



transforming the way the world works



BuildingGenerator & DTMaster Building Add-On

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Content

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 - Buildings
- **Building Generator**
 - Model-based approach
 - Automatic detection
 - Manual editing
- **Integration in a workflow system and process control**
 - novaFACTORY 3D

Buildings are easy, or?

INTRODUCTION

Construction World vs. Real World



Village



~ 80% automatic
detection rate (LOD 2)

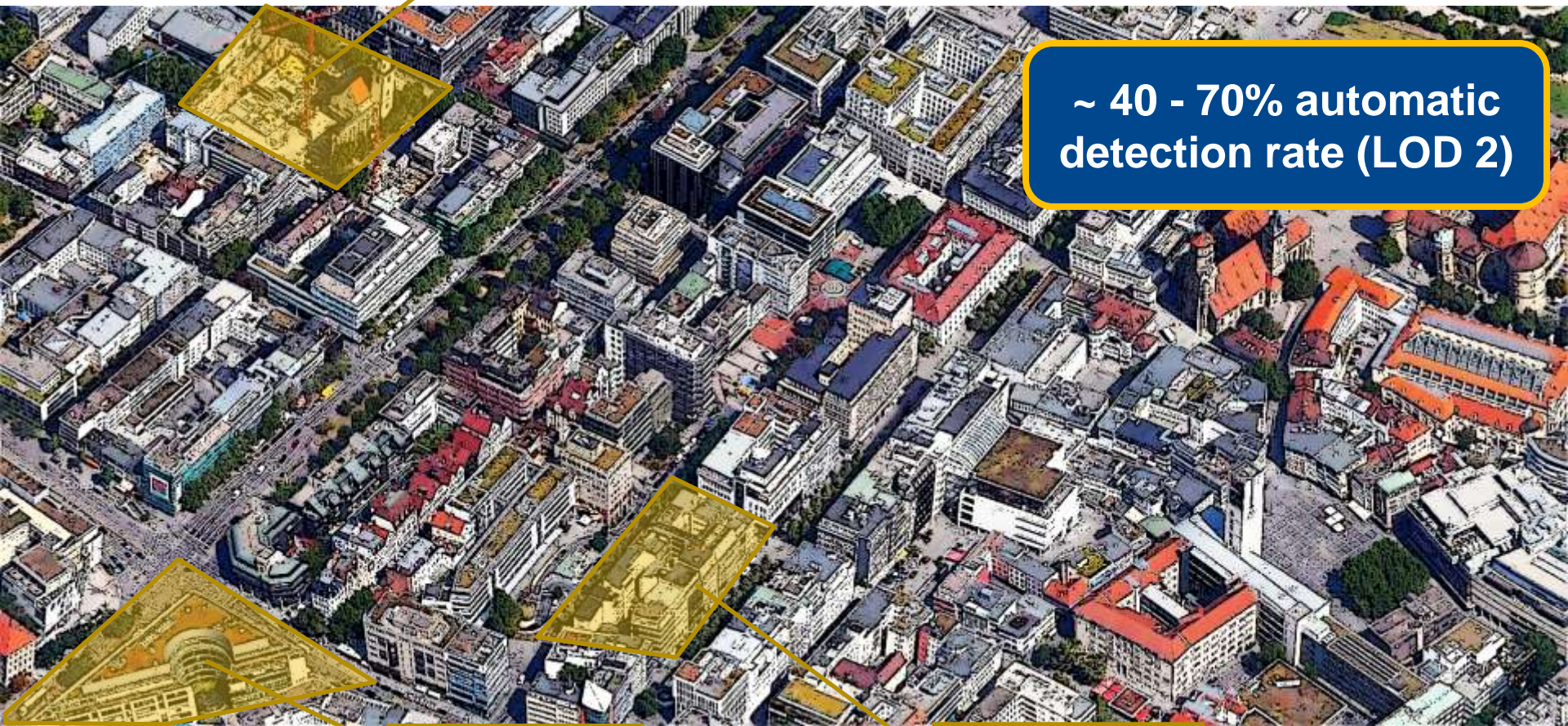
City

Construction

~ 40 - 70% automatic
detection rate (LOD 2)

