Integrating Visual Quality Modeling within an Agent-Based Hiking Simulation for the Swiss Alps

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While the visual qualities of a landscape are often key factors in attracting and retaining tourist visitors, they have been overlooked in recent simulation approaches to recreation modeling. While there has been a long history of modeling the visual quality of a landscape, particularly in forestry, due to computational restrictions these models have tended to be rather coarse and primarily suited for avoiding catastrophic impacts due to large-scale interventions in a landscape. However, the experience of the visual quality of a landscape for recreationists is much more subtle. Relatively small changes to spatial patterns and land use, when viewed cumulatively, can have a large impact on the attractiveness of a landscape for tourists. Methods for evaluating the changing visual quality of a landscape are invaluable for comprehensive long-term landscape planning.

This paper describes a computational approach for integrating visual quality information into an agent-based simulation of summer hikers in the Swiss Alps. The benefits of microscopic modeling (where the activities of individual hikers are simulated) is combined with detailed 3D models to provide the possibility of a highly nuanced visual quality analysis of a recreational area. Using real-time computer graphics techniques, simulated agents interpret computer generated 3D images of what they 'see' as they move through the landscape. Various landscape metrics are calculated based on these representations, including visual quality indicators such as view composition, enclosure, and depth of view. These metrics are evaluated over the course of an agent's hike, and integrated with more traditional parameters (such as hike distance, steepness, congestion and availability of amenities) in an agent-based simulation. Unlike other raster based visual quality models, analyzing 3D representations allows the model to easily incorporate subtle screening effects, and allows the model to determine visibility from any location in the model. The technique allows for very detailed visual representations, and scales easily to include more detail as required by the analysis. Currently, the model represents terrain, vegetation communities, structures, path and road networks and information aids such as signage.

The paper describes a working implementation of the technique, and discusses its advantages and limitations, including its substantial data requirements. The paper uses a specific case study in the Gstaad-Saanenland region of Switzerland to articulate how this integration of visual information within an agent-based simulation has advantages over more traditional methods of visual quality modeling. Approaches for integrating the entire modeling system into a scenario-based planning process are also discussed.