Mensch-Maschine-Interaktion 2

Interaction on Interactive Surfaces

Prof. Dr. Andreas Butz
Interaction Techniques on Int. Surfaces

• Motivation: thinking about bumptop
• Single touch
  – RNT
• Dual touch
  – The Pinch etc.
• Multi touch
  – possible contradictions
• Shape-based
  – Bringing physics to the surface
• Tangible UIs on surfaces
  – URP, illuminating light
Bumptop - the original video
Making fun of Bumptop - discussion
RNT - Rotate and Translate with 1 Touch Point

- Problem: only 1 touch point (= mouse)
- Goal: rotate and translate in a single gesture
- Idea: use a physical model (inertia, friction)
  - friction force is opposite to the direction of movement
  - rotation is recalculated in every frame
Rotate, Translate and Scale with 2 Touch Points

- track 2 points from frame to frame
- compute scaling from change in distance $d$ to $d'$
- compute rotation from angle between $<d,d'>$
- compute translation $t$ and use directly
Possible Contradictions with >2 Touch Points

- Consider R+T+S method for 2 TP
- With 3 TP we can find 3 pairs
- they will almost certainly yield
  - different $d$, $d'$
  - different orientation
  - possibly even different translations
- How to deal with this?
  - ignore 1 point ;-) looks weird in certain cases
  - use mean R,T,S to minimize error
  - deform the underlying object
Shape-based interaction

- Interaction in the real world uses not just contact points
- We use whole hands, arms, tools
- Cannot be adequately expressed using just contact points
- How can we deal with this?

- Remember the lava lamp in Jeff Han’s TED talk?
- Seriously: How can we do useful stuff with this?
Idea: Interaction using a physics simulation

• Take a ready-made physics engine for games
• Represent every interface object as a 3d physical object
• Assign proper weight and friction
• Entire interface behaves like real physics

• How do we deal with shape input?
• Idea: proxy objects
Approach: Proxy Objects

- Special objects introduced into the simulation per contact point
- Incarnation of fingertips in the virtual world
- Collide with other objects and push them aside.
Leveraging Collision Forces
Leveraging Friction Forces
Particle Proxies

• Idea: model contact shape with many proxy objects (particles)
• Collisions obey shape of the contact (e.g., flat or side of the hand)
• Distribution of forces is modeled more accurately (e.g., conforms to 3D shape)
From Tracking to Flow
Interactions in the Air (Hilliges 2009)
Tangible UIs on Interactive Surfaces

- classic TUI project: URP
- another classic: illuminating light

- examples already seen (hence not repeated):
  - MetaDesk
  - PhotoHelix
Luminous room: Urban Planning (URP)

(John Underkoffler and Hiroshi Ishii, CHI 99)

- Move physical models of houses on a desk surface

- Simulate in the computer:
  - Shadows
  - Window reflections
  - Air flow and wind
urp: an integrated urban planning tool with a physical interface
Luminous room: Illuminating Light
(John Underkoffler and Hiroshi Ishii, CHI 98)

• Simulation of optical/holographic setups
• Phys. objects represent optical elements
• Top projection of resulting laser beam
Additional Literature

  – (also the source of the image on slide 25)