Special shapes

Complex
building blocks

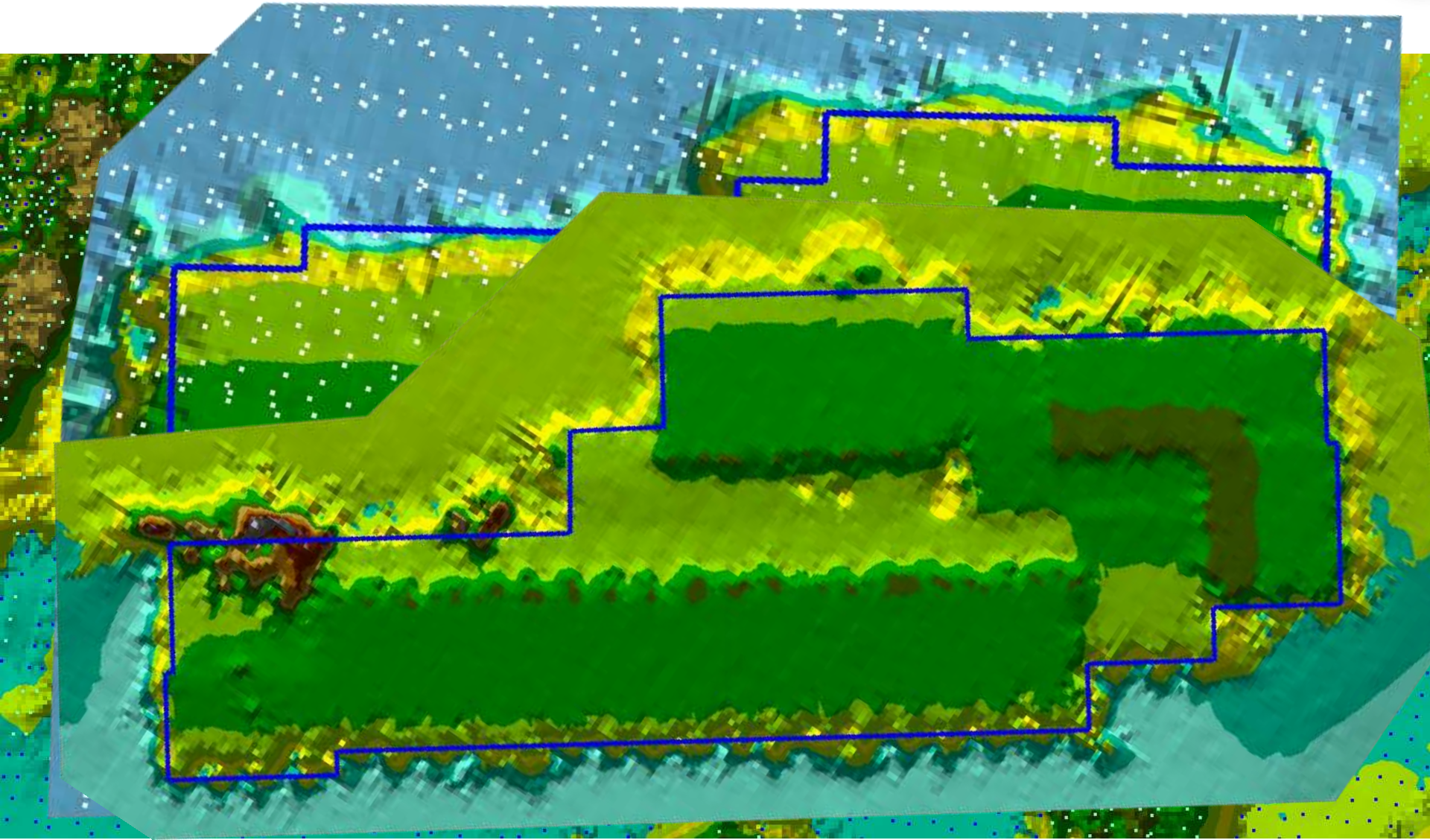


City – Complex Building Block

- How well are the individual buildings defined?
- Do we have for each building a footprint?
- Do we have dense LIDAR data?

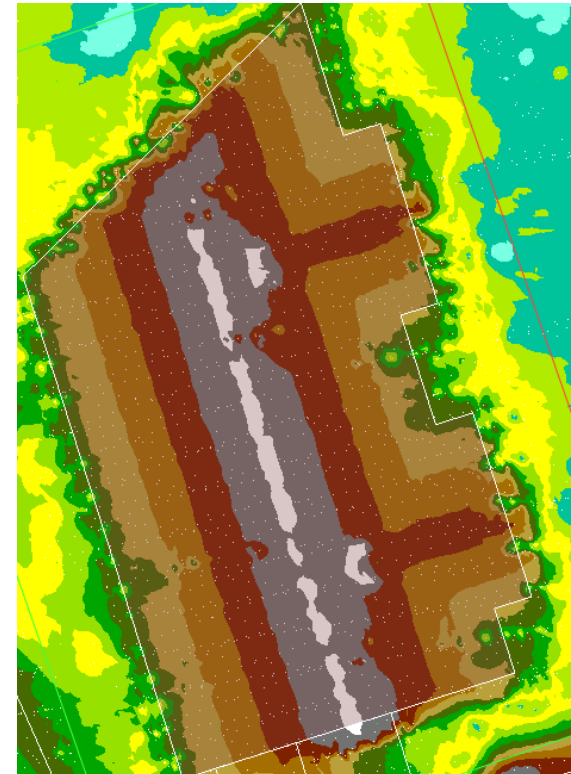
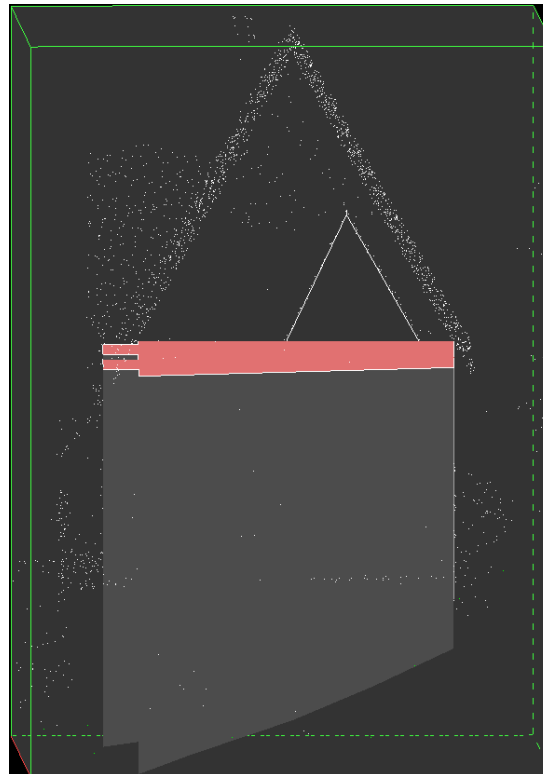


What do you see?



What do you see?

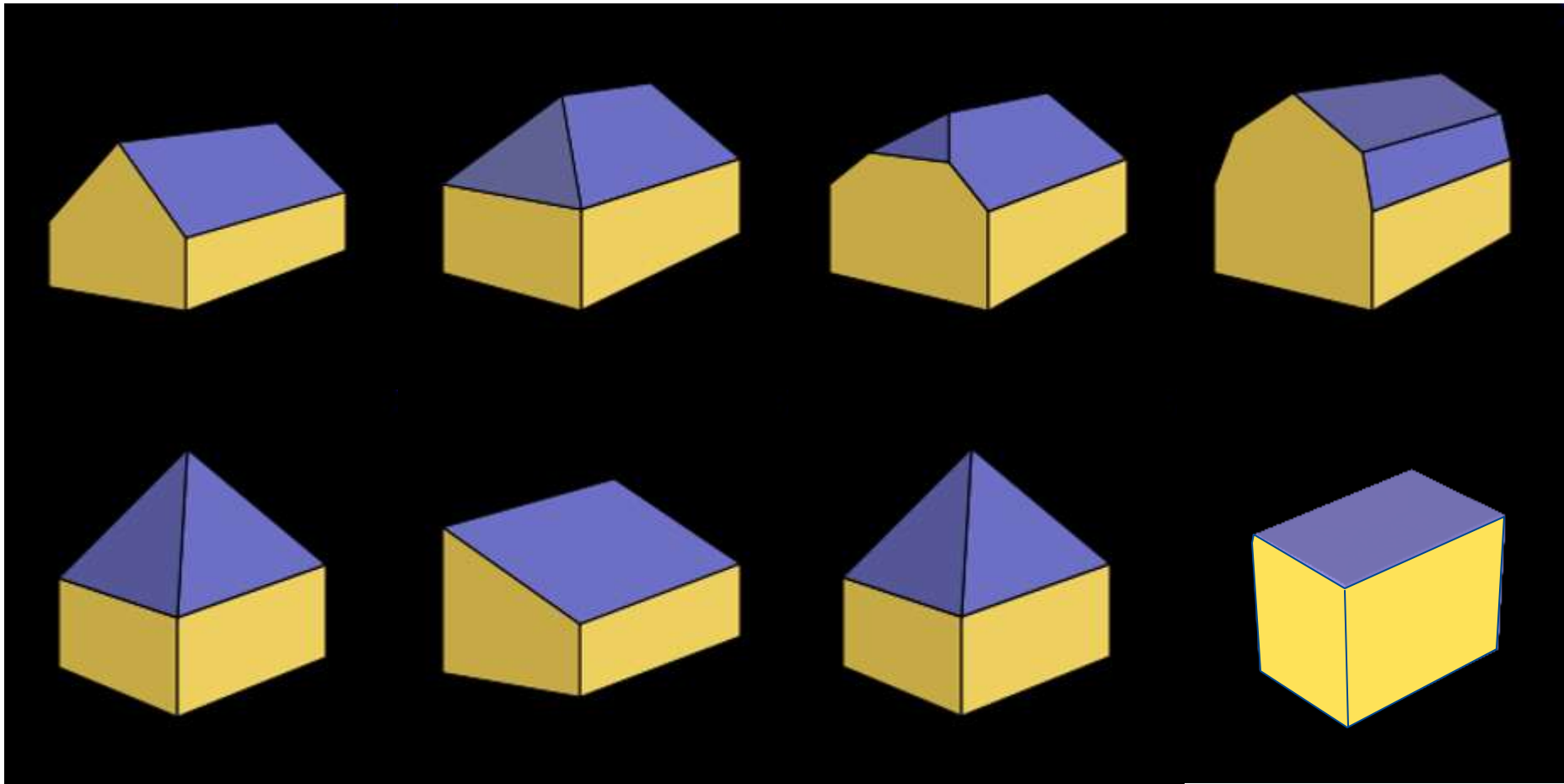
- **Complexity**
 - Generalization challenging
 - High automation for generalization solved with model-based approach



