Landscape and Urban Planning 100 (2011) 403–406

Contents lists available at ScienceDirect

Landscape and Urban Planning

journal homepage: www.elsevier.com/locate/landurbplan

99 volumes later: We can visualise. Now what?

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ARTICLE INFO

Article history:
Available online 3 March 2011

Keywords:
3D landscape visualization
Visual simulation
Virtual reality
Augmented reality
Landscape planning
Landscape design

ABSTRACT

The early years of landscape and urban planning coincided with the start of the era of digital landscape visualizations, and work published since then has contributed to advancements in representation, assessment, and decision-making in landscape planning and design. This paper examines the journal's articles on landscape visualization published over its 99 volume history (1974–2011), noting technological advances, case studies, and research topics and questions considered to be important during this time. This work is then examined in the context of subsequent developments in the field of landscape visualization in terms of distinct research areas, directions, and topics reflected in the publications. From this analysis, the paper presents an outlook on future challenges for research and practice that includes themes such as the diffusion of 3D visualization in our everyday environment, linking visualizations with underlying models, going beyond highly realistic but simply descriptive visualizations, using visualizations in an assessment and decision-making context, and incorporating multi-sensory experiences. It also considers the prospects for further technological advancements such as augmented reality for making decisions in the planning and design of our future environments.

1. Introduction

"Landscape and urban planning" are the words selected as the name of this journal; as an interdisciplinary focus of concern, they also refer to activities concerned with natural and urban environments of the past, present, and most importantly, the creation of future environments. Both the journal and the discipline deal with the study, analysis, planning, and design of biophysical and social environments that integrate a range of sensory qualities. Humans in turn possess a suite of perceptual systems that allow them to sense these qualities: an auditory system (the sense of hearing), a tactile system (the sense of touch), a kinaesthetic system (the ability to sense and coordinate movement), a vestibular system (the sense of balance), an olfactory system (the sense of smell), a gustatory system (the sense of taste) and a visual system (the visual sense). Of all the senses, the visual sense is by far the dominant component of human sensory perception (Bruce et al., 1996). Fortunately, for landscape and urban planners and designers, the visual environment with its range of stimuli can be represented via a palette of analogue and digital media as an essential means for communicating to experts and the public in planning and design.

This paper examines the journal's articles on landscape visualization published over its 99 volume history (1974–2011), and its contribution to the representation, assessment, and decision-making in landscape planning and design in a wider context. From this analysis, the paper presents an outlook on future challenges for research and practice and considers the prospects for further technological advancements.

2. Technological advances

Within only a few decades, contemporary Western society has evolved from being dominated by digital immigrants to a society and professional world now dominated by digital natives. In this short time span, tools and techniques for representing our world using 3D visualization have diffused into our everyday environment. Unborn babies can be seen in 3D ultrasound. Children of a few years play with 3D computer games, as do young adults, parents, and even some grandparents. Multiple generations can watch the weather forecast together in 3D on a new 3D TV screen; enjoy a multi-sensory 4D cinema and other futuristic movie experiences; travel to remote areas with a satellite navigation system that shows the environment in perspective view; and virtually "fly" around the world using Google Earth to explore remote environments through data streamed over the Internet (cf. Sheppard and Cizek, 2009), showing 3D representations of terrain and land use imagery tagged with a rich array of textual information. As landscape and urban planners and designers, how will we cope with the expectations of this new cohort of visual sophisticates?

While in previous decades visual representation techniques were only very sporadically utilised, they have now become a standard in landscape research and practice. The array of tech-

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doi:10.1016/j.landurbplan.2011.02.016

niques at our disposal is broad; physical models, drawings, and paintings have rapidly evolved into virtual realities and Internet-based visualizations. 3D landscape visualization has developed from an expensive technology requiring specialized equipment into an essential tool for landscape design, planning and management, accessed in the field on small tablet computers and mobile phones. Sophisticated 2D and 3D software is even available for free. Also within the last few decades, digital landscape representations have developed from abstract and static representations to highly realistic visualizations capable of being explored through dynamic spatial movement, with the potential to provide an immersive experience in multiple spatial and temporal scales.

Digital 3D visualizations have now become a common feature in landscape and urban planning, in reference to both this journal as well as the discipline. The use of visual representations based on digital or virtual environments is well established in planning statements as part of Environmental Impact Assessments, design competitions, and site development – just think of all those large display boards one sees these days showing a design proposal posted next to the actual construction site. In each of these cases, the purpose of the visualizations is to communicate with the public or potential clients. To a certain degree not yet investigated by the research community, visualizations also serve an internal communication function among experts of different (or within the same) disciplines working on a joint project. In terms of content, landscape visualizations still focus on the final product of a planning and design process.

