

High Quality Pose Estimation by Aligning Multiple Scans to a Latent Map

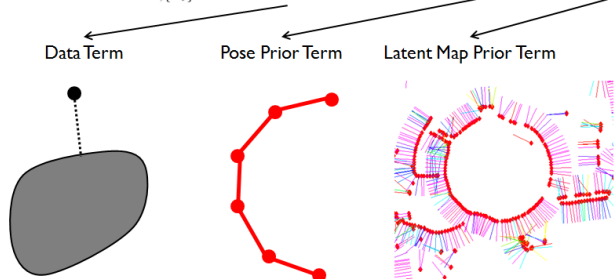
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Latent Map Based Registration

$$M^*, \{T_i^*\} = \arg \min_{M, \{T_i\}} (-\log P(\{S_i\}|M, \{T_i\}) - \log P(M) - \log P(\{T_i\}))$$



Alternating Optimization:

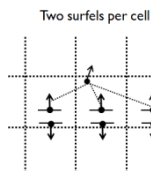
Fix the scan poses and optimize the latent map:

$$M^* = \arg \min_M -\log P(\{S_i\}|M, \{T_i\}) - \log P(M)$$

Fix the latent map and optimize the scan poses

$$\{T_i^*\} = \arg \min_{\{T_i\}} -\log P(\{S_i\}|M, \{T_i\}) - \log P(\{T_i\})$$

Hybrid Map Representation

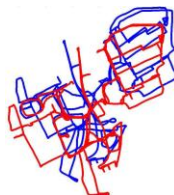


Three properties of our hybrid map representation

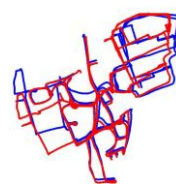
1. Efficient distance query
2. High approximation quality
3. Able to represent thin objects

Comparison

Ground Truth (red line) Estimated Trajectory (blue line)

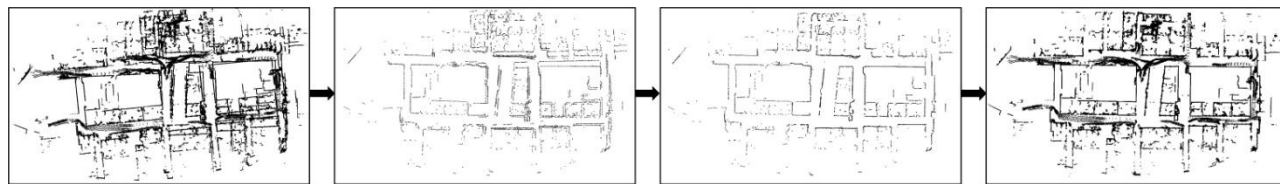


Pair-wise Registration



Sequential Registration at the first level

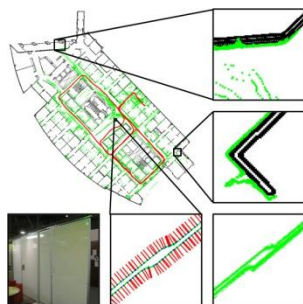
Hierarchical Pose Estimation



(a) Local Alignment

(b) Global Alignment

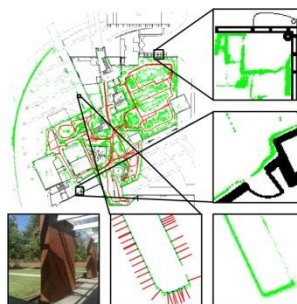
Results



Large office building (14182 scans, 412s)



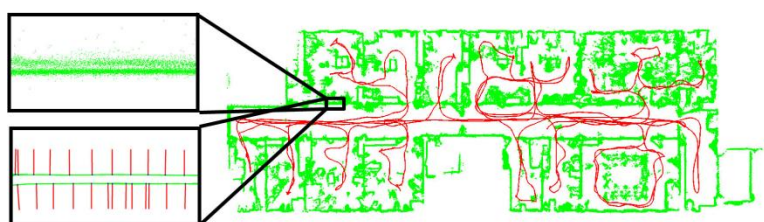
Computer History Museum, 1st floor (41459 scans, 612s)



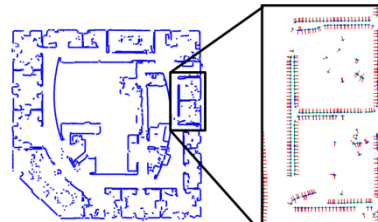
Computer History Museum, 2nd floor (35420 scans, 718s)



Exploratorium Museum (60527 scans, 1018s)



Radish dataset (4943 scans, 200s)



Intel Research Lab