
The YoYo: A Handheld Device Combining Elastic and Isotonic Input

Andreas Simon
Bernd Fröhlich

Fraunhofer IMK
Bauhaus University Weimar

Overview

Motivation

The YoYo

Interaction

Evaluation

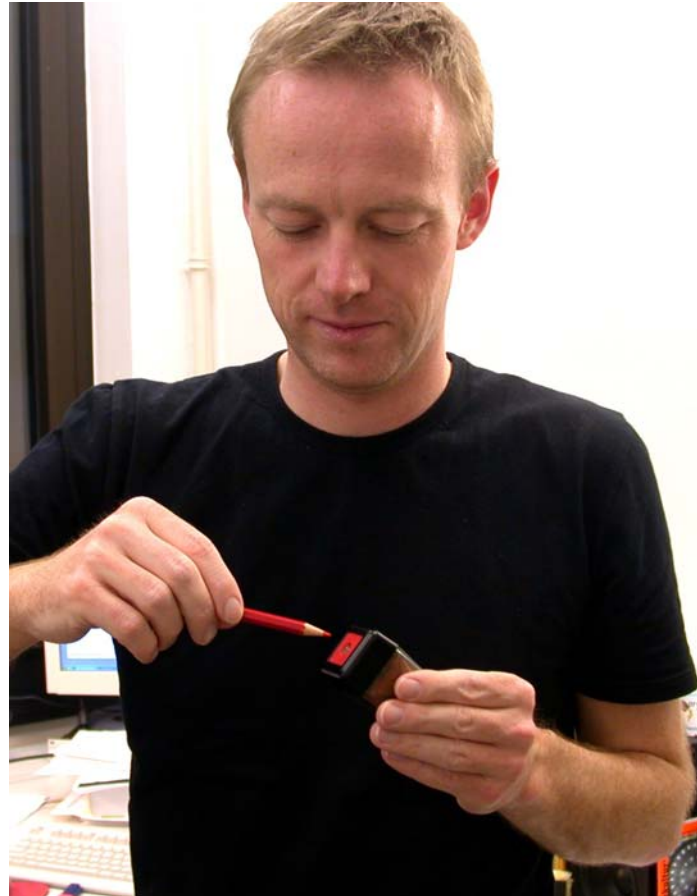
Conclusion

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

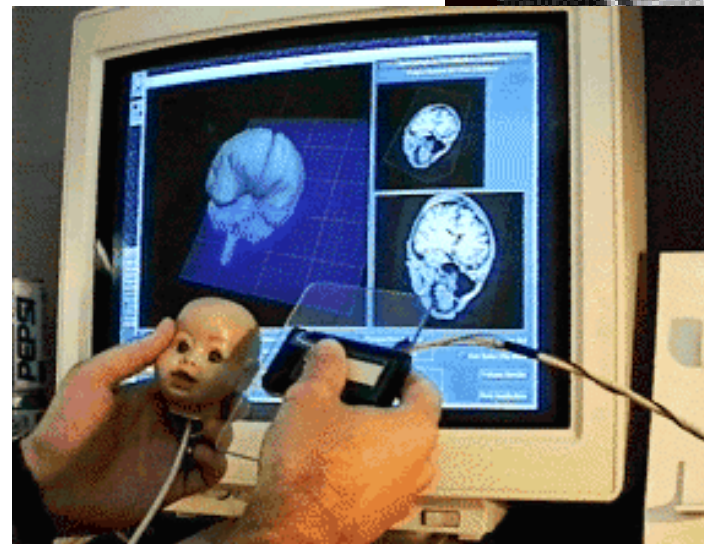
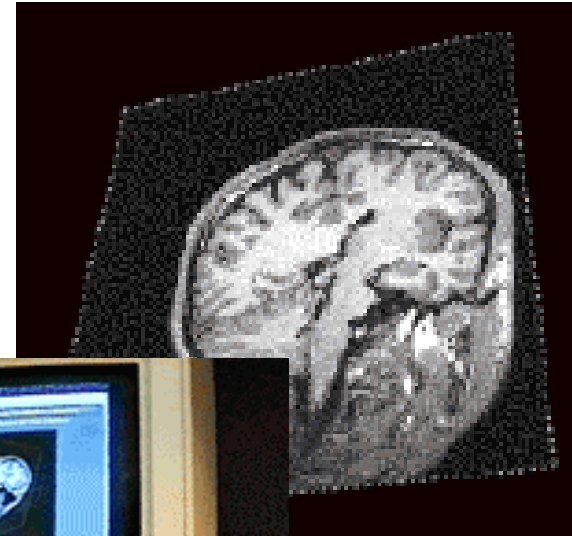


