Continuous Transitions from Realistic Stylized Rendering with an Application to Navigation

Doctoral Thesis Topic

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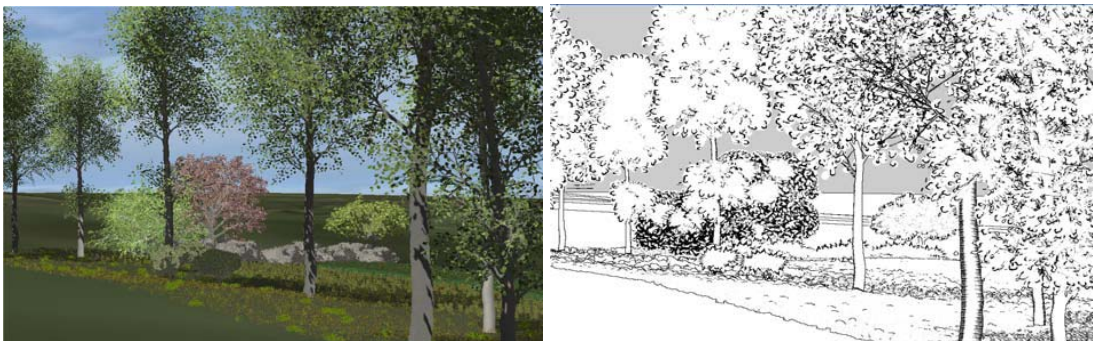
Navigation in virtual environments can benefit from the use of abstract or expressive rendering styles (also called "non-photorealistic rendering"). However, in most virtual environments today, high levels of realism are often required in many situations. In particular, novel, fast global illumination algorithms, such as [Ritschel08] can be used to present high quality illumination for such scenes. Imagery of such quality is often desirable in computer games or in urban simulations. There has been recent interest in “expressive” renderings for map-like views of cities in the context of the multiple virtual tourist applications such as GoogleMaps/GoogleEarth or VirtualEarth (e.g., [Grabler08]).



Left: Realistic (direct lighting only) rendering and Right: pen-and-ink rendering (from [Coconu06]

In previous work, little attention has been paid to defining continuous transitions from realistic rendering (potentially including global illumination), to more expressive or abstract styles which depend heavily on the task at hand. In this thesis we will investigate how to achieve smooth and meaningful transitions between photorealistic illumination, including global illumination effects and expressive rendering styles, such as the Gooch NPR lighting model ([Gooch98]) or pen-and-ink styles (e.g., [Coconu06]) or even watercolor. We will investigate how to maintain both spatial and temporal consistency when performing transitions between styles for various rendering elements. We plan to start with realistic rendering with high-quality illumination and shadows, including those from indirect light, and move on to the treatment the colors and materials. We expect that image analysis techniques recently introduced in computer graphics, such as the bilateral filter will be part of the tools used to achieve these goals.

The input for this work will be both entirely synthetic models, using traditional textures, and also image-based models of facades of buildings for example. These models could include approaches which combined image-based and procedural methods.

To evaluate the success of these algorithms, we will concentrate on styles appropriate for navigation tasks in Virtual Environments. This will include ``map-like" abstract rendering styles when using a global ``map-view" of the environment, as well as styles which are appropriate for ``first-person" viewing. We will also investigate cases where hybrid styles are appropriate, for example using realistic rendering for landmarks, and abstract renderings for the less important parts of the scenes. Navigation task performance will evaluated with user tests in appropriate situations.

This work will be related to the ARC INRIA project NIEVE which has recently received funding, including for a postdoctoral fellow, and will be in collaboration with the ARTIS research group in Grenoble.

Requirements

The successful candidate should have a Masters degree in Computer Science, and have preferably taken courses in computer graphics and have experience in computer graphics programming, with knowledge of OpenGL or DirectX, and some experience with shading languages such as GLSL/HLSL/Cg.

References

[Coconu06] Liviu Coconu, Oliver Deussen, Hans-Christian Hege Real-time pen-and-ink illustration of landscapes, NPAR 2006. http://graphics.uni-konstanz.de/publikationen/index.php?language=english#2006

[Grabler08] Floraine Grabler, Maneesh Agrawala, Robert W. Sumner, Mark Pauly Automatic Generation of Tourist Maps, SIGGRAPH 2008 http://www.floraine.ch/berkeley%20site/Automatic%20Generation%20of%20Tourist%20Maps.htm

[Ritschel08] Tobias Ritschel, Thorsten Grosch, Min H. Kim, Hans-Peter Seidel, Carsten Dachsbacher, Jan Kautz, Imperfect Shadow Maps for Efficient Computation of Indirect Illumination, ACM Trans. on Graphics (Proceedings SIGGRAPH Asia 2008), 27(5), 2008. http://www.uni-koblenz.de/~ritschel/

[Gooch98] Amy Gooch, Bruce Gooch, Peter Shirley and Elaine Cohen , A Non-Photorealistic Lighting Model For Automatic Technical Illustration (SIGGRAPH 1998). http://www.siggraph.org/publications/bibliography/index.php?detail=11591