The YoYo: A Handheld Device Combining Elastic and Isotonic Input

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Overview

Motivation

The YoYo

Interaction

Evaluation

Conclusion
Motivation

Complex interaction

Simultaneous control of many degrees of freedom

Simultaneous control of positions and forces
Motivation

Styling and design

Modeling and deformation of complex surfaces

Chrysler: PT Cruiser
Motivation

Data analysis

Simultaneous navigation and manipulation

Hinckley: Doll’s Head Interface
The YoYo

Interaction device for simultaneous control of 18 degrees of freedom

Design from three elastically connected handles

Combination of position and force input
The YoYo

Handling and use

Two-handed operation with variable handling and grip
Video

Controlling three coordinate systems
The YoYo

Components

One position and orientation sensor

Two elastic force sensors
The YoYo

Components

Assembly

Polhemus, Ascension or Intersense trackers
The YoYo

Force effect

Transformation from device coordinates to world coordinate system
The YoYo

Interactive control of three coordinate systems
Video

Controlling three coordinate systems
Material Simulation

Simulation of a flexible material in real time

Finite element model of a tube
Material Simulation

Pre-computation using Green’s functions

Characteristic response of a linear system
Material Simulation

Mapping of the interaction

Transfer of force input to control points in the simulation
Video

Using the YoYo for elastic deformation
Data Analysis

Scientific and technical application

Cutting planes and volume lenses

Fraunhofer IMK: VRGeo
Data Analysis

Mapping of the interaction

Control of the cutting plane

Navigation by position and force input
Video

Controlling a cutting plane
Evaluation

Informal user evaluation: Talking out loud, interview

Five participants: Three male, two female

Three Demos: “Coordinates” “Tube” “Cutting Cow”
Evaluation

Limited introduction: “Coordinates” “Tube”

No problems with basic operation, concept

“Tube”: Direct mapping of forces, very clear, playful

“Cutting Cow”: Switching handedness

Alternate isotonic, elastic control

Extended learning curve for elastic control

Smooth, soft, “fascinating”, playful
Conclusion

Simultaneous control of many degrees of freedom

Simultaneous control of forces and positions

Simple construction from few complex device components

Interesting & fun to interact with

Learning curve for elastic input