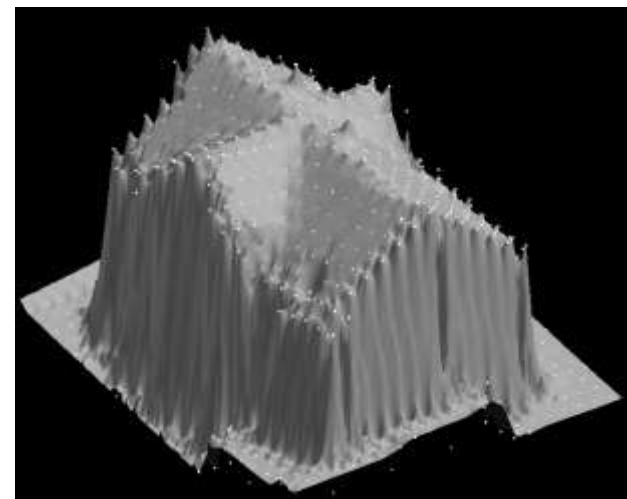
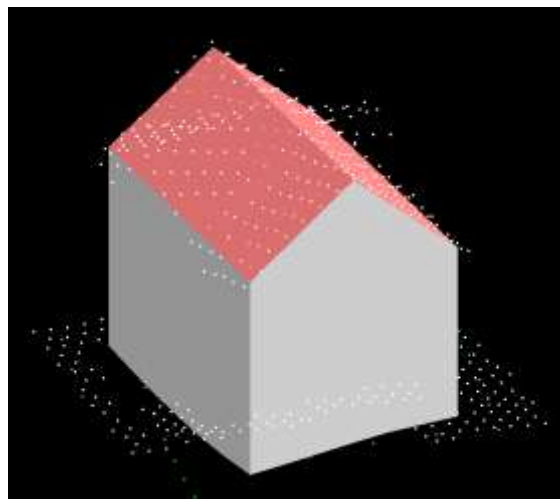
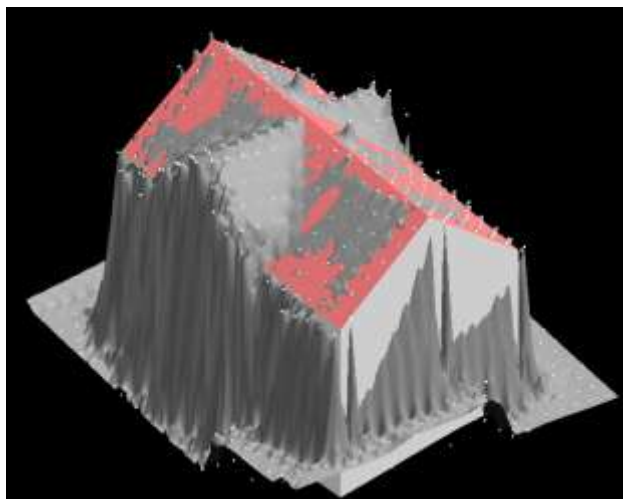
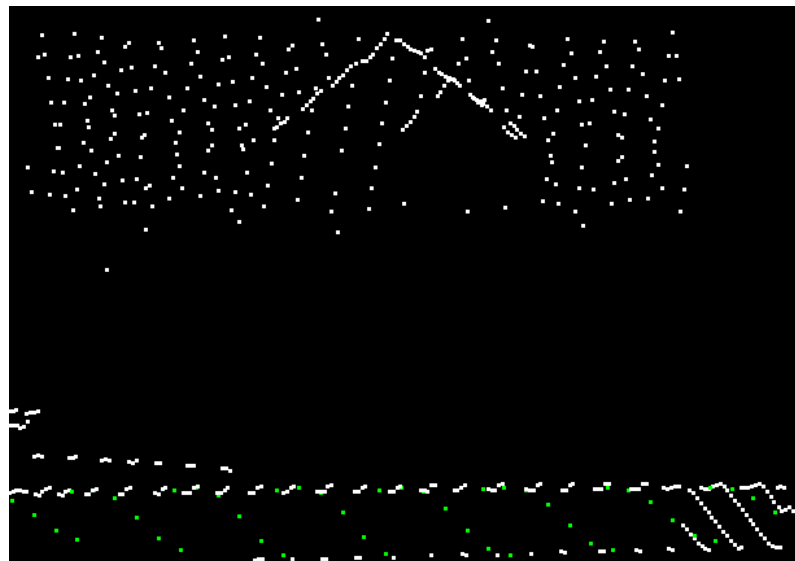
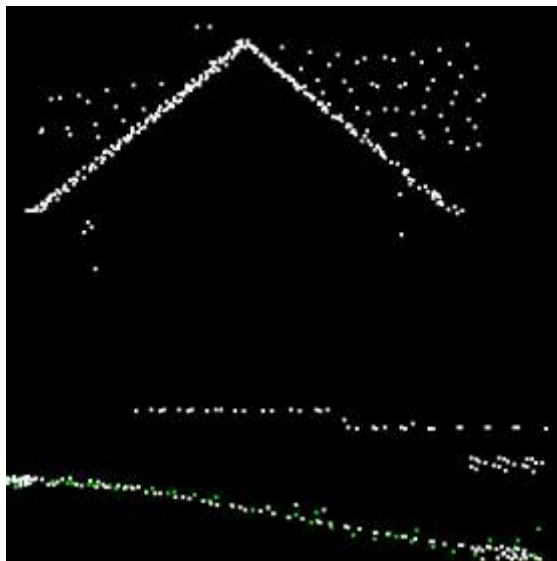
Building Generator

