

CITYFIT

High-Quality Urban Reconstructions by Fitting Shape Grammars to Images and derived Textured Point Clouds

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The Challenge

Creating **realistic and complete 3D city models** is the ambitious goal of this project. This reconstruction has to be performed **fully automatically**. The basis is an existing automatic method for creating extruded ground polygons with roofs from aerial images. The challenge is to provide all of these houses with detailed facades.



The system will be evaluated, taking the city of Graz as example: many different building styles coexist, from medieval, over highly decorated neo-classical, to post-modern facades.

Input Data

Only terrestrial input data is used:

- Highly redundant **road side photographs**
- Road side **LIDAR scans** 180° in 1° resolution, ~30cm spacing
- Preprocessing yields registered textured point clouds

Processing

- **Filter out obstacles:** cars, trees, people or parking ticket machines
- **Segmentation** of facades, detection of: windows, doors and other structural elements
- Aim: classify and represent every detail down to a resolution of 50cm

Shape Grammar

- Urban shape grammar based on **generative modeling (GML)**
- Hierarchical representation of facades: split hierarchy
- **Parametrized buildings**
- Analysis of facade structure: building style, periodic sequences of elements or symmetries
- Compact data representation, goal: web transmission
- Extensive library of terminal elements
- **Convex polyhedra** serve as geometric representation



Fitting

The terminal symbols of the urban shape grammar are parametrized by fitting them directly to 3D point clouds.

The fitting, as well, **proceeds in a hierarchical manner**. If, for example, a door or balcony is detected, first, the basic parameters are fitted and then the element is differentiated (round arch) and sub-geometry is fitted (columns on balcony). This helps to keep the parameter space on every level small, and to limit the element search space.

References

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- [2] A. Klaus, J. Bauer and K. Karner. *Metropogis: A semi-automatic city documentation system*. ISPRS 2002
- [3] P. Müller, G. Zeng, P. Wonka, and L. Van Gool. *Image-based procedural modeling of facades*. SIGGRAPH 2007

www.cgvtugraz.at/cityfit
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