Chrysler: PT Cruiser

Motivation

Data analysis

Simultaneous navigation and manipulation



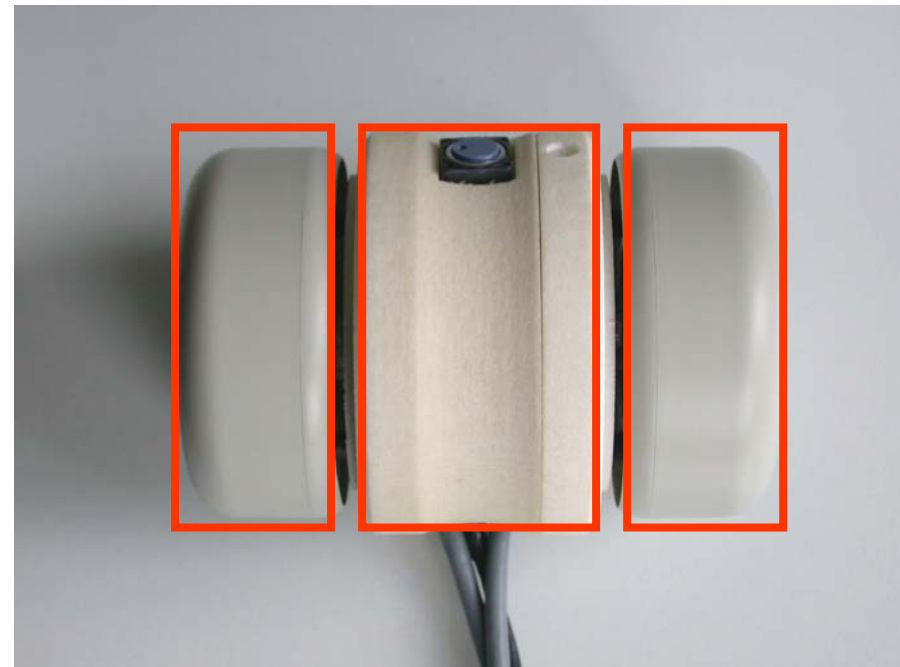
Hinckley: Doll's Head Interface

The YoYo

Interaction device for simultaneous control of 18 degrees of freedom

Design from three elastically connected handles