MODEL-BASED APPROACH

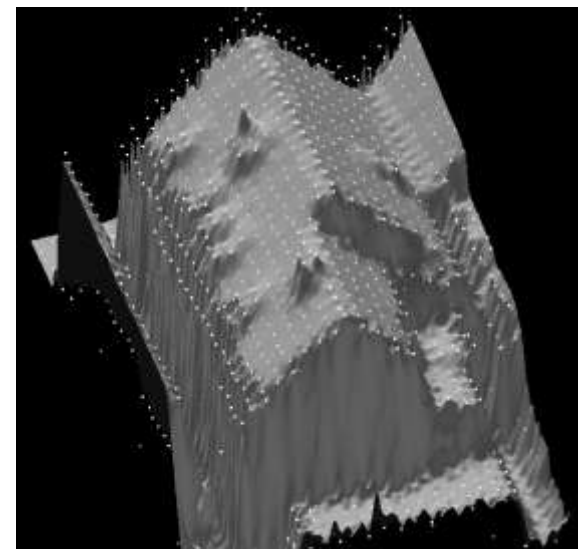
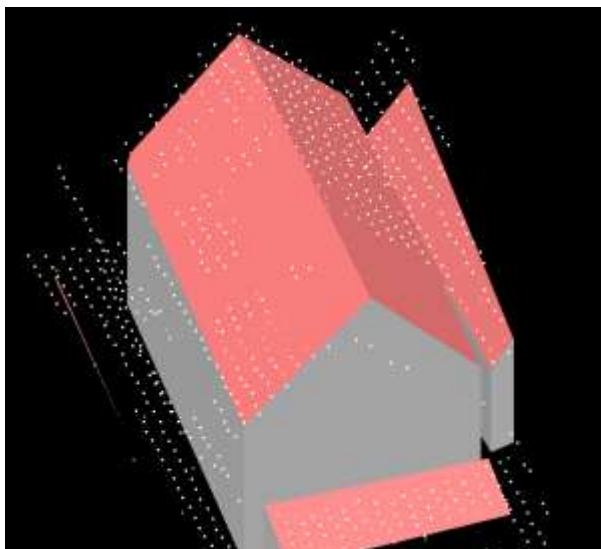
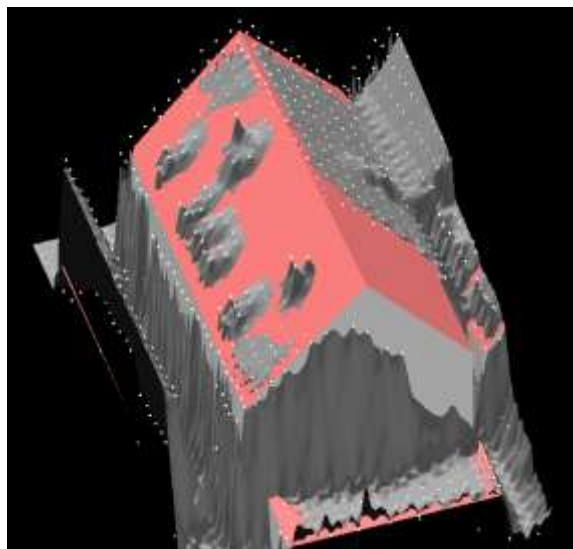
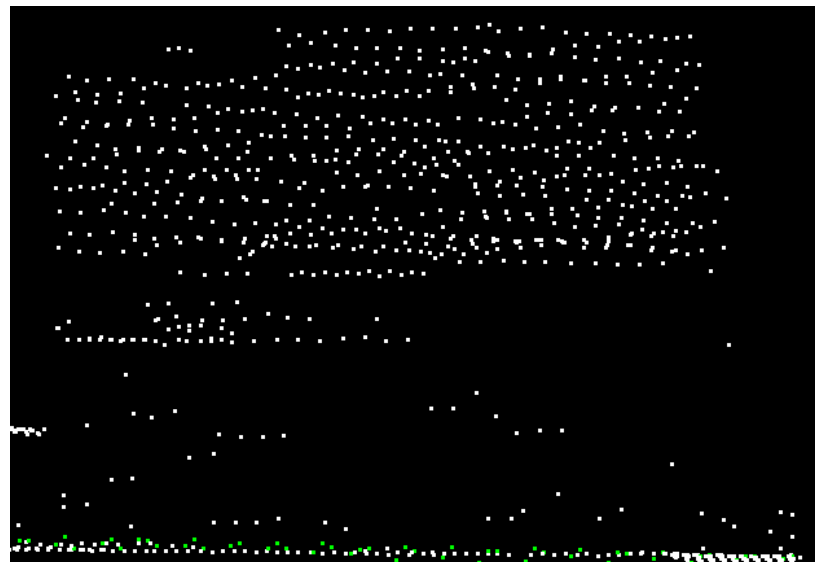
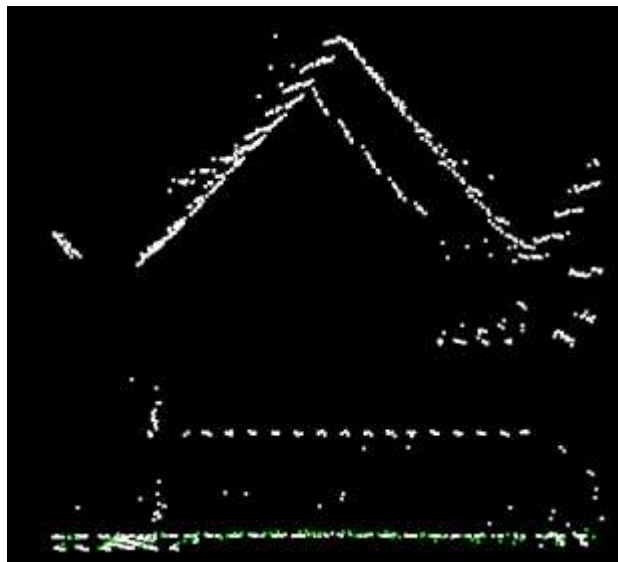
Model-based Approach



