Interactive landscape visualization

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Abstract

In recent years the development of graphics hardware and efficient rendering algorithms enabled researchers and game developers to create and render large landscapes with interactive rates. However, the shown scenes are still rough approximations that do not reach the complexity of real nature. To obtain sufficient simulations, a couple of problems have to be solved.

Creating a good scene requires powerful modelling algorithms on different levels. First a sufficient set of plant models has to be created. Nature is very diverse: modelling the most important plants that are found in Europe requires thousands of different models, and this is why efficient modelling algorithms for plants have to be found. In the talk I will present our xfrog modelling system, which was designed for that task.

The plant models then have to be combined to a virtual landscape. At this stage another modelling program is needed that enables the user to edit a huge number of small objects. Even a small garden consists of tens of thousands of plants, one square kilometre incorporates billions of single plants, and even storing the plant positions is here a problematic task. The plants interact with each other; complex patterns arise due to seeding mechanisms and the fight for resources. Sometimes, the development of a landscape has to be simulated.

Having modelled plant models and positions, we end up with tons of geometry even for a small landscape. A single tree model consists sometimes of millions of surfaces, a forest of billions. Efficient level-of-detail algorithms are necessary to obtain interactive rendering with these scenes. This can be done by representing the plant models by billboards or point clouds. The size of the representation is computed for each model and frame and thus allows us to carefully adapting the shown geometry to what is necessary.

Rendering the models is also an interesting problem. The interaction of light with the plant surfaces and especially leaves is not trivial. Subsurface scattering and different optical properties of plant tissues makes it necessary to adapt standard rendering techniques to these models. Especially for hardware rendering this is a complex task.

In the talk I will outline our modelling and rendering pipeline and show some of the algorithms we implemented. Also I will review the problems and frontiers we currently focus while solving our goal of rendering one square kilometre of nature at interactive frame rates.

Speaker Bio

Oliver Deussen graduated in 1996 at the University of Karlsruhe about graphical simulation techniques. From 1996 to 2000 he was research assistant at the Department of Simulation and Computer Graphics at the University of Magdeburg.
In 2000 he received an associate professorship at the Dresden University of Technology. Since 2003 he is full professor at the University of Constance and chair head for computer graphics and media informatics. His research topics include modelling and visualization of complex landscapes, non-photorealistic rendering and information visualization.