3. Case studies and areas of research: a timeline of published articles

In the early 1970s, the US Forest Service was a major driver in developing new methods for landscape assessment as well as new techniques of landscape representation. The first published paper in this journal that introduced 3D computer graphics was thematically focused on the visual management of forested landscapes over time (Myklestad and Wagar, 1977). Most parts of the paper, however, concentrated on the technology itself. Rather abstract tree and ground cover symbols were used to communicate landscape changes caused by timber harvesting. It was published only two years before the highly influential 1979 Lake Tahoe conference "Our National Landscape" (Elsner and Smardon, 1979), which included state-of-the-art methods of digital landscape representation and landscape assessment.

In the early 1980s, in Berkeley, Syracuse, and Lund, "modelscopes" comprising a miniature lens and camera hung from overhead gantries enabled researchers to explore alternative planning scenarios within analogue, physical models and to study urban landscape perceptions from a visual and dynamic perspective (Smardon, 1988). In 1990, digital photomontages and photo editing, now standard tools of landscape architectural education and practice as well as landscape research, were for the first time introduced in *Landscape and Urban Planning* to explore vista management options in Acadia National Park in response to anticipated landscape change (Lange, 1990).

Since 1990 there have been three major Special Issues of *Landscape and Urban Planning* published that have helped spur interest in the visualization and modelling of landscapes in the research community. The first focused on "Data Visualization Techniques in Environmental Management" (Orland, 1992) and addressed visualization linked to the modelling of environmental systems including air pollution, fire history, ozone concentration, ocean currents, and forest pest impacts. While the modelling-visualization linkage is in need of further research, especially considering the advent of real-time interactive technologies, many of the basic technical difficulties regarding software, hardware and data have now largely been resolved.

A second Special Issue appeared shortly thereafter and focussed on "Landscape Planning: Expanding the Tool Kit" (Bishop, 1994). It covered new approaches to GIS-based landscape visualization and modelling and introduced the concepts of cellular automata and autonomous agents. Cellular automata act based on rules affecting neighbouring cells of a grid, while autonomous agents are able to pursue programmed goals (such as finding a route on a mountain top, Cavens et al., 2003), which can also include learning or communicating with other agents.

The third and most recent Special Issue dedicated to this topic was from the 1999 Ascona conference, "Our Visual Landscape: Analysis, Modelling, Visualization and Protection" (Lange and Bishop, 2001). It addressed landscape assessment, GIS-modelling, visual representation, and perceptual issues in digital landscape representation. These included questions of realism and perception of simulated landscapes as well as representational validity and criteria (Bishop et al., 2001; Danahy, 2001; Lange, 2001; Sheppard, 2001), previously cited as important topics for research by several authors in the earlier special issues.

The relative ease of use of the digital photomontage (Lange, 1990) revolutionized landscape preference research, allowing investigators to digitally create images of alternative landscapes instead of relying on photographs of existing landscapes. Furthermore, by systematically varying features and their combinations within rigorous factorial designs, investigators could quantitatively determine the importance of each feature (independent variables), the functional form of their relationship with preference measures (dependent variables), and the interaction effects among features. These and related approaches resulted in numerous applications to landscape design and planning, as evidenced by a large number of research publications in this area (recently, e.g., Lindemann-Matthies et al., 2010; Zheng et al., 2011). Furthermore, in landscape preference research this has also expanded to using virtual landscape models (Lange et al., 2008).

4. Outlook and further questions for research

There are a number of neglected or unresolved research areas requiring further exploration. These include issues of real world dynamics, human perception of landscapes, simulated sensory environments, new and emerging technologies, as well as landscape visualization for improved communication, public engagement, and decision-making (e.g. Lange and Hehl-Lange, 2005).

Nowadays, we can create virtual environments that are highly realistic representations of the real landscape. Does it matter that representations of the appearance and movement of animals and humans, as well as the dynamics of water, atmosphere, and light are less convincingly done? Perhaps, but it also depends on the questions that one would like to answer.

Regarding people's perception of landscapes, both real and virtual, there is a tendency to assume that an image is worth a thousand words. However, we must also consider how landscape stimuli are processed by humans. Perceptions and values attached to proposed landscapes may differ just as they do when associated with real landscapes. Therefore, even the most realistic virtual representations that we create may not be perceived as we intend. Landscape visualizations are illusions—illusions of the past, present and future. We can judge landscape visualizations against their existing counterpart; in many cases the results will be surprising. A plan or design can look plausible when visualized on paper or a screen, but appear and function quite differently when viewed as a real-world space. The challenge of producing realistic visuals is