skylineEngine

An urban procedural modeling system

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This project is partially supported by grant TIN2010-20590-C02-02, MICINN
We present **skylineEngine**, an urban procedural modelling tool developed as a test-bed for new algorithms and techniques in urban modelling. In spite of being a starting open project, it has many features only available on high-end commercial modelling systems, like pattern-based district styling definitions, possibility to import city maps from images or from *OpenStreetMap* files, parameterizable models of cities and buildings, global city control through image maps (districts, land-use, height, etc.), and a user-friendly building modelling module based on shape grammars. This system also presents some novel features that make it a unique system, like a graph-based paradigm that allows the user to create content-rich cities with distinct districts, major and minor roads, blocks, lots and buildings, but also other urban elements like streets, sidewalks, parks, bridges and landmarks. Also, during its development we have developed new ways of generating urban content which increase the realism of the resulting environments.

Procedural modelling is an umbrella term for a number of techniques in computer graphics to create 3D models from rules instead of constructing them from geometric primitives such as cubes and spheres. Hence, procedural modelling focuses on the rule-based generation of semantic 3D content, rather than the cumbersome and complex manual editing of individual 3D primitives. As a consequence, procedural modelling is several times more efficient than traditional modelling.
In film, games, and other applications, consumers expect richer, higher-quality digital content. Because budgets won't allow content producers to increase cost significantly, producers have only one choice: they must improve their tools. One of the main drivers of these trends is urban content. Cities are huge, richly detailed artifacts often required in digital productions. Modelling them with existing tools can take hundreds of man months.

Nowadays, procedural geometric city modelling is an open problem which has no standard or open source solutions. This issue is quite important in many different sectors like architectonic and urban design, cinema and theatre, virtual reality and, of course, the videogames industry. Within this, there appear several interesting sub-problems that must be faced. One of these is the modelling of streets, buildings and other architectonic structures.

The skylineEngine system offers a variety of features currently only available at high-end urban modeling systems, like the commercial system CityEngine (www.procedural.com):

- **skylineEngine** offers unique street pattern-based tools to design urban layouts. Street patterns such as grid, organic or circular are available.
- Real street networks of any city can be imported directly from images or from OpenStreetMap.
- Furthermore, street networks or lots designed in other programs can be imported via the .obj file format.
- Inside **skylineEngine** there is a building definition module, buildingEngine, based on a shape grammar implementation but evolved to a more user-friendly visual environment. The graph-based paradigm is specialized for architectural 3D content and offers modelling possibilities to control or vary mass, elements, proportions, rhythms or materials.
- The parameters of the many buildings and streets can be controlled globally via image maps (for example the building heights or the land-use distribution). This allows intuitive city modelling and quick changes.

http://ggg.udg.edu/skylineEngine/