

Procedural Modelling of Cities implemented as a Blender Plug-In

Supervisors: Kevin Glass and Hannah Slay

20/09/2007

1 Previous Short Term Objectives

Due to the lengthy nature of the period between this progress report and the last the decision was taken to set the implementation of most of the remaining tasks for the project as the short term objectives going forward.

A brief breakdown of the various remaining sections of the project is thus presented below as the short term objectives for this progress report. This breakdown follows a top down approach similar to the layout of the objects within the project implementation.

1.1 City Overview

A city overview was to be created which will be used to determine the nature of the city being generated. This city overview can be used to implement the various parameters that may possibly be used within the city generation project. A major role of this city overview is also to facilitate the input of an underlying landscape for the city to be generated. This includes the definition of legal and illegal areas on the underlying landscape. A city is also defined by a specific region on the landscape, thus the city object must effectively be able to represent that region and perform various calculations relating to both the region and the underlying landscape. Finally a city object will also be used to determine the highway layout within the generated city. Specifically through the use of parameters the city object will have to link an appropriately generated highway network to the city object.

1.2 Region Extraction

As a part of representing the city within a specific region of the underlying landscape, a region object needs to be defined. This object needs to represent an area within the generated model. These region objects can then be used to effectively represent various layers of the city generation process and in so doing allow for an effective procedural approach to be implemented. Within this region object logic will have to be implemented to determine where the

region is within the greater model, whether this region overlaps another region and whether any given point or object falls within the bounds of this region.

1.3 Landscape Representation

Some means of reading in generic landscape data and converting it into a usable landscape object within the city generation project is required. This representation will have to successfully determine which areas of the landscape are usable for the process of city generation and which are not, allowing for the generation of cities around existing obstacles within the landscape. Further to this a landscape object will need to contain the logic to determine if a given object or point is within both a legal region on the landscape and exists above the landscape plane.

1.4 Highway Network

A highway network is defined as the major road objects which are used to define the layout of the overall city. Specifically a road network will have to provide the functionality to generate various layout types and patterns dependent on the input parameters and the underlying landscape. Each of these patterns will have to follow different generation methods but will eventually return a uniform highway network which can be easily represented as a part of the generated city. A highway network will thus have to keep track of both the highways implemented and of the various suburbs or areas between those highways,

1.5 Suburb Regions

Using the logic implemented in the region abstract data type, areas between highway segments will need to be extracted and stored as city regions or suburbs. Each of these suburbs in turn can then be used to generate further road networks and road layouts. Each suburb can then also be used to specify some common parameters for the buildings and roads within a certain section of the city.

1.6 Road Networks

With each suburb a further road network will have to be implemented which initially can follow a simple subdivision formulation to determine the placement of individual roads. This road networks object is similar in various aspects to that of the highway network object, in that it too will have to keep track of the individual roads and also the regions between those roads.

1.7 City Blocks

City blocks are again represented with the use of the region data type, they represent the areas between the various minor city roads that will be filled with building objects.

1.8 Building Objects

These objects are included in the process of city generation to easily allow for further extension of the project. Initially these objects will represent simply the position and height of the building objects, they can however be extended in the future to represent more complex building types and attributes.

2 Progress

2.1 City Overview

The city overview object was completed and successfully reads in landscape data and passes it to the landscape object. It further keeps a record of any parameters entered through the blender interface and can parse those parameters and implement the various restrictions to the city generation process. The city object also contains a region object which is used to determine the outer limits of the city region as defined on the landscape object. All objects below the city object in this hierarchy assume themselves to be working at the origin and rely on the layers above them to relocate their representations to the appropriate place on the final model. Thus the city object is used to relocate the generated city form the origin to the specifically assigned region on the landscape.

2.2 Region Extraction

The region abstract data type has been implemented. This data type is represented through a list of vertexes and edges. This representation allows for any region on the landscape to be effectively represented and for further logic to be applied to that region. Specifically the region object contains the logic to determine if a given point or polygon object falls within that region.

2.3 Landscape Representation

A landscape representation object has been created which takes in and processes generic forms of landscape representation. This data is then used by the various methods within the landscape object to determine if a given point or polygon falls within the legal bounds of the landscape object. Methods to determine where on a landscape a point falls as well as whether that point is above, below or on the landscape object. This logic will be used to ensure that roads and buildings are not built below or above the landscape object, but rather exist on the plane itself.

2.4 Highway Network

The highway network object has been generated and is used to store the layout type of the overall city as well as the highway segment information and a list of city suburbs. The major logic included within this highway network object is

that of road segment generation. Dependent on the road layout type the highway network object uses various generation methods to simulate the generation of roads in the given layout. Further to this methods were added to this object which allow it to extract the enclosed regions between the generated roads and to represent these areas as suburb objects.

2.5 Suburb Regions

Suburb objects have been created which store the region of each suburb using the region data type. These objects allow for specific properties to be associated with individual regions within the city. These properties are then in turn used by the road generation and building generation processes to determine the size and types of the roads and buildings which are represented within each region. This allows for the creation of different areas of the city including some form of high-rise city center to more low-rise outlying areas.

2.6 Road Networks, City Blocks And Building Objects

These sections still need to be implemented, each has been created in a skeleton form, however the inner logic for area subdivision and road creation must still be implemented. Building objects will at this stage be represented as simple cubes of varying heights.

3 Objectives for Next Week

3.1 Expansion of Project Outline

A simple thesis outline has been drawn up and further expansion on that outline will be required. Specifically each heading and subheading will need to be explained as well as their relevance to the project as a whole

3.2 Road Networks

The final road network object must be completed by next week in order for the final results of the system to be produced and reviewed. This will include the implementation of a subdivision method which can convert a suburb region into a complex collection of road objects and then allows for the extraction of the areas between those road objects to be used as city blocks

3.3 City Blocks

The city block object must be completed by next week. This object however will contain much of the same logic as the suburb object and thus should not be too difficult to implement.

3.4 Building Objects

Some form of generic city object will have to be created for next week to formalize the process of building generation. Initially it will simple record the cube objects which will be used to represent the buildings.