

Exploring and Controlling Multidimensional Parameter Spaces

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Multi-Dimensionality of Simulation Data

Situation

- Simulation data often has spatial properties and a demand for visualization
- Gap between spatial exploration and control of further parameters
 - Usually spatial dimensions are controlled inside the visualization environment
 - Further parameters require complex controls or user has to leave visualization environment

Approach

- Integrated solution for viewpoint motion control and control of multi-parameter space
- Interaction using one hand-held input device
- Separation between Viewpoint Control and Parameters Adjustments

Viewpoint Motion Techniques

- Which size and form factor of the device supports handy control while providing sufficient space for further interaction elements?
 - Which metaphors are suited best for viewpoint control?
- How many degrees of freedom (DOF) are necessary for viewpoint control to provide highest flexibility for motion with good usability?

Approach

- Hand-held device with either built-in sensors or tracked from outside
- Clear separation between translation and rotation

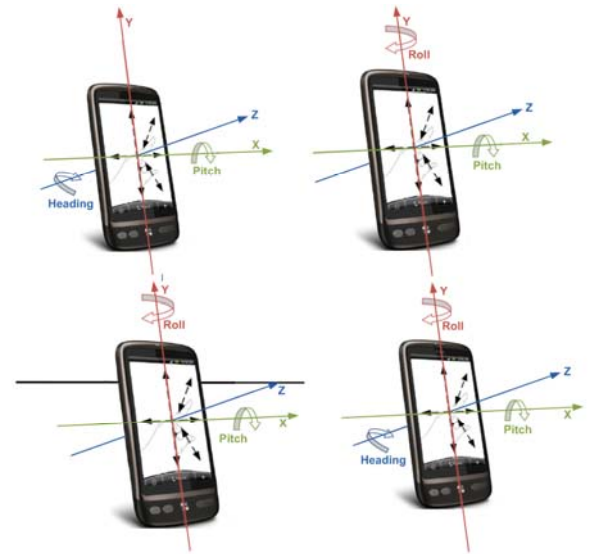
Steering Concepts

One-handed travel technique for virtual environments (right):

- **Touch based translation control:** Thumb displacement on mobile screen maps to viewpoint translation in the virtual environment
- **Steer based rotation control:** Viewpoint orientation is led by the mobile phone orientation. In case of built-in sensors: accelerometer and compass

Two-handed travel technique (below):

- Two simultaneous metaphors: steering-wheel and airplane



From left up to right down:
 (a) Rotate by Heading
 (b) Rotate by Roll
 (c) Rotate by Roll with fixed Horizon
 (d) Merged Rotation

Ongoing Investigation: Integrated Parameter Adjustments

Proposed Solutions

- Usage of 2D metaphors on the touch display: Sliders and two-dimensional cross-sliders
- Integration of 2D touch display and 3D motion of the phone using the built in sensors
- Overlay of parameters adjustment metaphors on basis of widget on visualization, and using a tracked handheld device for selection and touch display for adjustment.

