ICA2011 Workshop on Persistent Problems in Geographic Visualization

From Static to Dynamic Virtual Urban Environment: Challenges and Considerations

Dr. Bo Wu, The Hong Kong Polytechnic University

This century will, for the first time, see over half the world's population living in cities. Making urban environment sustainable and livable is one of today's great challenges. An ideal urban environment very much depends on our knowledge and effective control of the urban static and dynamic components. In recent years, Virtual Urban Environment (VUE) has been pursued, which models the urban geospatial information in a virtual reality vision. 3D digital cities such as provided by Microsoft's Virtual Earth or Google Earth have become incredibly popular. They show strong trends of public interest and acceptance towards virtual urban environments.

Virtual urban environment possess two interrelated aspects. A static aspect refers to the human-made surroundings that provide the setting for human activity, and a dynamic aspect refers to any urban dynamics related to human activities or environmental variations. Recent developments in modeling the static urban components are promising. Techniques using combinations of space-borne, airborne, and terrestrial 2D and 3D data have been proposed, and 3D city models can be produced semi-automatically. While modeling the dynamic urban components are still very rudimentary. This talk will address a few persistent challenges and considerations for pushing further the static virtual urban environment towards dynamic virtual urban environment.

1) The need for 3D city data is immense worldwide, while the methods for generating these models are still immaturity and relatively slow. Development of a more automated pipeline for 3D city modeling from satellite, aerial and terrestrial imagery and/or LiDAR point-clouds is a challenge. Dense and robust 3D point cloud extraction and modeling is a critical issue. High redundancy (e.g., every ground point can be seen in 10 to 15 images) may play a major role in the design of fully automatic methods for high-quality 3D reconstructions;
2) Currently, no operational solutions are available for maintaining and updating 3D city models (4D city modeling), which is a great challenge. 2D change detection techniques have been studied on low-resolution images for a long time, but they are totally inappropriate for 3D objects on the scales considered here. New approaches for automated change detection of 3D city models should be developed. Change detection on high-resolution images with the support of prior knowledge in object space is a potential approach;
3) Nowadays, more geospatial data from a variety of sources (e.g., from satellite, airborne, on-board vehicle, and surveillance systems) are available in urban areas. It is desirable to integrate these multi-platform data to monitor and simulate dynamics in urban environment. Development of methods for extracting, visualizing, and modeling dynamic variations within the urban environment will be a challenge. Development of new active/adaptive vision sensors is necessary for detailed monitoring and modeling of specific urban dynamics (e.g., traffic flow and urban security incidents) in addition to the traditional fixed-vision sensors;
4) The immersive quality and the sense of "being there" are the goals for most of the existing virtual reality products, while interactive dynamics have become very demanding for the next generation of virtual reality applications. Apart from virtually visiting the environment, users want to become interacting parts of the various activities in the virtual environment, which is a significant challenge. The recently developed VRCUHK (Virtual Chinese University of Hong Kong) system presents a good endeavor for interactive virtual reality.