Generalization



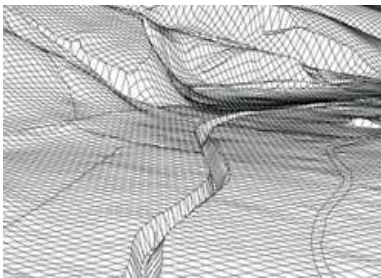
Generalization



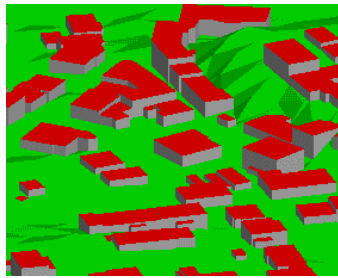
Level-of-detail (LOD)

■ Level-of-Detail

- LOD2 from BuildingGenerator created
 - Buildings that cannot be created as LOD2, are created as LOD1
- Option: Full set of **LOD1**



LOD0
2.5D terrain model



LOD1
bricks



LOD2
generalized
roof forms



LOD3
Real roof forms



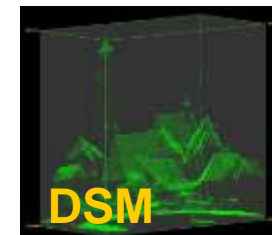
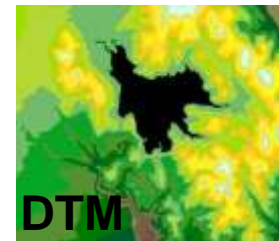
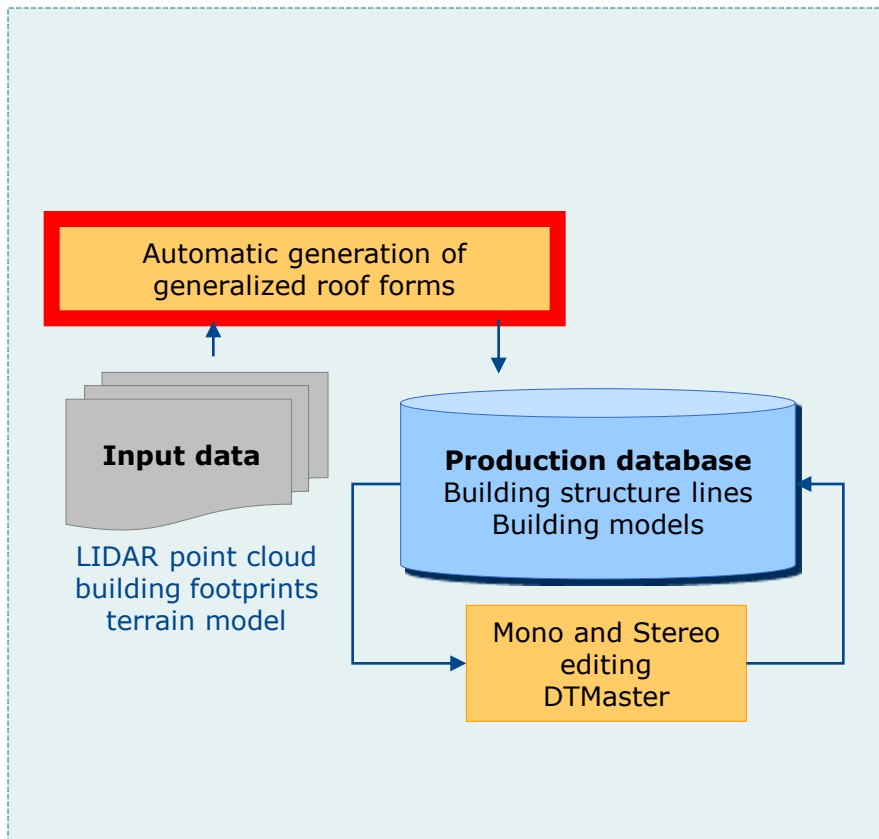
LOD4
Includes interior model

Technology

BUILDING GENERATOR

BuildingGenerator

- **Input data**
 - Point cloud
 - Building footprints
 - Terrain model

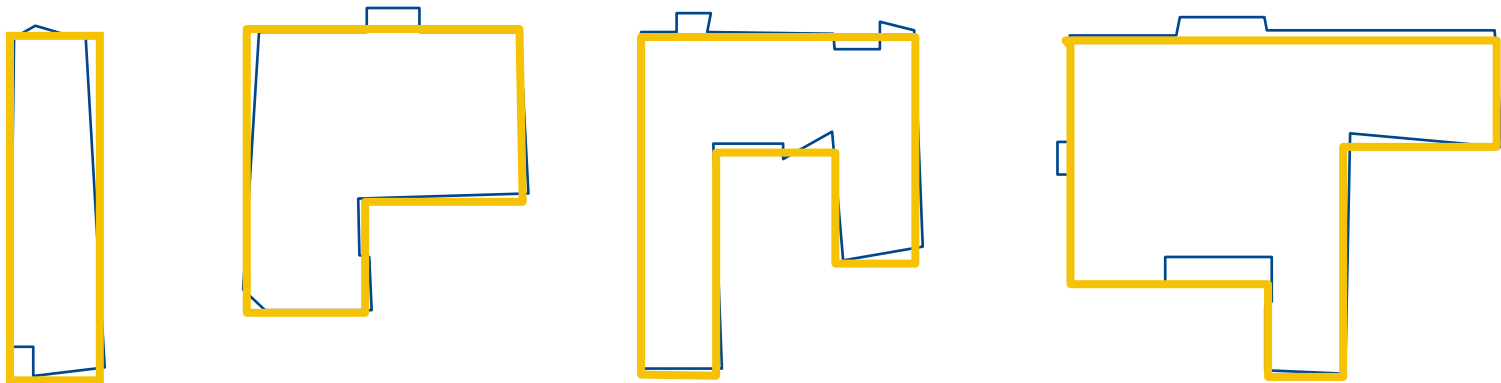


How works the BuildingGenerator?

