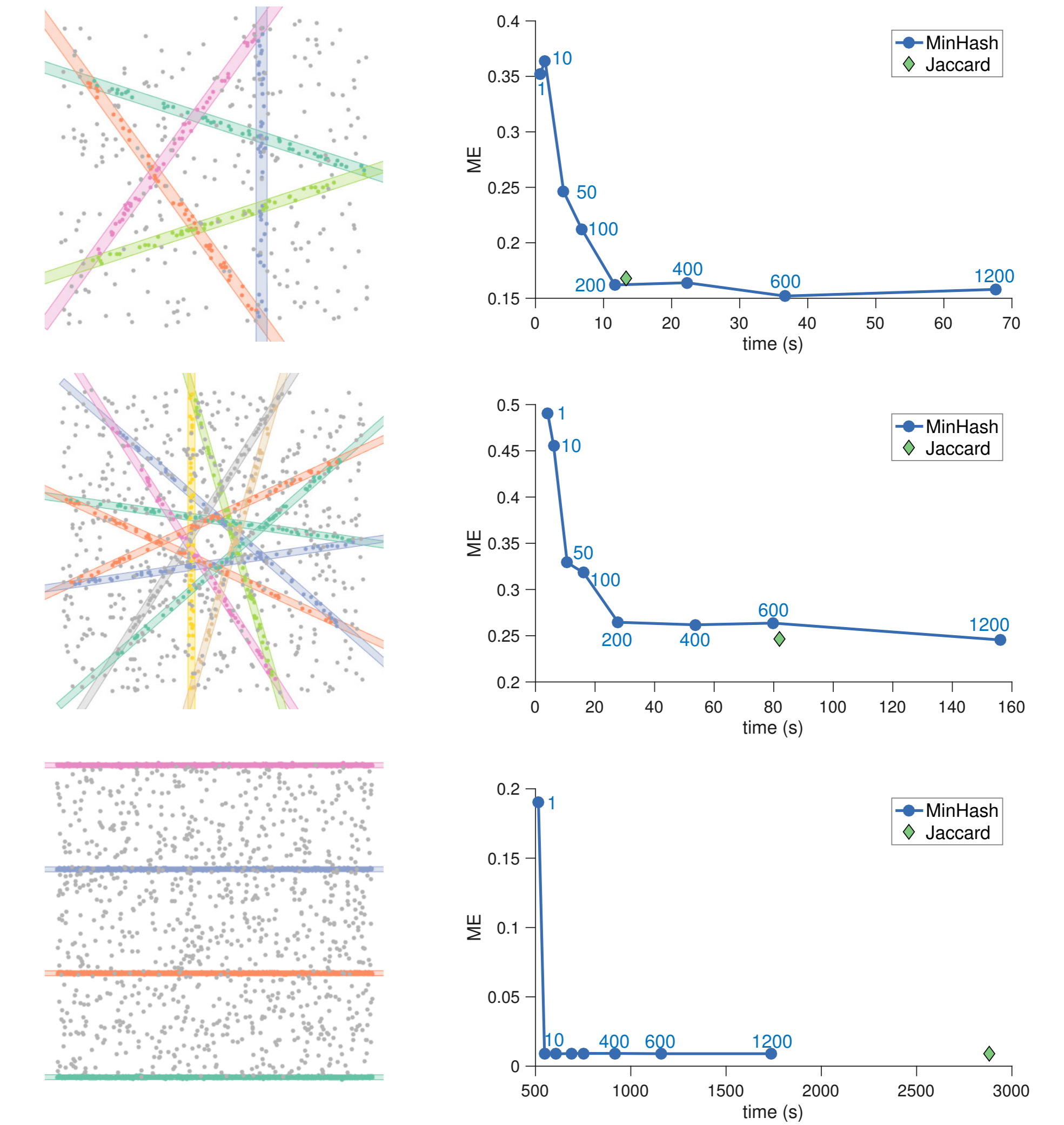
To speed up the computation and to tackle large dataset we use a min-hash scheme to approximate the Jaccard distance without impacting accuracy.

