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Science-Driven Immersive Environments for Land Management Simulations

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Abstract

Our research explores automated techniques for visualizing environmental processes and land management decisions. The resulting 3D environment models provide a more realistic look and feel for simulated outcomes than 2D or 2.5D GIS maps and extracted statistics. Automated model generation reduces workflow complexity and increases fidelity by directly coupling science inputs with 3D output.

Urban and environmental scenes are generated within CityEngine utilizing GIS data from various sources. Procedural modeling is applied to create realistic 3D views of alternative scenarios predicted by the Envision integrated planning and environment assessment tool, as well as to visualize discrete events such as fire and firebreak placement. Simulated environments also hold the potential for development of virtual data-generation and collection tools, such as light detection and ranging (LIDAR) scanning.

The resulting 3D models can be explored on a computer, over the web, or in the form of interactive games (utilizing Unity3D), which can further incorporate science results and management policy. The presented tools have been developed to prototype level. Future work is envisioned to validate the 3D models against the original science and measure the effectiveness for outreach, engagement, and public input collection.

Science-driven Immersive Environments for Land Management Simulations

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Motivation

This research explores automated techniques for visualizing environmental processes and land-management decisions. The resulting 3D environment models provide a more realistic look and feel for simulated outcomes than 2D or 2.5D GIS maps and extracted statistics. Automated model generation reduces workflow complexity and increases fidelity by directly coupling science inputs with 3D output.

This project seeks to develop simple and accessible illustrative tools that will allow users to directly observe and intuitively interact with simulations, computations, and data flows; a common definition of visualization. Automation is a key performance parameter to retain the scientific validity, testability, and repeatability of the underlying growth models.

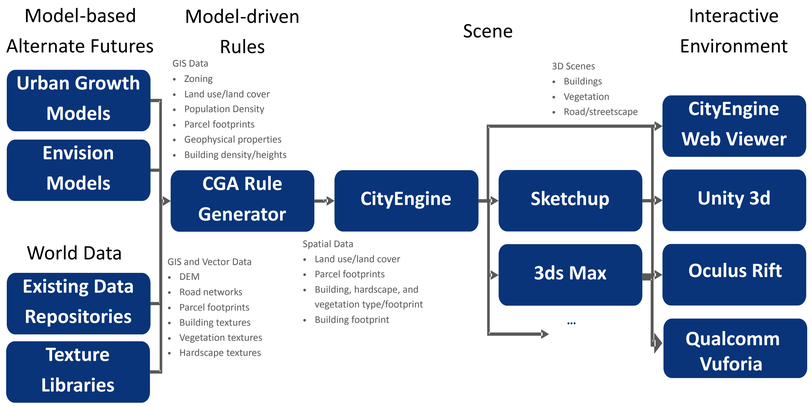

Figure 1: Block diagram of visualization process. Data extracted from alternate futures and the current state are converted to interactive visual models.

Research Procedures and Goals

The goal is to automate procedures to produce scenario-based visualization of both environmental[1]and urban-growth model-driven scenarios.

- Urban and environmental scenes are generated within CityEngine utilizing GIS data from a variety of sources. Procedural modeling is applied to create realistic 3D views of alternative scenarios predicted by the Envision integrated planning and environmental assessment tool
- Visualize discrete events such as fire and firebreak placement, utilizing standard GIS formats
- Simulated environments also hold the potential for development of virtual data-generation and collection tools, such as light detection and ranging (lidar) scanning
- The resulting 3D models can be explored on a computer, over the web, or in the form of interactive games, which can further incorporate scientific data or management policy

References

[1] ENVISION Integrated Modeling Platform http://envision.bioe.orst.edu

[2] CityEngine Software http://www.esri.com/software/cityengine

[3] Unity3d Software http://unity3d.com/unity

[4] Esri CityEngine, Unity 4.0 and the Oculus Rift (Zekiah Technologies Inc) http://www.zekiah.com/index.php?q=blog/2014/02/04/esri-cityengine-unity-40-and-oculus-rift /

[5] Oculus Rift https://www.oculus.com/

[6] *3D laser range finder simulation based on rotated LMS SICK 200,* Będkowski, Kretkiewicz, Masłowski (2007) http://www.robot.uji.es/documents/rise08/reports/Bedkowski.pdf

Figure 2: Sample urban development scene from CityEngine, utilizing GIS texture, parcel, and Boise street map data.