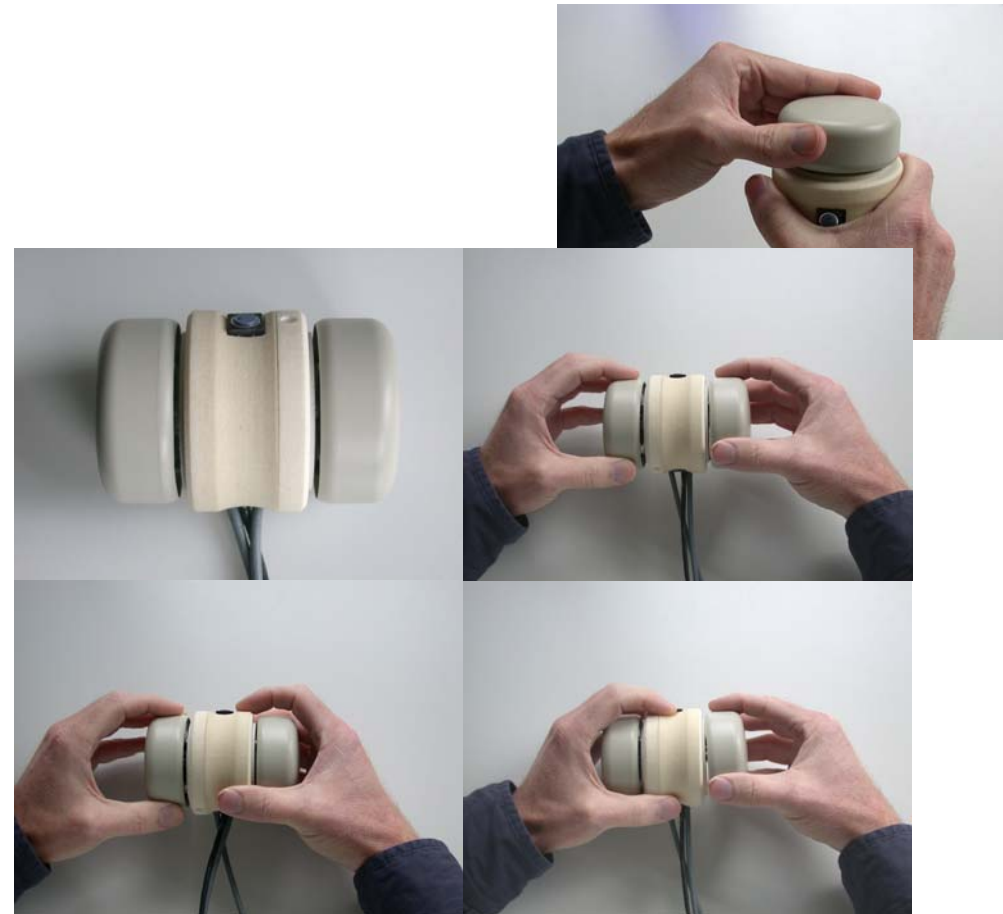
Combination of position and force input



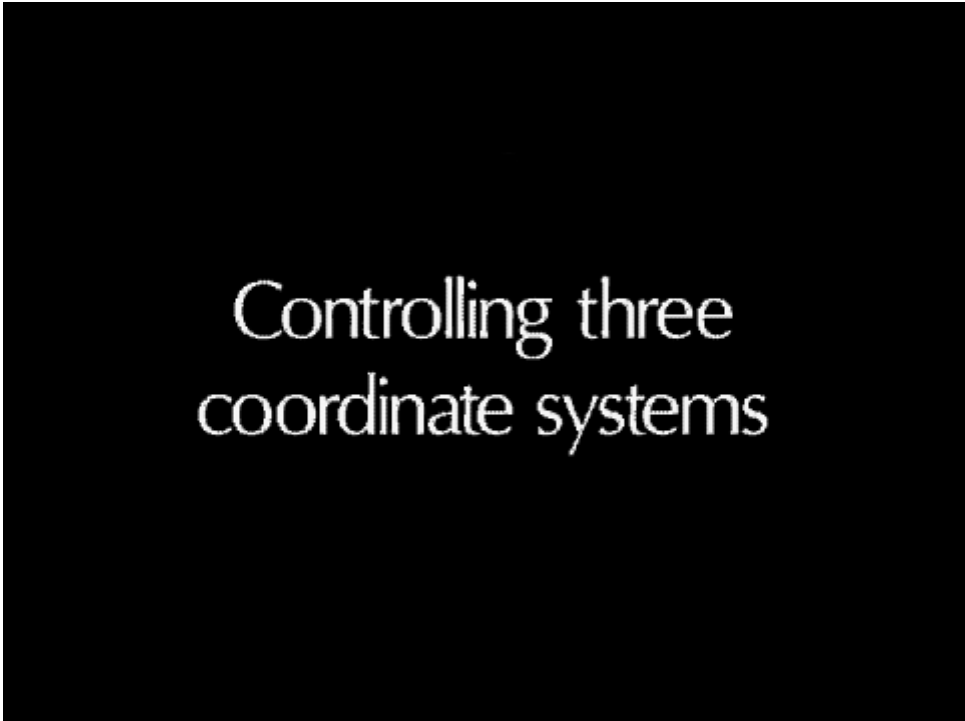
The YoYo

Handling and use

Two-handed operation with variable handling and grip



Video

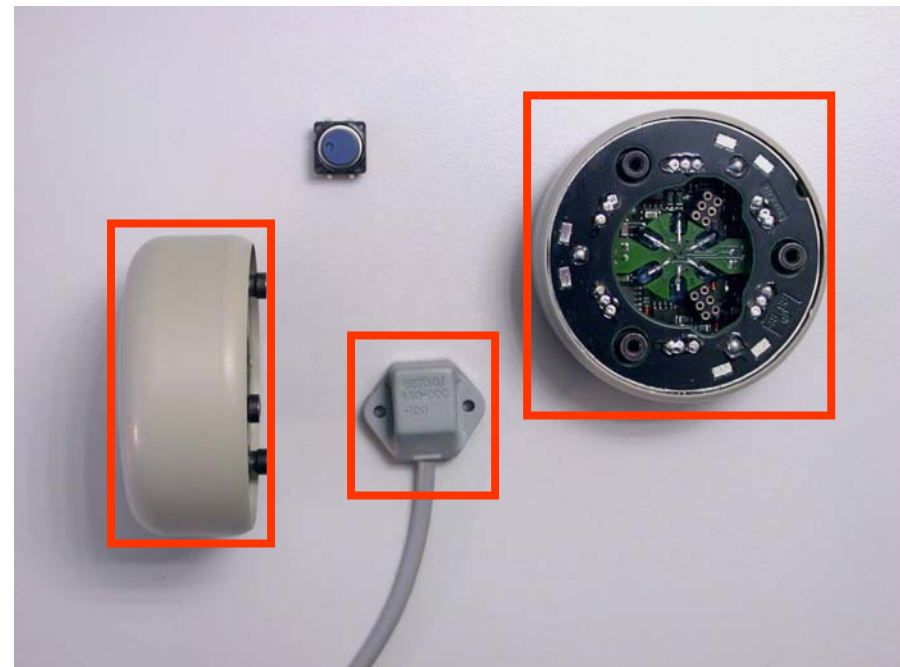


