Procedurally generated realistic virtual rural worlds

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Today

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Chapter 1

Introduction

Creating detailed virtual worlds can be a tedious task for artists. Indeed, modelling terrain, vegetation, water streams, rivers, water reserves, soil, rocks, buildings and road networks for large virtual worlds "by hand" can be extremely repetitive and tiresome. This is especially true when realism is a key requirement. The increase in size and complexity of these virtual worlds mirror that of the processing capabilities of computing hardware. As consequence, the task is only getting worse.

A popular technique to overcome the burden of repetitive tasks is to have them automated. In computer graphics, this involves generating algorithms which, given a set of input parameters, generate the required content automatically. This is called *procedural content generation* and has already been successfully applied in different areas of computer graphics including: the generation of non-repetitive textures [a.a. Efros and Leung(1999), Liang et al.(2001)Liang, Liu, Xu, Guo, and Shum, Wei et al.(2009)Wei, Lefebvre, Kwatra, and Turk], modelling plants [Boudon et al.(2012)Boudon, Pradal, Cokelaer, Prusinkiewicz, and Godin, Fourcaud et al.(2008)Fourcaud, Zhang, Stokes, Lambers, and Körner, Guo et al.(2011)Guo, Fourcaud, Jaeger, Zhang, and Li, Lewis(1999a)], generating terrains [Smelik et al.(2009)Smelik, Kraker, Groenewegen, Hague, Tutenel, and Bidarra, Gain et al.(2009)Gain, Marais, and Straß er, Doran and Parberry(2010)], generating river networks [Derzapf et al.(2011)Derzapf, Ganster, Guthe, and Klein, Emilien and Cani(2015)] and generating city landscapes [Gain et al.(2014)Gain, Marais, and Neeser, Kelly and McCabe(2007)] (figure 1)

A common difficulty with these methods, however, is finding the appropriate input parameters for the procedural algorithms. The correlation between the parameters and the resulting content is often unintuitive and, as a consequence, often comes down to iterative trial-and-errors until a "close enough" result is found.

To overcome this, interactive techniques are often used in an attempt to make generating the input parameters more intuitive. These range from simple paint tools such as lassos and brushes [Emilien and Cani(2015)] to sketch-based recognition algorithms [Gain et al.(2009)Gain, Marais, and Straß er].

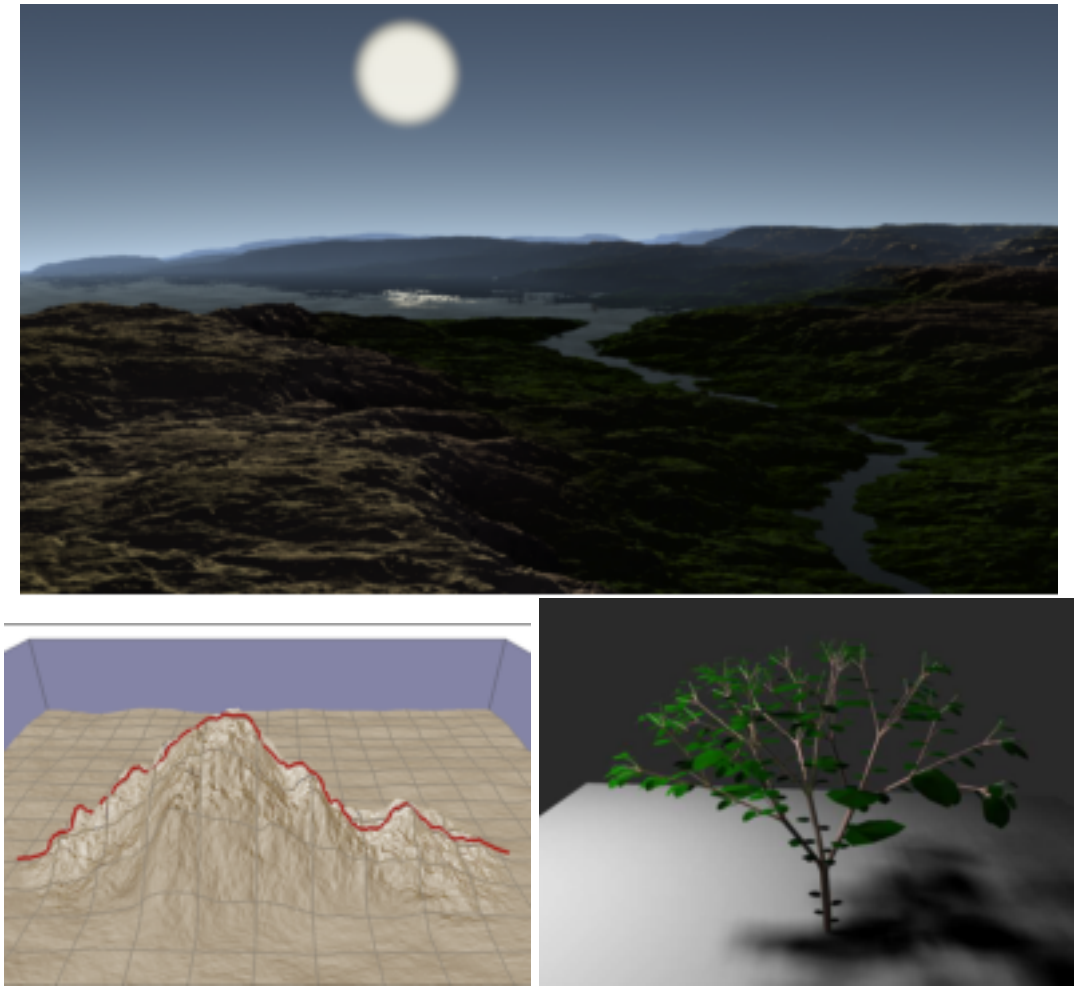

Figure 1.1: Example of procedurally generated content. From top to bottom, left to right: Procedurally generated river stream [Derzapf et al.(2011)Derzapf, Ganster, Guthe, and Klein], procedurally generated terrain through sketching [Gain et al.(2009)Gain, Marais, and Straß er], procedurally generated plant [Soler et al.(2001)Soler, Sillion, Blaise, and Reffye]

1.1 Research Goals

The research goals for this project are as follows:

- Develop procedural methods to automate the generation of realistic virtual rural worlds.
- Provide intuitive and smart controls in order for the system to be as user-friendly as possible.
- Make the system as real-time as possible.

One of the most important aspect of rural landscapes is vegetation. As such, our first goal must strongly focus on the insertion of plants. The automation provided should not limit user control and the flexibility of the system. For example, it must be possible to generate worlds with varying elevations, river networks, water sources and vegetation.
For the second goal, lots of thought must be put into making all user oriented controls intuitive. To do so, it will be important to research the pros and cons of other graphical applications in

terms of control. If need be, multiple prototype controls should be developed in an attempt to find the best suited.
Maintaining a continuous feedback loop between user action and corresponding reaction is extremely important for both user-friendliness and to optimize usage. In an attempt to meet our third goal therefore, efficient algorithms must be developed in order to keep there time complexity to a minimum. When suited, these algorithms should be developed to run on the GPU.

1.2 Contributions

State contributions of this thesis

1.3 Structure

Outline structure of the thesis

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