- **3 step algorithm**
 - Generalization of building footprints
 - Segmentation of roof parts
 - Modelling of buildings

BuildingGenerator

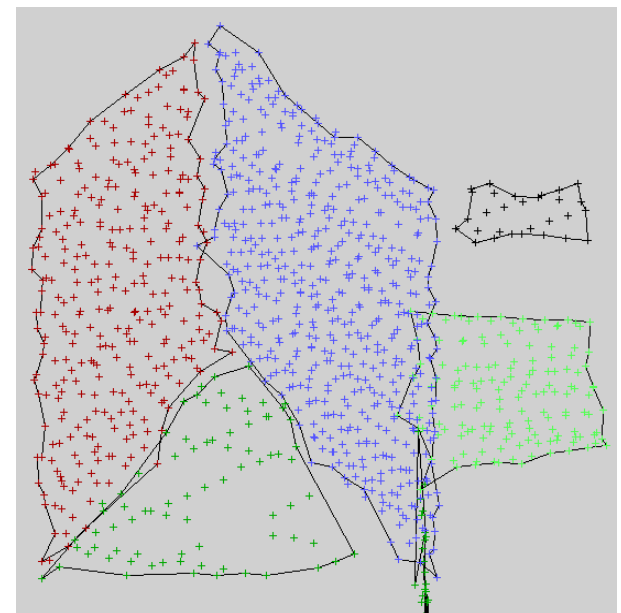
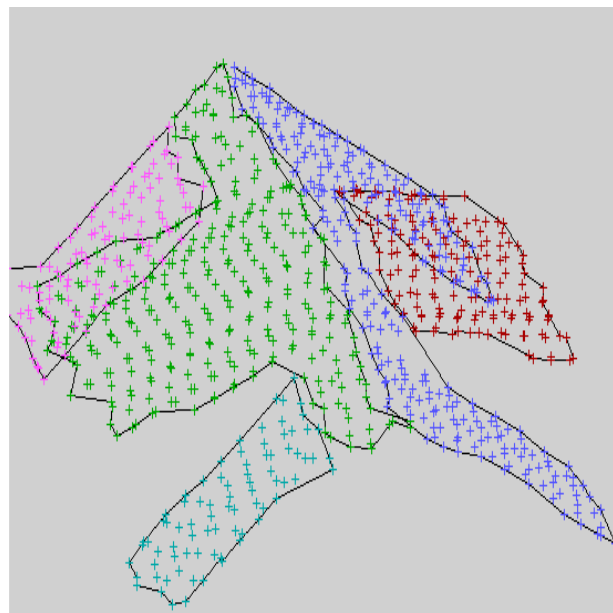
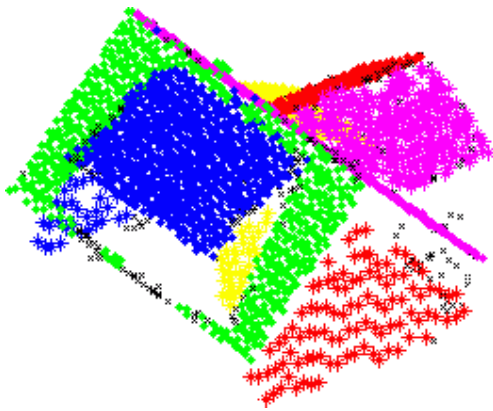
- **Step 1: Generalization footprint**
 - „Recognition“ of generalized forms (rectangular, L-, U- or T- shape footprint)



BuildingGenerator

■ Step 2: Segmentation

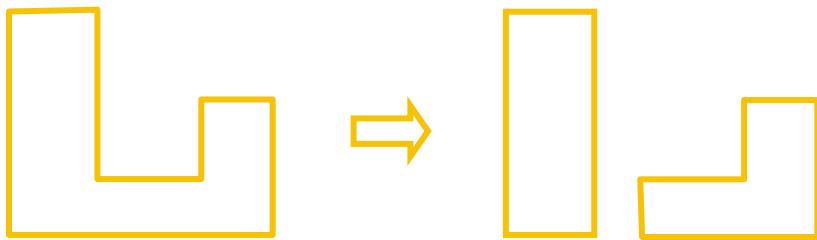
- Selection of point cloud within generalized building footprint
- Calculating for each point the normal vector
- Clustering roof parts
- Bounding segments (border lines definition)



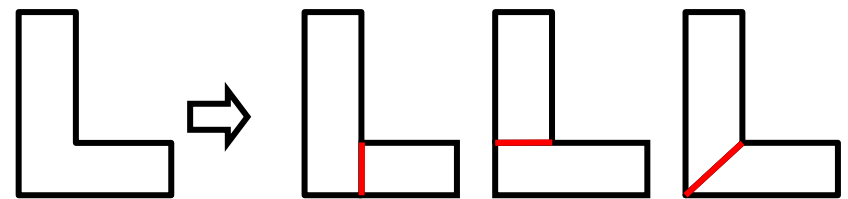
BuildingGenerator

■ Step 3: Modelling

- Partitioning of complex buildings
 - Preset of possible partitioning methods based on generalized footprints
 - Selection of best partitioning
- Independent modelling of the partitions with building roof forms



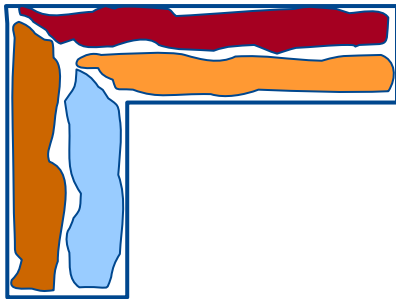
Example: Hierarchical partitioning of U- form



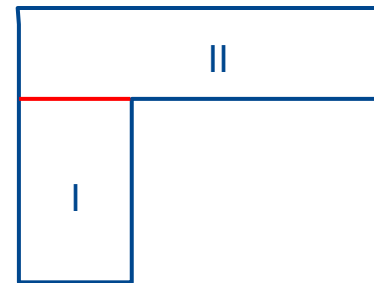
Example: Hierarchical partitioning of L-form

