



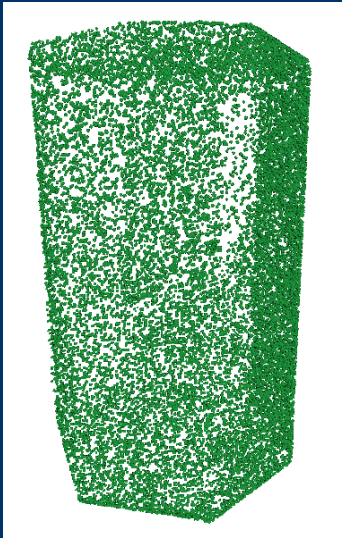
Hauptseminar Winter Term 2009/2010

3D Object Recognition and Registration

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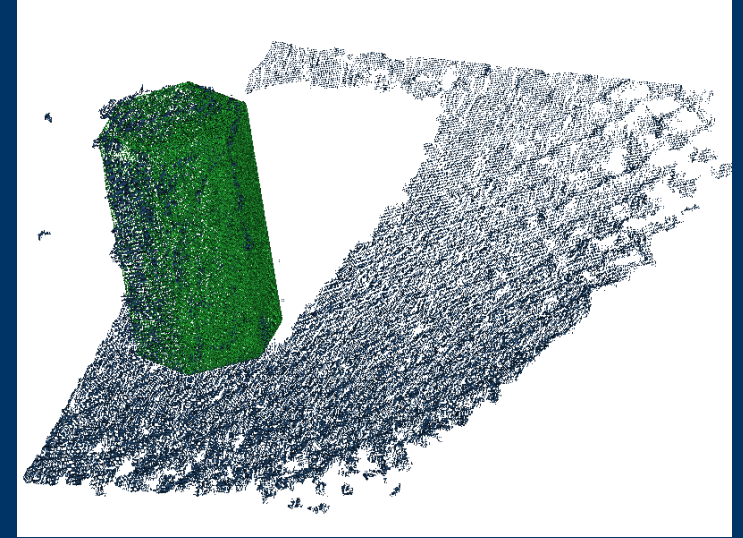
3D Object Recognition



Model point cloud



Scene point cloud



Model correctly located in the scene

Input: 1) A set of known geometric objects, called models
2) A scene that partially contains some of the models

Aim: Automatic correct identification and localization of known objects in a scene

Models and scene are given as point clouds, meshes, CAD models, ...

Output: List of recognized objects and their location in the scene

3D Object Registration

Source: N. Gelfand et al.: *Robust Global Registration*



Partially overlapping input surfaces



Globally consistent model

Input: A set of partially overlapping geometric objects

Aim: Automatic alignment of partially overlapping data sets

Models and scene are given as point clouds, meshes, CAD models, ...

Output: A set of transformations (in our case rigid motions) which aligns the data sets such that they build a complete model.

Object Recognition/Registration Based on Local Geometry Descriptors

Processing Steps:

Interest Point Detection



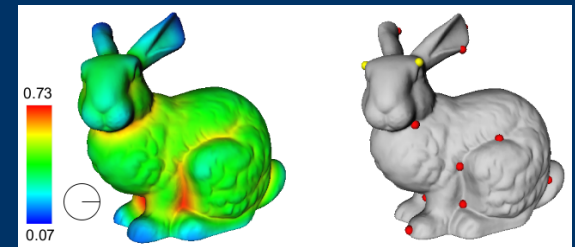
Local Geometry Description



Pose Recovery

Selection of distinct points (features) from models and scene, i.e., points of high curvature.

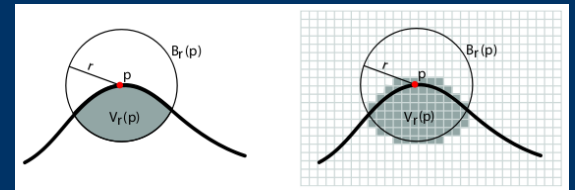
Output: a set of features



Source: N. Gelfand et al.: *Robust Global Registration*

Geometry description in the vicinity of the interest points (low-dimensional vs. high-dimensional descriptors).

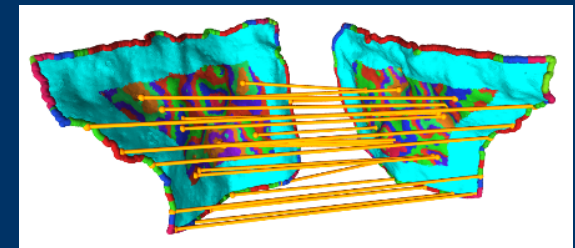
Output: a set of pairs, consisting of a feature and its description



Source: N. Gelfand et al.: *Robust Global Registration*

Pose recovery based feature correspondence and other geometric criteria

Output: set of objects localized in the scene



Source: Q.-X. Huang et al.: *Reassembling Fractured Objects by Geometric Matching*

Papers:

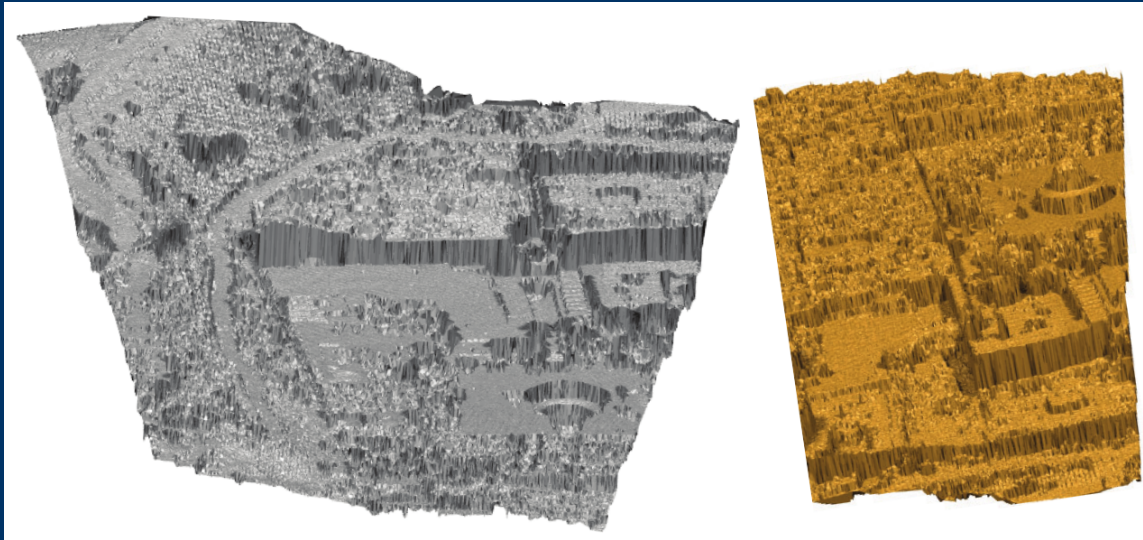
[1] A. Johnson and M. Hebert: *Using Spin Images for Efficient Object Recognition in Cluttered 3D Scenes*, TPAMI 21(5):433-449 (1999)

[2] N. Gelfand, N. Mitra, L. Guibas, H. Pottmann: *Robust Global Registration*, Symposium on Geometry Processing 2005:197-206

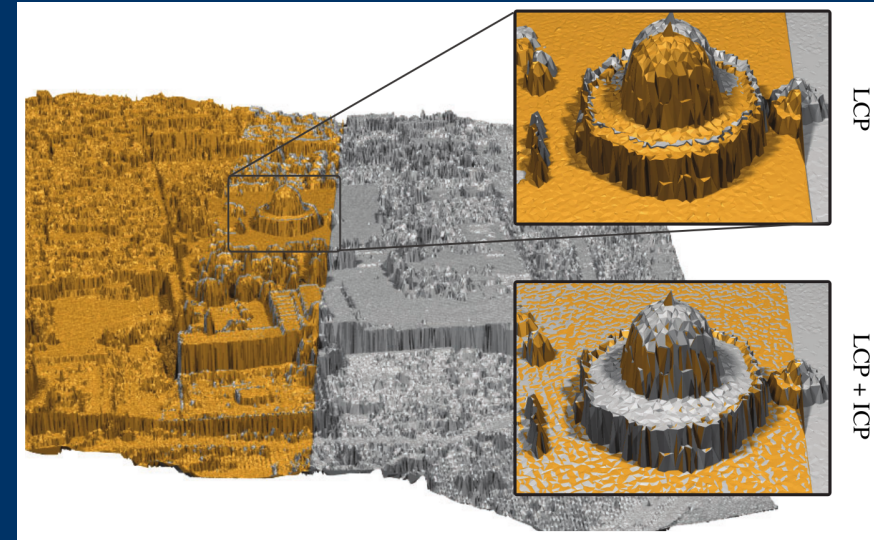
[3] R. Gal, D. Cohen-Or: *Salient Geometric Features for Partial Shape Matching and Similarity*. ACM Trans. Graph. (TOG) 25(1):130-150 (2006)

Object Recognition/Registration: Local vs. Global Methods

Source: D. Aiger, N. Mitra, D. Cohen-Or: *4-Points Congruent Sets for Robust Pairwise Surface Registration*. ACM Trans. Graph. (TOG) 27(3) (2008)



Input data sets (areal city scans)



Registration result

Global methods

- make no assumptions about initial alignment between input data sets
- are not very fast and
- not very precise

Local methods

- assume a good initial alignment between input data sets
- are faster and
- more accurate

Papers:

[4] P. Besl and N. McKay: *A Method for Registration of 3-D Shapes*. IEEE Trans. Pattern Anal. Mach. Intell. (PAMI) 14(2):239-256 (1992)

[5] Y. Lamdan and H. Wolfson: *Geometric Hashing: A General and Efficient Model-Based Recognition Scheme*. ICCV (1988)

[6] D. Aiger, N. Mitra, D. Cohen-Or: *4-Points Congruent Sets for Robust Pairwise Surface Registration*. ACM Trans. Graph. (TOG) 27(3) (2008)

