Realistic Terrain Modeling via Constrained Surface Manipulation and Terrain Synthesis by Example

Abstract

Generating realistic terrain data can be tediously and costly (both in the real time visualization as well as material expenditure). The objective of this project is to produce an application capable of allowing a user to generate using constrained surface modeling a unique and aesthetically pleasing basis model for use in a terrain synthesis by example to add refined detail to the surface that will make the terrain appear realistic enough for use in animation, film, game design, or simulations.

Introduction

The project is a culmination of two publications. The first being an exploration of Local Modification for constrained meshes, the second being Terrain Synthesis by Example.

Local modifications of constrained meshes is a useful technique for producing clean and wildly varied surface meshes that do not suffer from the traditional issues of global modification and having locally modified patches that smoothly integrate with the rest of the surface.

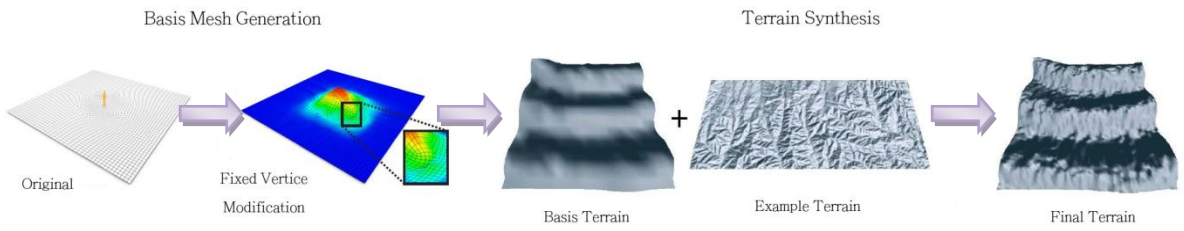
These generated surface meshes provide a terrific, easily modifiable surface that can then be used as a basis mesh for a terrain synthesis by example. This will add the realistic and varied feel of actual terrain to our newly produced basis surface.

The final result being a unique tool for users to design widely varying terrain basis' and transforming them into highly realistic looking terrain models with nothing more than an example terrain and simple modifications to a surface mesh.

Methodology and Timeline

The project has a clear division of goals that must be completed to produce the end product. Firstly, the implementation of a constrained surface modeler is needed to create the basis meshes that will be used in the terrain synthesis with an example mesh. Secondly, the terrain synthesis which will take the output of the surface modeler and with the user's example terrain, produce a higher resolution model with new higher resolution detail.

These two processes may be developed individually, as long as the output of the constrained surface modeler is compatible with the input for the terrain synthesis.



Process of manipulating a mesh into a basis terrain via constrained modeling, followed by its synthesis into a finalized terrain mesh.

The process of performing a constrained surface manipulation is somewhat more defined than the synthesis and is expected to take less time.

There are two methods described in "Terrain Synthesis by Example" for performing the actual mapping of the basis models features to matching features in the example terrain. A decision will have to be made between performing manual (human aided) or automatic synthesis of these matching terrains. This may largely depend on the simplicity of implementation given time constraints, or more likely, based upon the quality of the synthesized terrain given either process. Ideally, both would be implemented to allow user choice to enter, improving upon the features of the end application.

Based upon the Terrain Synthesis by Example's recommendation, the Chaikin MRA method will be used to capture the individual details of associated areas to produce a unique terrain, given a unique example terrain.

Any remaining time left to the project will be placed in optimizing the usability of the process. That is, improving the interface. This will likely be largely associated with the human aided matching of the basis and example terrain and editing the basis terrain mesh. It is proposed in "Terrain Synthesis by Example" that brushes be used to select associations between the basis terrain and the example terrain. Editing the basis mesh will likely involve developing standardized modeling tools similar to Autodesk Maya or Mudbox for scale, deformation, and translation using constrained surface manipulation.

Resources

The project will be wholly developed for Microsoft Windows, built using Visual C# and Visual Studio. Graphical components will be visualized using the OpenTK C# libraries. Processing may be optimized off the CPU onto the GPU via OpenCL to decrease processing times.

Citations

Terrain Synthesis by Example
John Brosz and Faramarz F. Samavati and Mario Costa Sousa, "Terrain Synthesis by Example," In Advances in Computer Graphics and Computer Vision, pp. 122-133, 2007.

Exploring Local Modification for Constrained Meshes
Bailin Deng and Sofien Bouaziz and Mario Deuss and Juyong Zhang and Yuliy Schwartzburg and Mark Pauly, "Exploring Local Modification for Constrained Meshes," Computer Graphics Forum (Proceedings of Eurographics 2013), [online] 2013, http://lgg.epfl.ch/projects/LocalMod (Accessed: 18 October 2013).