BuildingGenerator

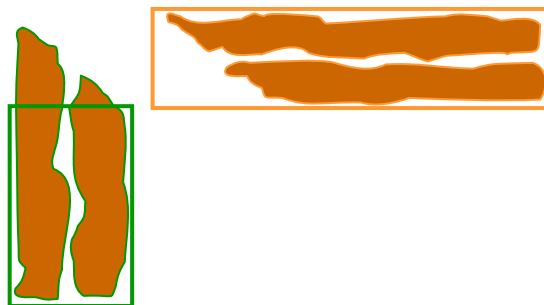
■ Step 3: Modelling



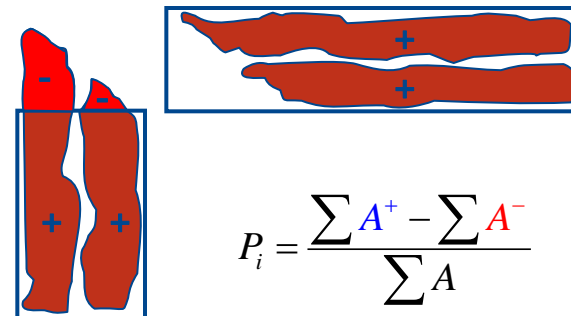
2D View – Footprint & Segments



Selection of partitions



Assignment of Segment-Partitions

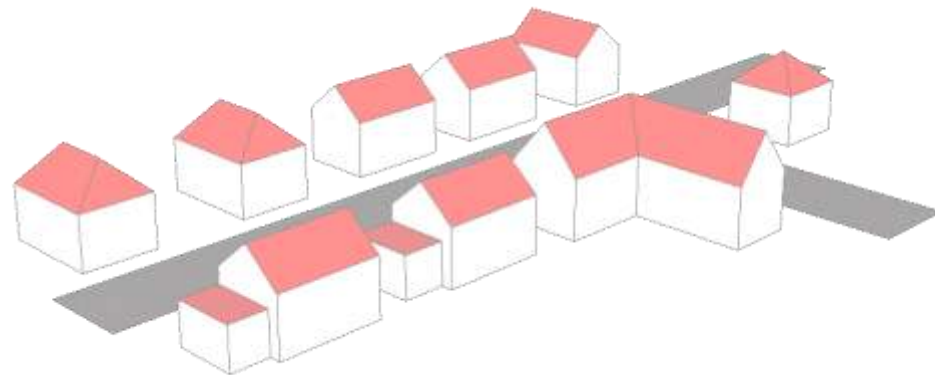
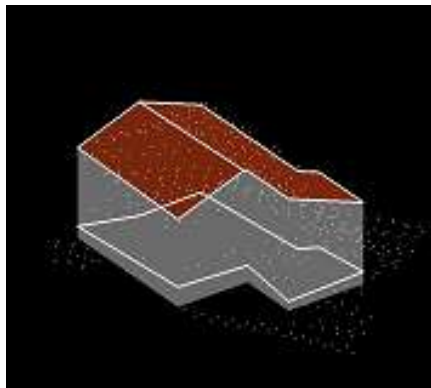
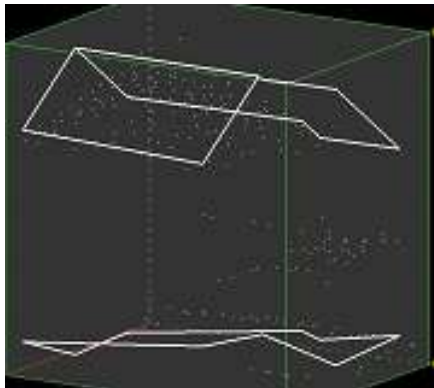


$$P_i = \frac{\sum A^+ - \sum A^-}{\sum A}$$

Calculation of probability values for partitioning

Results – Data structure

- Ridge lines created through exact cuts of adjusted segment faces
 - No redundancy problems during cuts of segments
 - Only primary data stored in database
 - On-the-fly calculation of models, allows to introduce up-to-date DTMs

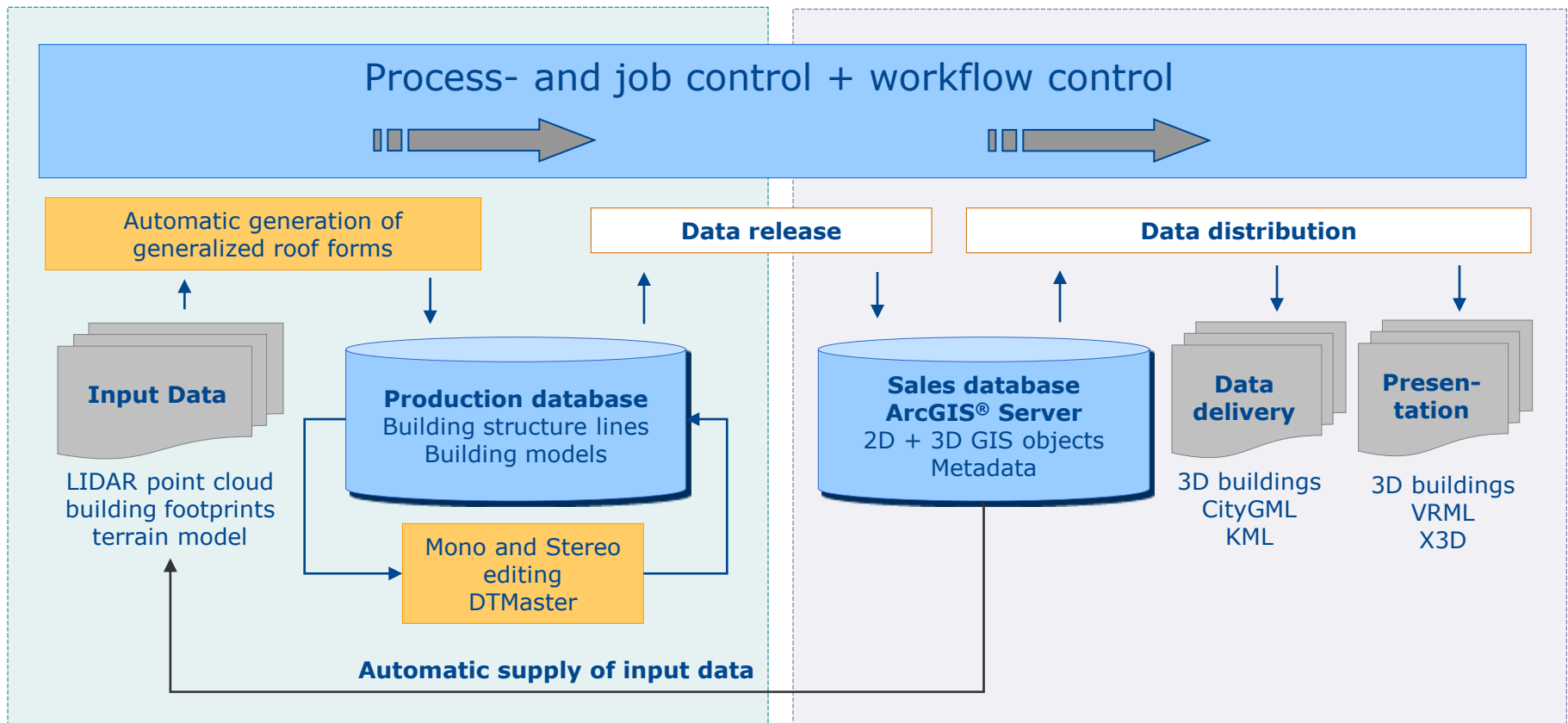


How does it work?