The YoYo

Components

One position and orientation sensor

Two elastic force sensors

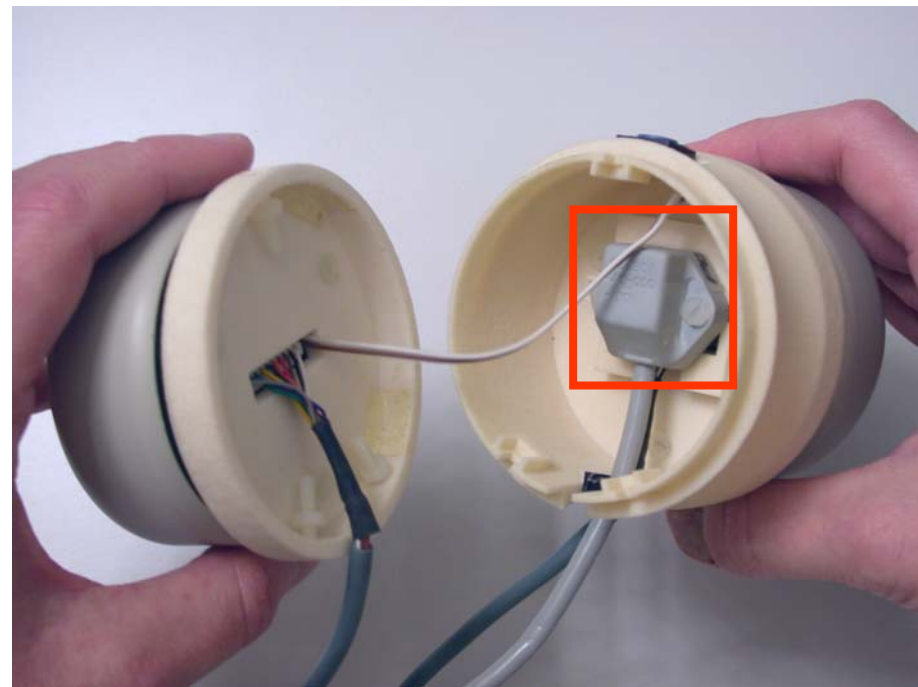


The YoYo

Components

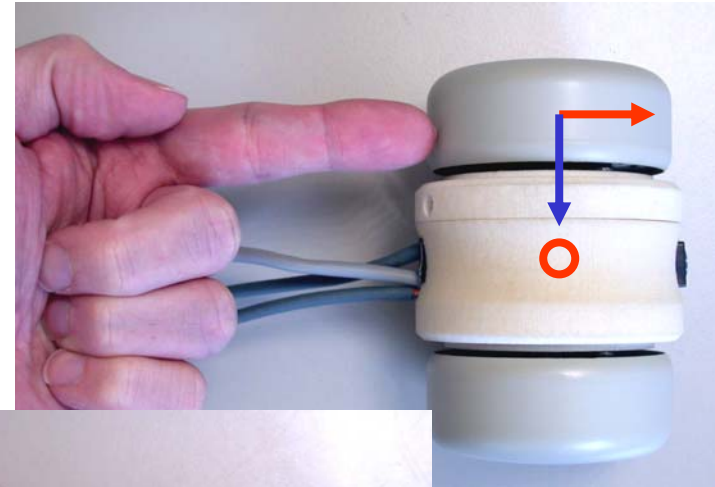
Assembly

Polhemus, Ascension or
Intersense trackers

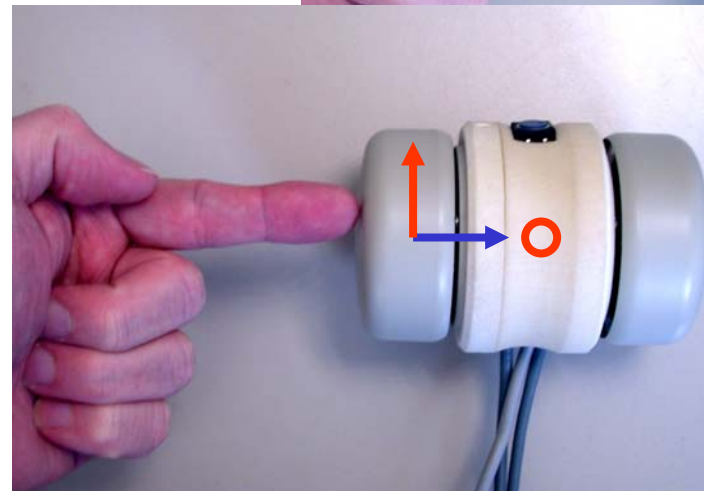


