



Artist Controlled Modeling of Urban Environments

Masterstudium:
Computergraphik &
Digitale Bildverarbeitung

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Problem Statement

Creating large-scale **virtual environments** for interactive applications such as computer games poses a demanding challenge for computer graphics. Urban environments are **usually hand-crafted by artists** using commercial 3D modeling software. For today's detail-rich games, this process becomes less and less feasible.

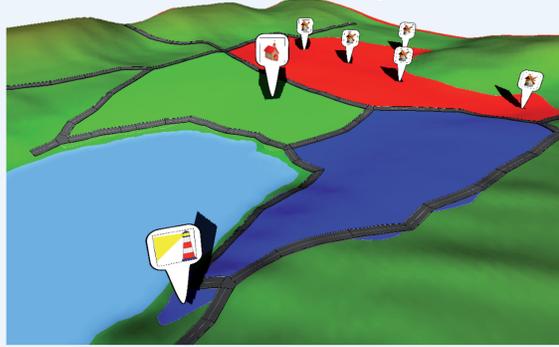
In this thesis, a system is presented that helps artists and game designers to **plan, layout and model urban environments** for games and other media by employing procedural modeling techniques.

City Hierarchy Definition



Planning and Layout

- **Terrain** can be generated from a heightmap image
- **Area and gameplay maps** are projected onto terrain
- Points of interest (e.g. mission targets) can be denoted using **markers**
- Interactive **street sketching**



Main Limitations in Previous Systems

- **No tools available for artists to plan virtual cities**
- **Procedurally created street networks:** Minor roads are created inside quarters surrounded by major roads → sparse regions at city outskirts
- **No tessellated street geometry** that is able to connect many street segments and dynamically adapts to terrain
- **Not possible to interactively edit the street network and street geometry**
- **Buildings have to be placed manually at their positions**

Street Network Creation

- Automatic process guided by **city hierarchy**:
- Major roads created first using **L-Systems**
 - **New contribution:** Bulged convex hull forms **city boundary** to create quarters at outer city regions and fill them with **minor roads**
 - Blocks are split into **parcels**



Previous methods

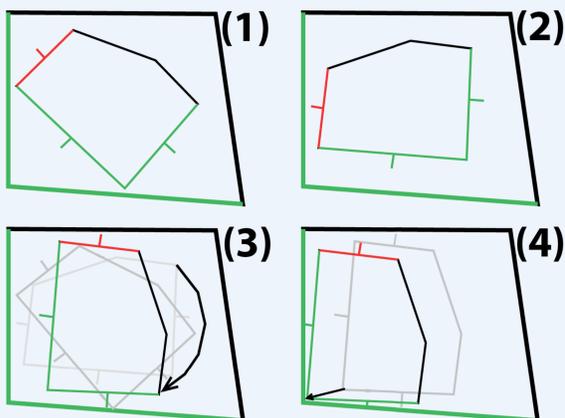
New method

Building Assignments

Buildings automatically **assigned to parcels** from a set of previously modeled buildings.

Algorithm chooses building that **occupies most** of a parcel, while satisfying the following **constraints**:

- Building is completely contained in parcel
- Sides with doors face a street
- Plain brick walls or backyards do not face a street



Algorithm:

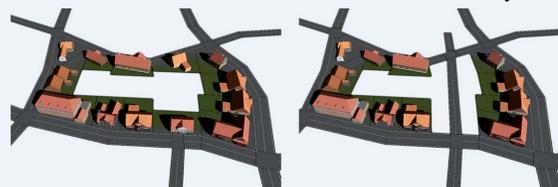
- (1) Building is **placed on parcel center**
- (2) Largest **street access side** is aligned with street
- (3) Building is **rotated** until all conditions met,
- (4) And **moved** near the streets

If any of the constraints is violated, process is repeated with the **next smaller building**.

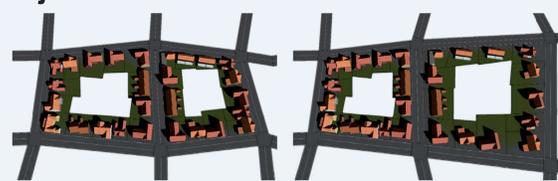
Street Network Editing

User can **directly edit** street geometry:

- **Add and remove streets** interactively



- Street segments, parcels and buildings are **updated** automatically when **junctions are moved**



Street Geometry

- New **polygonal street representation** that allows **junctions** to connect an **arbitrary number of segments**
- Street geometry adapts to **underlying terrain**
- **Textured** to make it visually appealing

