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

\[ x_t^* = \arg \max_{x_t} \left\{ p(z_t \mid x_t, m_{t-1}) p(x_t \mid u_{t-1}, x_{t-1}^*) \right\} \]

- current measurement
- robot motion
- map constructed so far
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

Raw Odometry
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