The YoYo

Force effect

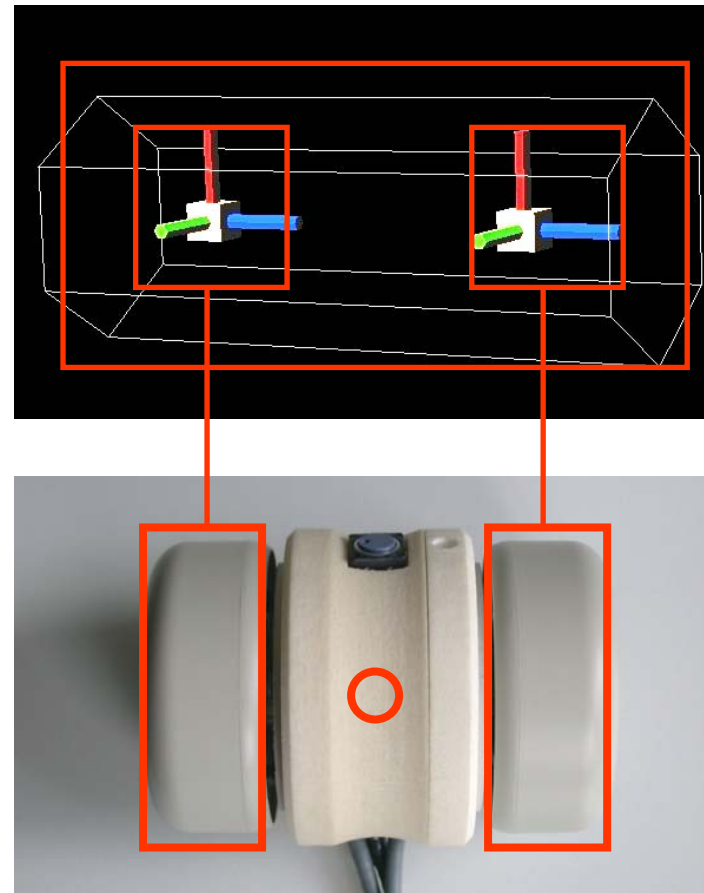


Transformation from device coordinates to world coordinate system

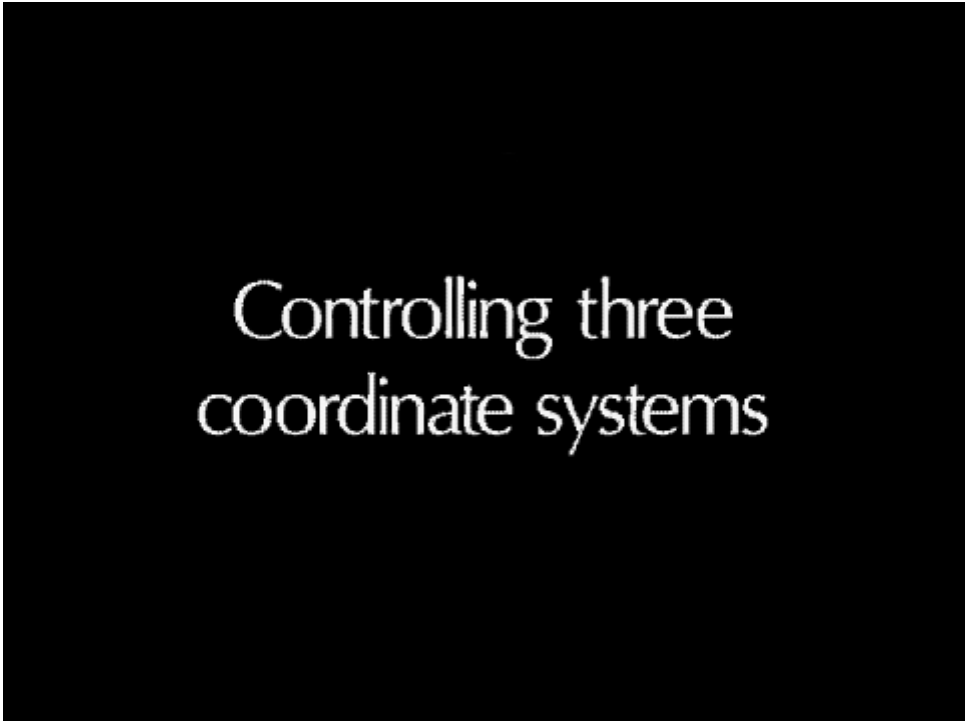


The YoYo

Interactive control of three coordinate systems



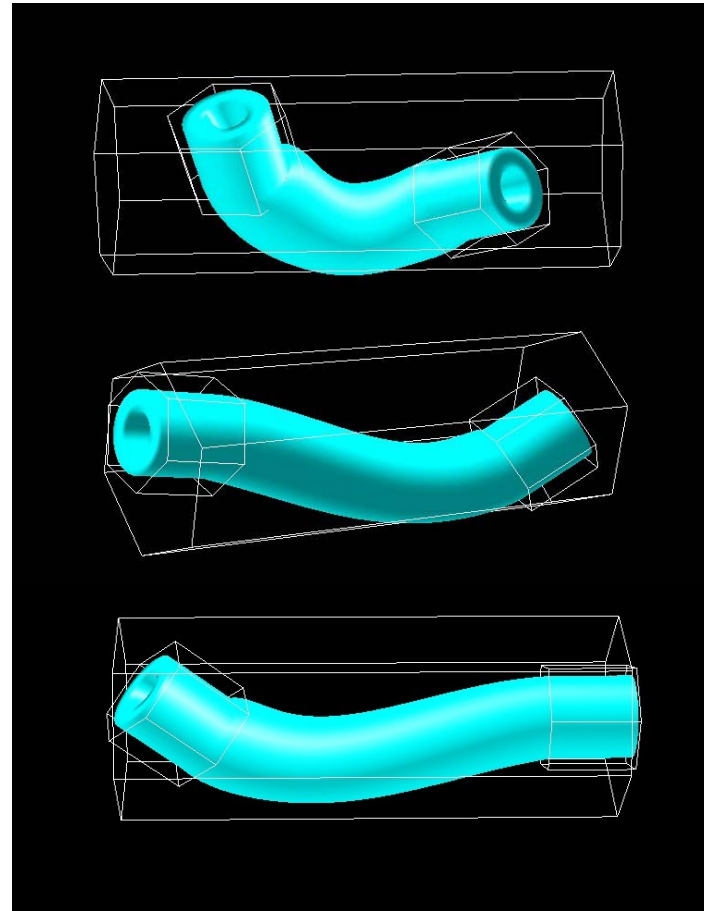
