3D User Interfaces

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3D user interfaces (3D UIs) have a long tradition in several specific application domains such as VR and AR, digital-content creation (DCC), computer-aided design (CAD), and visualization. Such interfaces are also appearing in operating systems, PDAs, and mobile phones. The game industry has embraced 3D input as well, and new consoles employ video input, tracking, or depth cameras. Even 3D cinema is making a comeback, and studios are regularly producing stereoscopic versions of movies. Many next-generation television systems are announced as being 3D capable. Hardware, software, and, in particular, users seem ready to deal with a computer-generated 3D world and the corresponding 3D UIs.

3D UIs might take into account the user's head motion, hand motion, and potentially full-body input to provide powerful interaction techniques—not only for dealing with 3D content but also for 2D information spaces. For working with 2D content at the desktop, constraining input and output to planar surfaces appears effective. However, getting up from the office chair and stepping back from the screen doesn't necessarily imply that the user is no longer interested in the displayed information. The user might want to gain an overview of the data or invite colleagues for an informal presentation, which involves direct pointing from a distance—a truly spatial operation.

For 3D content, common 2D interaction facilities might have severe drawbacks regarding efficiency and expressiveness. When a user moves his or her head around in front of a display showing a 3D model, that user is probably trying to obtain a different view of the scene, not doing some morning gymnastics. Head tracking enables this basic, intuitive navigation, which is the most fundamental form of 3D interaction in VR. Tracking heads, hands, fingers, or even full bodies and operating input devices in 3D space enable a rich set of 3D interactions. Such interactions could leverage human motor skills and real-world experiences while letting users focus on their tasks rather than on operating the computer.

In This Issue

During the past several years, the 3D UI community has been significantly expanding, including the establishment of its own research forum: the IEEE Symposium on 3D User Interfaces (for information on the 2010 conference, visit http://conferences.computer.org/3dui/3dui2010). This special issue is another outlet for the rapid developments in this area. It consists of five peer-reviewed contributions: an imaginative tutorial and four high-quality articles selected from more than 30 submissions.

Alexander Kulik's tutorial, "Building on Realism and Magic for Designing 3D Interaction Techniques," discusses 3D UIs in the complementary frameworks of reality- and imagination-based interaction. He suggests an initial taxonomy for imagination-based interaction techniques and argues that interface designs based on the two frameworks will provide a high level of consistency.

Ferran Argelaguet and Carlos Andujar discovered that an occlusion mismatch might exist between what the user's eye sees and what can be selected by a pointing ray emanating from the user's hand. In "Efficient 3D Pointing Selection in Cluttered Virtual Environments," they suggest a novel eye-rooted pointing technique, which performs better than regular ray casting from a hand-held input device.

Karin Nieuwenhuizen and her colleagues identified five task phases during rapid aimed movements in 3D. In "Insights from Dividing 3D Goal-Directed Movements into Meaningful Phases," they argue that the conclusions drawn from such detailed analysis can inform the design and refinement of input devices and interaction techniques much better than overall task completion times and other basic measures.

 Published by the IEEE Computer Society

Marc Wolter and his colleagues developed an approach for exploring temporal data in scientific visualizations. In "Spatial Input for Temporal Navigation in Scientific Visualizations," they evaluate different techniques for temporal navigation based on direct interaction with visualization objects' 3D trajectories. Their spatial trajectory-dragging technique nicely complements the commonly used time slider interface for visualization of temporal phenomena.

Finally, in "Navigation Tools for Viewing Augmented CAD Models," Pierre Fite Georgel and his colleagues present tools for navigating CAD models augmented with images of the actually built object. Their mixed views consistently merge rendered views of the CAD data with real-world photographs for checking discrepancies or AR viewing. One tool employs an adapted pan-and-zoom technique to support constrained navigation within a mixed view; another facilitates navigation between views by automatically selecting the best view in a chosen movement direction.

We're grateful to the authors for the many submitted papers, which provided us with a choice but also a challenge. We thank our expert reviewers for their tremendous job and the editors and staff of *IEEE CG&A*, who provided perfect guidance and support throughout the process.

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