■ Overview

novaFACTORY 3D Pro

novaFACTORY 3D GDI

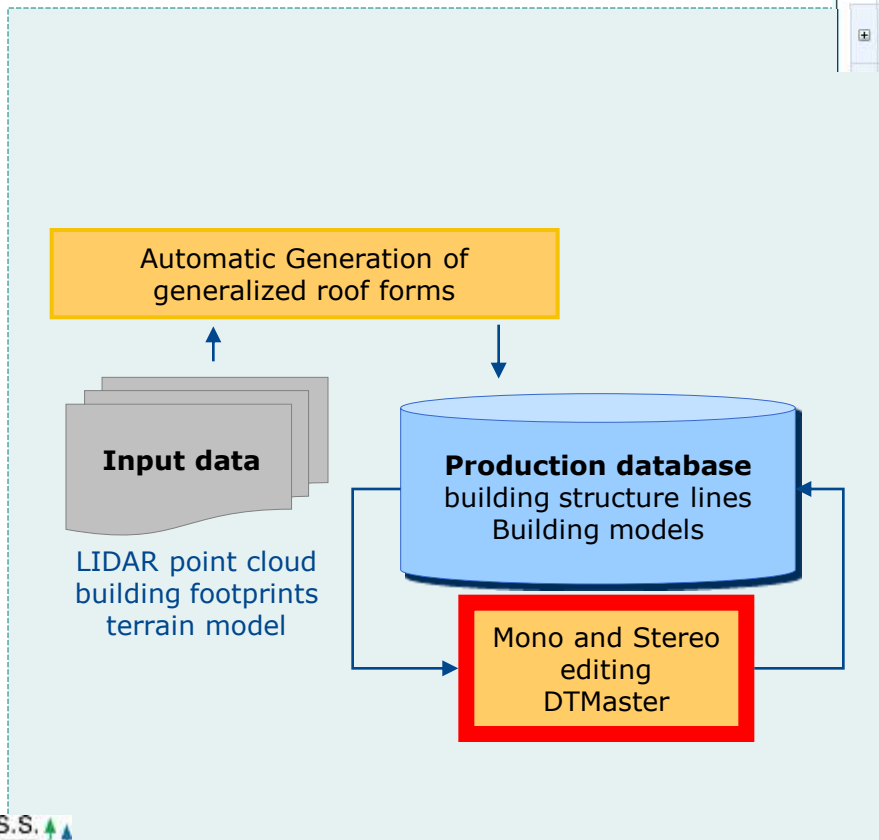


novaFACTORY 3D Pro

HOME | HILFE | LOGOUT

novaFACTORY [Import 3D]

Aufträge			Konfiguration		DB-Information			
Nr	Produkt	Gebiet	Quellzustand	Status/ Aktion	Zielzustand	Eingetragen am	Starten am	Gestartet am
406	Gebäude LOD2	Büdingen	Modelldaten		Daten freigeben	14.05.2008 17:55		



- **Data**
 - Point cloud
 - Terrain Model
 - DB-Connection
- **Building structure lines**
 - Metadata
- **Optional**
 - Aerial Images (recommended)
 - Orthophotos

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- **Direct DB-connection**
 - **Quality control**
 - graphical
 - numeric
 - **Object-ID**
 - **Attributes remain and are enhanced with additional information**
 - **Multi-User capability**
 - **Lock only on current building. Multiple users can work on the same project**

nF 3D Pro

Name	S*	Q* ▲	RF*	BY*	AT*
11532020		0.0	FLACHDACH		
11533176		0.0	FLACHDACH	tille	02.10.2009 16:15:46
003333333		0.0	MISCHFORM	Fschram	08.01.2010 14:40:35
003333333_b		0.0	MISCHFORM	Fschram	13.01.2010 14:07:31
01		0.0	MISCHFORM	tille	13.01.2010 14:20:13
02		0.0	MISCHFORM	tille	13.01.2010 14:21:53
11524130		87.0	MISCHFORM		
11524033		88.1	MISCHFORM		17.03.2010 16:26:03
11523881		90.1	SATTELDACH		
11524150		90.4	SATTELDACH		
11524048		91.2	WALMDACH	test4	
11524168		91.5	PULTDACH	Fschram	
11524152		91.7	SATTELDACH		
11530413		92.7	PULTDACH	tille	
11530425		93.3	PULTDACH		
11524116		93.5	WALMDACH	user	
11531190		93.9	PULTDACH		
11530308		94.3	SATTELDACH		
11524074		94.4	SATTELDACH		
11524091		94.6	PULTDACH		
11524122		94.6	SATTELDACH		

Checkout...
Undo Checkout
Commit...
New Line...
New Unit...
Delete...
Close
Triangulate
Attach
Hide Overlay

Video

- [Link](#) (D:\I_Produkte\DTMASTER_BUILDING-ADDON\Camtasia\novaFACTORY\novaFACTORY_1024x768)

novaFACTORY 3D Pro

■ Object-ID

— Attributes

- Data source: Height extracted from LASERSCAN, NUMBER OF FLOORS, DEFAULT, PHOTOGRAMMETRIC, MANUAL, UNKNOWN
- Ground height: All LOD1 And LOD2 buildings are cut with the terrain model. Lowest point of cut will be introduced into DB
- Roof height: Highest point of building will be introduced into DB
- Building height: Difference between ground height and roof height
- Reference Roof: RIDGE, EAVE, MEDIAN, ...
- Roof form: FLAT, PITCHED, SADDLEBACK, HIP, ...
- Creation Time: Time when building has been automatically created with BuildingGenerator first time
- Quality: see quality value
- Last Editor: User who edited last the building
- Last Change: Time when building has been changed
- Changed: Value that shows which building has been manually edited
- Release Date: Date when building has been released for sales database

Export Formats

- **CityGML 1.0**
 - Like most virtual 3D city modeling efforts, these services provide only graphic or geometric models, neglecting the semantic and topological aspects of the buildings and terrain being modeled. These models can only be used for visualization purposes but not, in most cases, for thematic queries, analytical tasks or spatial data mining. Another problem with these and other city 3D modeling efforts is lack of interoperability. CityGML offers a solution for it.
(<http://www.directionsmag.com/articles/citygml-an-open-standard-for-3d-city-models/123103>)
- **VRML**
- **KML, KMZ**
- **3D DXF**
- **3D SHP**
 - Includes only triangulated surfaces with knowledge of material (with/without texturing) and Metadata
 - Detailed grouping (roof, wall, ground floor) is not supported with 3D-Shape
 - 3D-Shape files (.shp) describe the 3D-Model as MultiPatch features
 - 3D Shape can only store triangle lists and attributes per feature
- **MDB**
 - Material information for MultiPatch features can only be stored with the usage of a geo database
 - MDB (or GDB) needed to successfully keep this information