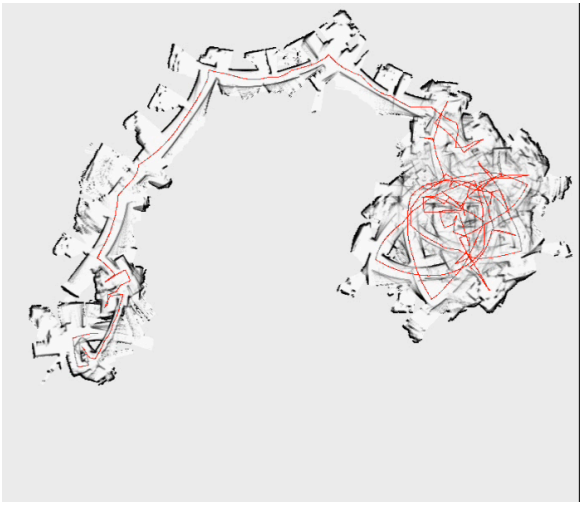
Robot Mapping

Scan-Matching in 5 Minutes

Cyrill Stachniss

Mapping With Raw Odometry



Courtesy: Dirk Hähnel

Motivation

- Motion is noisy
- Assuming known poses fails!
- Often, the sensor is rather precise

- Scan-matching tries to incrementally align two scans or a map to a scan, without revising the past/map

Pose Correction Using Scan-Matching

Maximize the likelihood of the **current** pose and map relative to the **previous** pose and map

$$x_t^* = \underset{x_t}{\operatorname{argmax}} \left\{ p(z_t \mid x_t, m_{t-1}) \; p(x_t \mid u_{t-1}, x_{t-1}^*) \right\}$$

current measurement

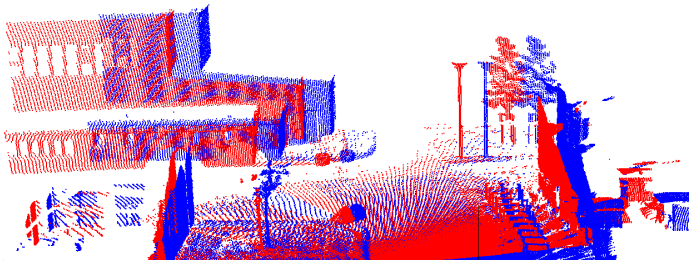
map constructed so far

robot motion

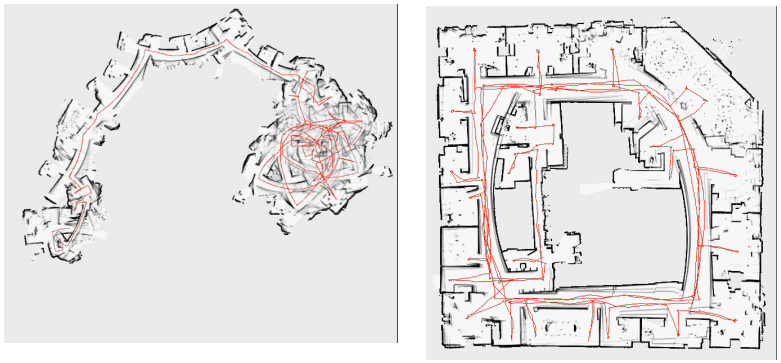
Various Different Ways to Realize Scan-Matching

- Iterative closest point (ICP)
- Scan-to-scan
- Scan-to-map
- Map-to-map
- Feature-based
- RANSAC for outlier rejection
- Correlative matching
- …

Example: Aligning Two 3D Maps

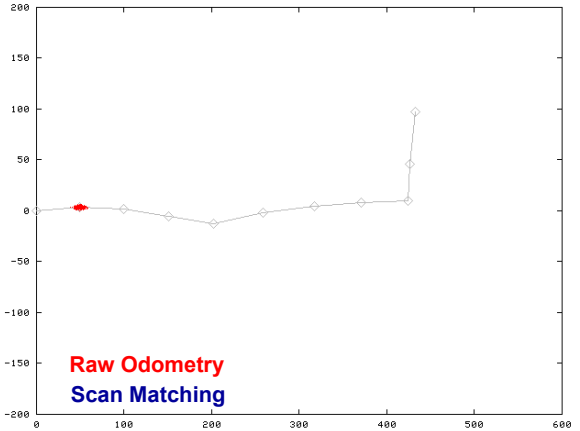


With and Without Scan-Matching



Courtesy: Dirk Hähnel

Motion Model for Scan Matching



Courtesy: Dirk Hähnel

Conclusion

- Scan-matching often improves the mapping substantially
- Locally consistent estimates
- Often, however, it is not sufficient to build a consistent map

Literature

Scan-Matching

- Besl and McKay. A method for Registration of 3-D Shapes, 1992
- Olson. Real-Time Correlative Scan Matching, 2009