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 ,odel generation reduces workflow complexity and increases fidelity by directly coupling science inputs with 3D output.

Balancing the need for economic growth with myriad environmental concerns is a challenge faced by governments at all levels. Effective forecasting, strategic planning, and regulatory implementation all benefit from timely communication and stakeholder engagement[1]. 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.

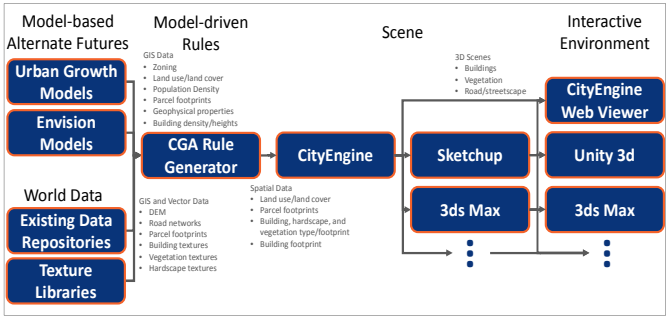

Figure 1: Block diagram of visualization process. Data extracted from alternate futures and the current state are converted to interactive visual models.

Research Goals

The goal is to automate procedures to produce scenario-based visualization of both environmental[2]and urban-growth model-driven scenarios.

- Produce interactive visualizations of Treasure Valley alternate futures using CityEngine[3]and procedural modeling to generate realistic 3D buildings, trees, and land cover
- Visualize discrete events such as fire and firebreak placement, utilizing standard GIS formats
- Integration with Forest Vegetation Simulator, which has the potential to represent stands according to prescribed climate and management protocols
- 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

Acknowledgements

- All of the Idaho ESPCoR project staff and collaborators on 2014 CI-Viz iSEED
- This project is supported by NSF award number IIA-1301792 from the National Science Foundation. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of NSF

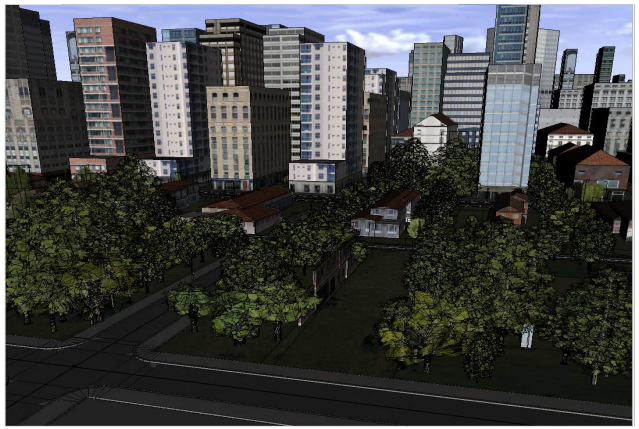

Figure 2: Sample urban development scene from CityEngine.

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 allows users to analyze development scenarios from every angle to see how they fit into a city's overall vision for the future. Making the virtual 3D visualization as real as possible in the design phase helps avoid costly mistakes in the building phase. 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.

Figure 3: CityEngine webviewer scene with Fire Break before and after views

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.[4]

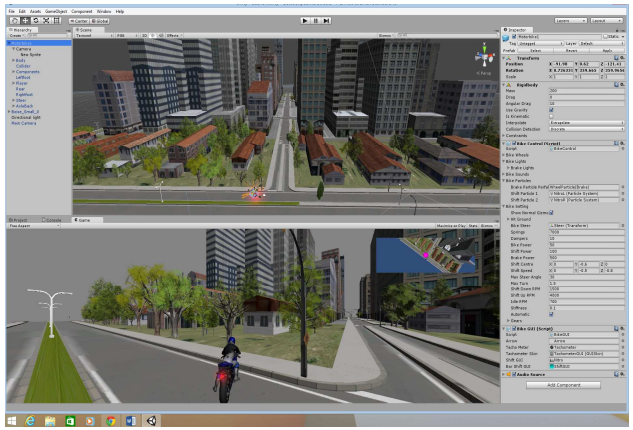

Figure 4: Sample CityEngine scene exported to Unity 3d with added player controller.[5]

Forest Vegetation Simulator (FVS)

FVS is a family of forest growth simulation models. It is a system of highly integrated analytical tools that is based upon a body of scientific knowledge developed from decades of natural resources research and experience.

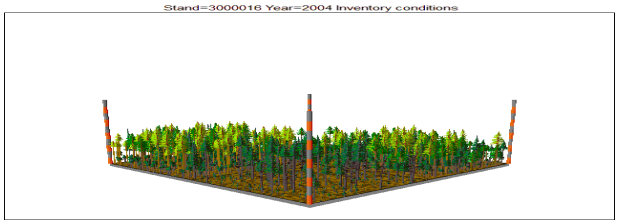

Figure 5: Sample FVS stand visualized with existing Stand Visualization System (SVS).[6]

References

[1] Cheng, N., et al, (2013), Data-Driven Illustrations for Climate-Smart Communities Scenarios, Technical Report, Oregon Transportation Research and Education Center (OTREC)

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

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

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

[5] 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

[6] Forest Vegetation Simulator (US Forest Service) http://www.fs.fed.us/fmsc/fvs/