Video



Material Simulation

Simulation of a flexible material in real time

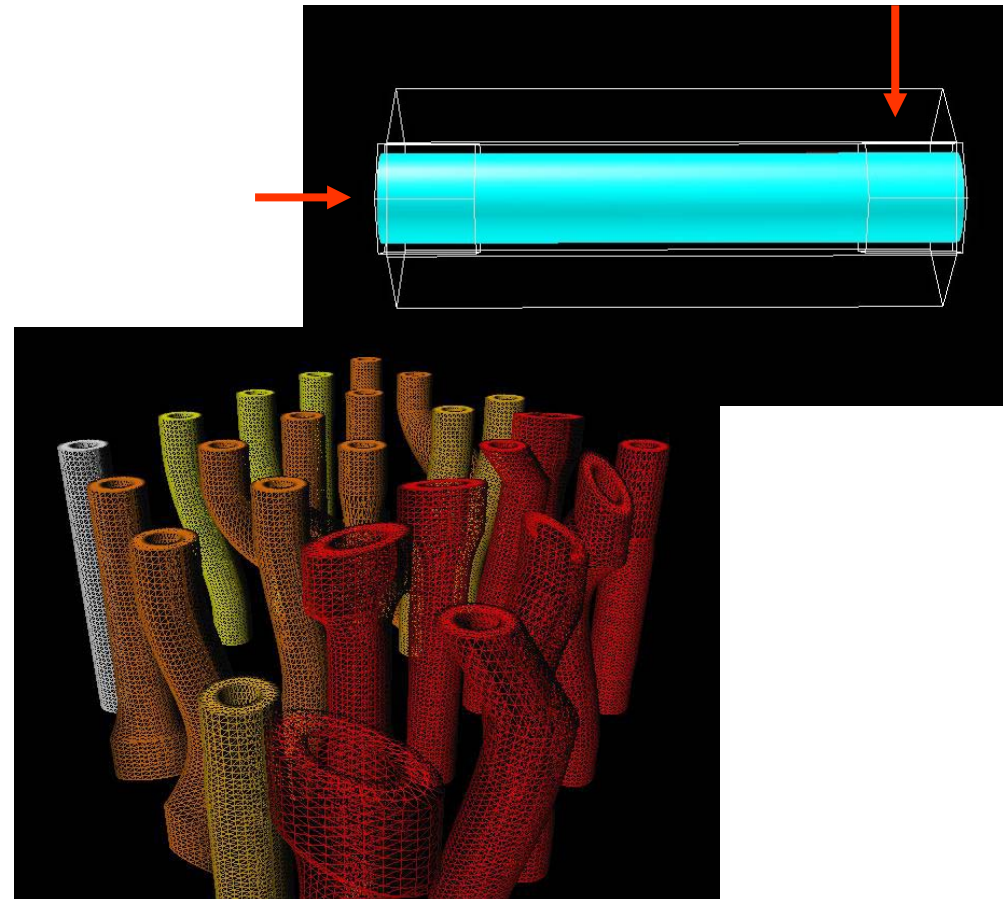
Finite element model of a tube



Material Simulation

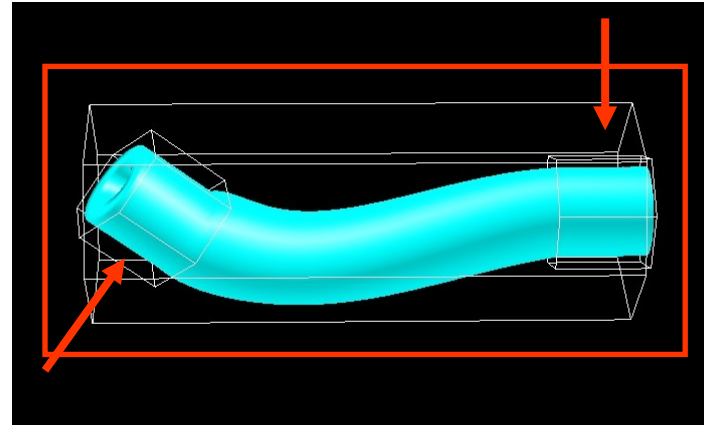
Pre-computation using
Green's functions