$$J(A, B) = 1 - \frac{|A \cap B|}{|A \cup B|}$$

$$\text{Prob}(\min(A) = \min(B)) = \frac{|A \cap B|}{|A \cup B|}$$



Sample results



Wall reconstruction

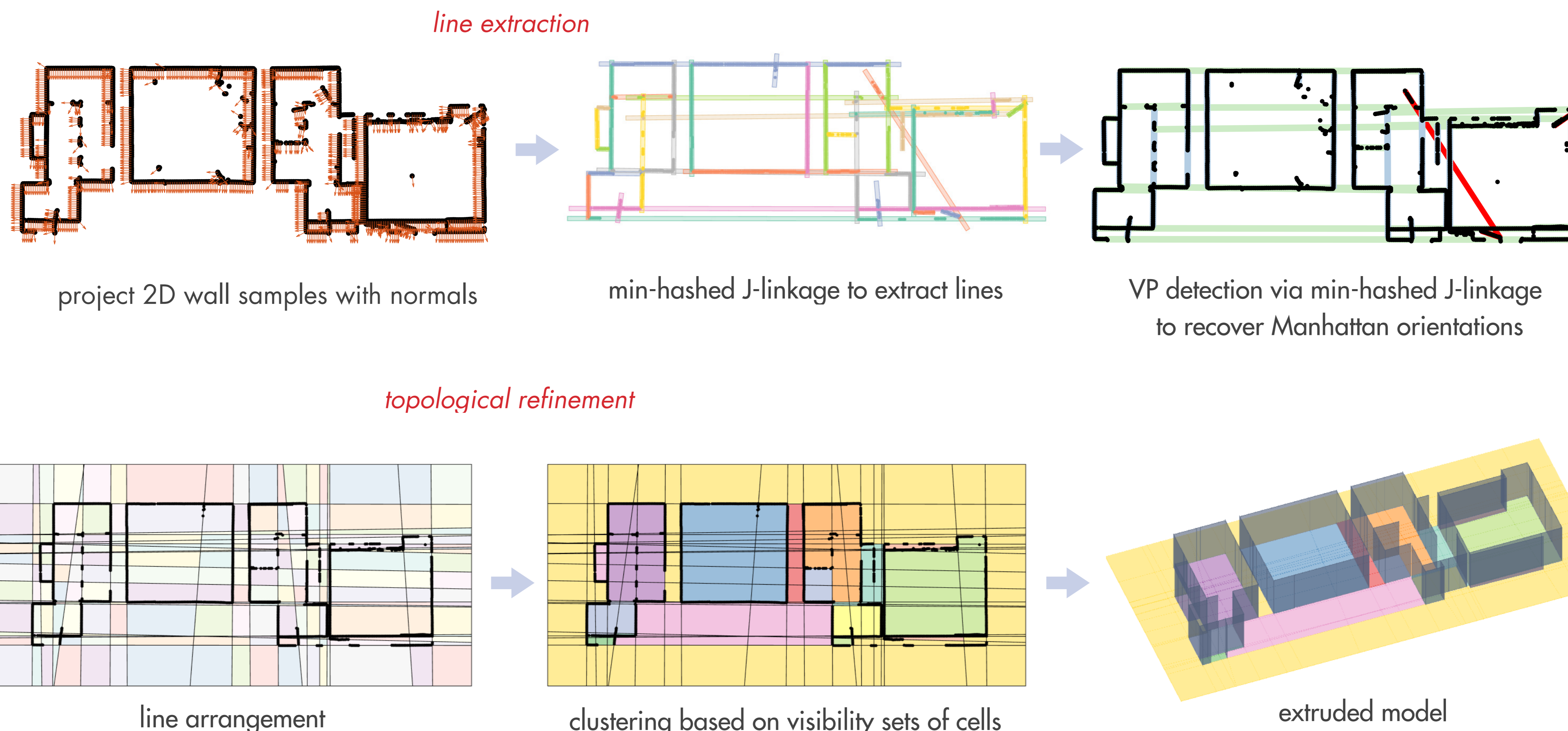


Line extraction: 2D wall samples are identified, then min-hashed J-linkage robustly recovers the main lines.

As a preliminary pruning, those lines that are supported by few wall samples, and the ones that do not conform to the Manhattan Word assumption are rejected as outliers.

Topological refinement: subsets of faces that are adjacent and, at the same time, “see” a consistent extent of common walls, are grouped through a min-hashed single-linkage clustering based on visibility.

Segments that separate cells belonging to distinct clustered regions are retained as dominant walls.



Vanishing point estimation York Urban DB

	Jaccard	min-Hash
ME [%]	mean 2.83	2.83
	median 1.58	1.58
time [s]	mean 0.90	0.15