CityEngine

Esri CityEngine improves urban planning, architecture, and design by utilizing 3D visualization power to see the relationships of projects, assess their feasibility, and plan their implementation. CityEngine even allows you to publish your 3D model online, where others can interact with it, understand your urban plan, and participate in improving their community.

Unity 3d

Unity is a game development ecosystem: a powerful rendering engine fully integrated with a complete set of intuitive tools and rapid workflows to create interactive 3D and 2D content.[3]

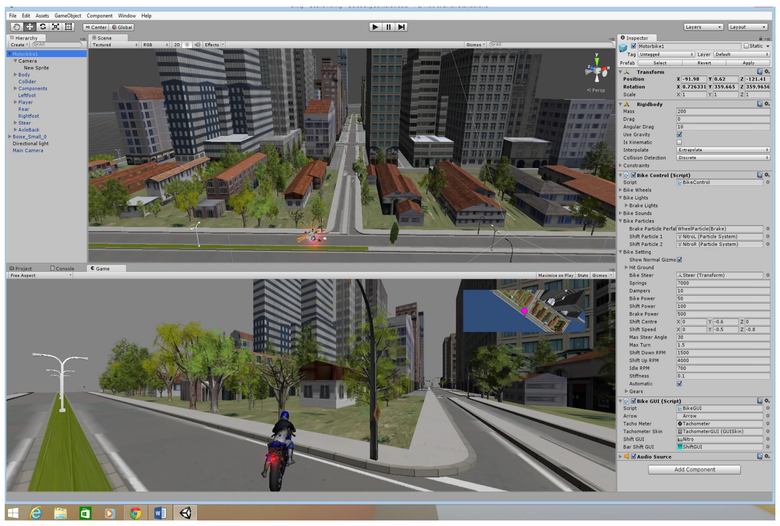

Figure 3: Sample CityEngine scene exported to Unity 3d with added player controller.[4]

Oculus Rift

The DK2 development kit from Oculus Rift allows developers to build games and other immersive experiences for the Oculus Rift virtual reality headset.[5]

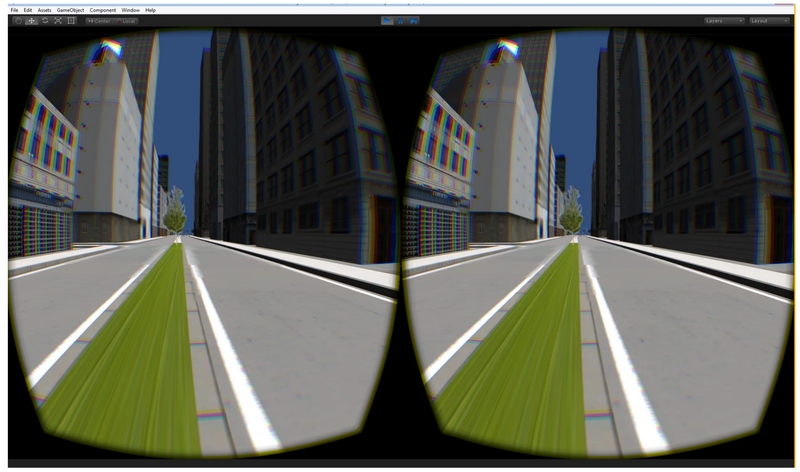

Figure 4: Sample CityEngine scene exported to Unity 3d and viewed through Oculus Rift headset.

Lidar

Ground-based light detection and ranging (lidar) is an approach to high-resolution surface model generation. Below is output from a Unity module that simulates a lidar system based on the LMS SICK 200. This example produces 180 scan lines at the rate of three scans per second. Further research is warranted to determine the potential applications of this system.[6]

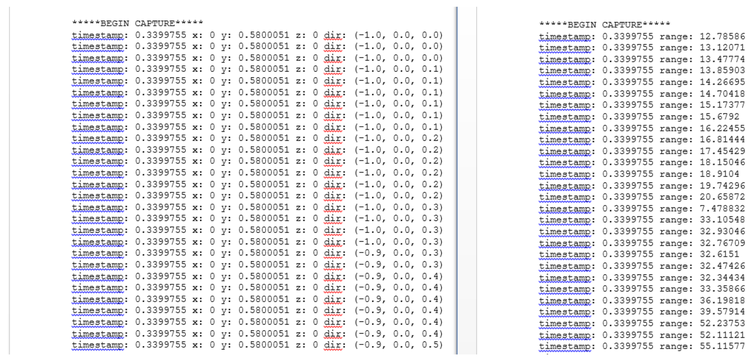

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Figure 5: Simulated ground-based LIDAR data collection output from Unity 3d