Characteristic response of a
linear system

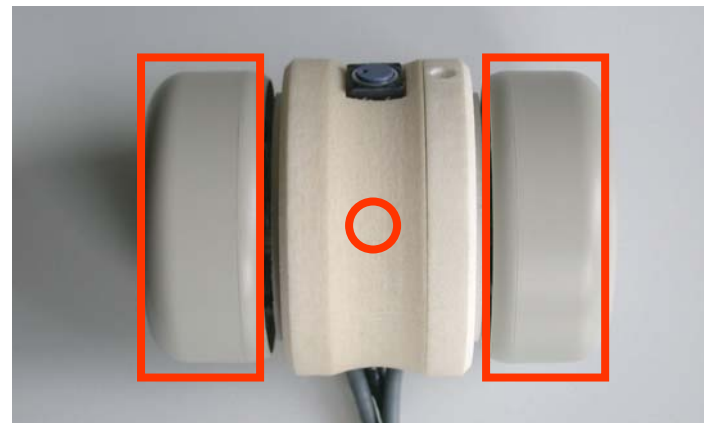


Material Simulation

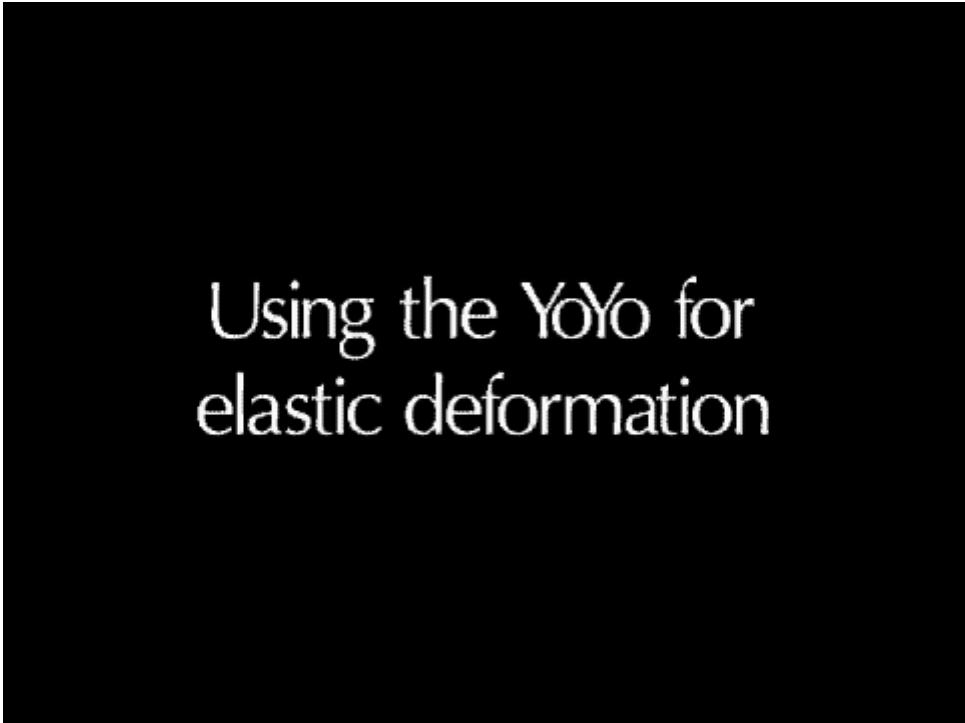
Mapping of the interaction



Transfer of force input to control points in the simulation



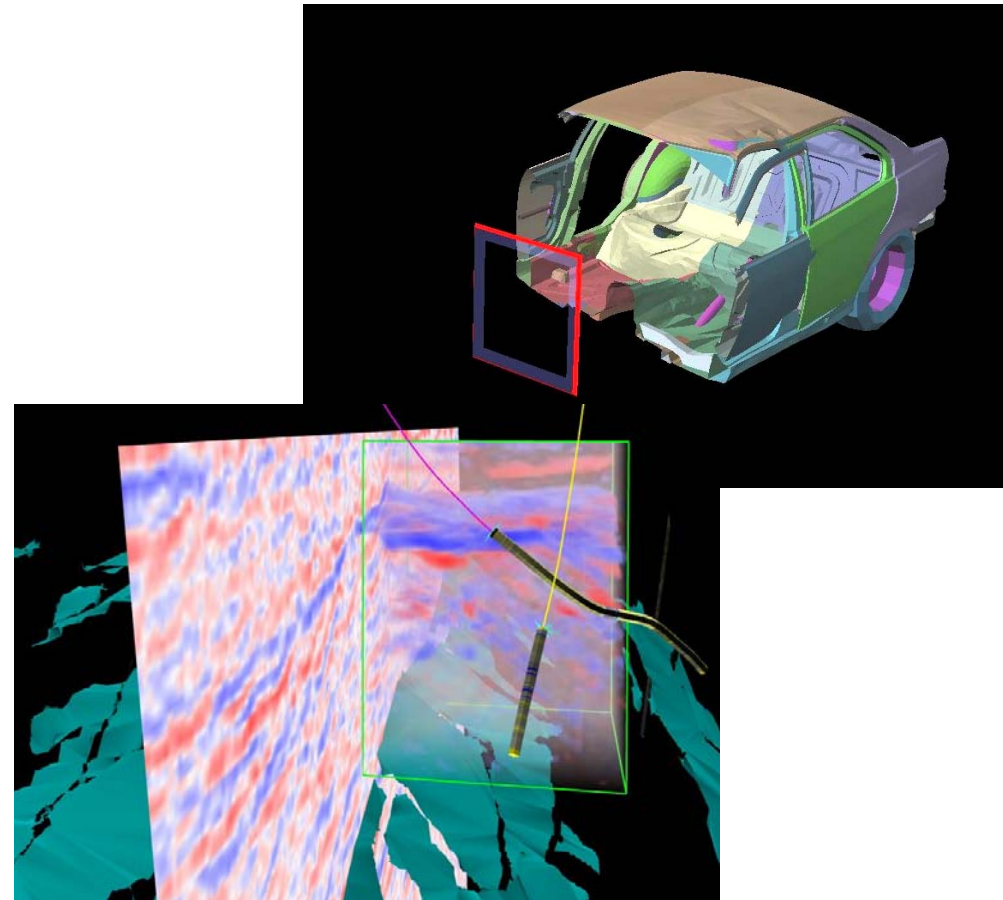
Video



Data Analysis

Scientific and technical application

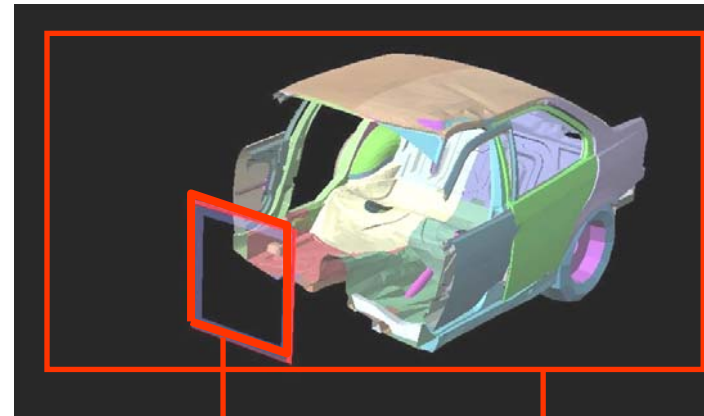
Cutting planes and volume lenses



Fraunhofer IMK: VRGeo

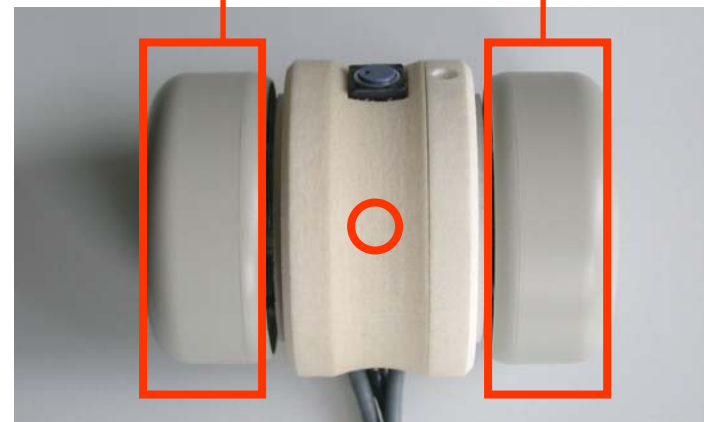
Data Analysis

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

