Mensch-Maschine-Interaktion 2

Interaction on Interactive Surfaces

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Interaction Techniques on Int. Surfaces

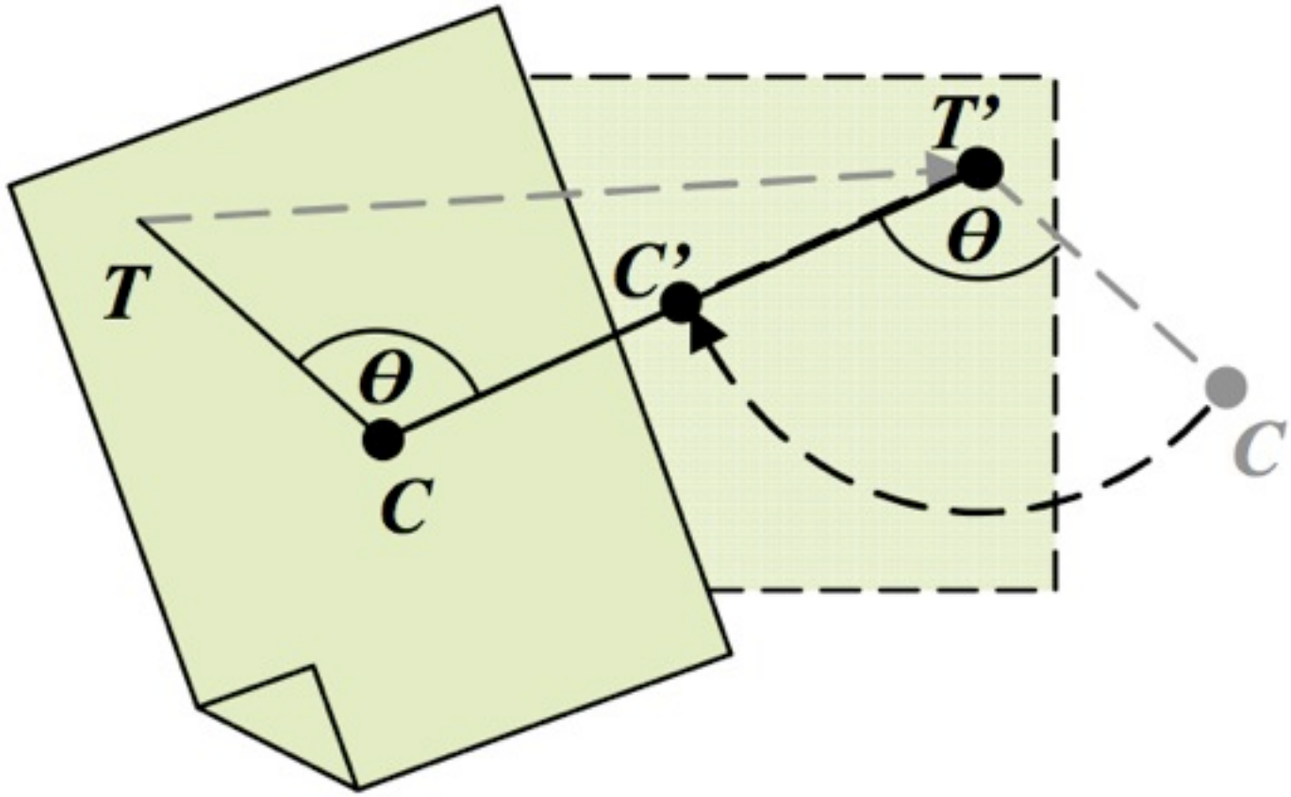
- Motivation: thinking about bumptop
- Single touch
  - RNT
- Dual touch
  - The Pinch etc.
- Multi touch
  - possible contradictions
- Shape-based
  - Bringing physics to the surface
- Tangible UIs on surfaces
  - URP, illuminating light

Bumptop - the original video

Making fun of Bumptop - discussion

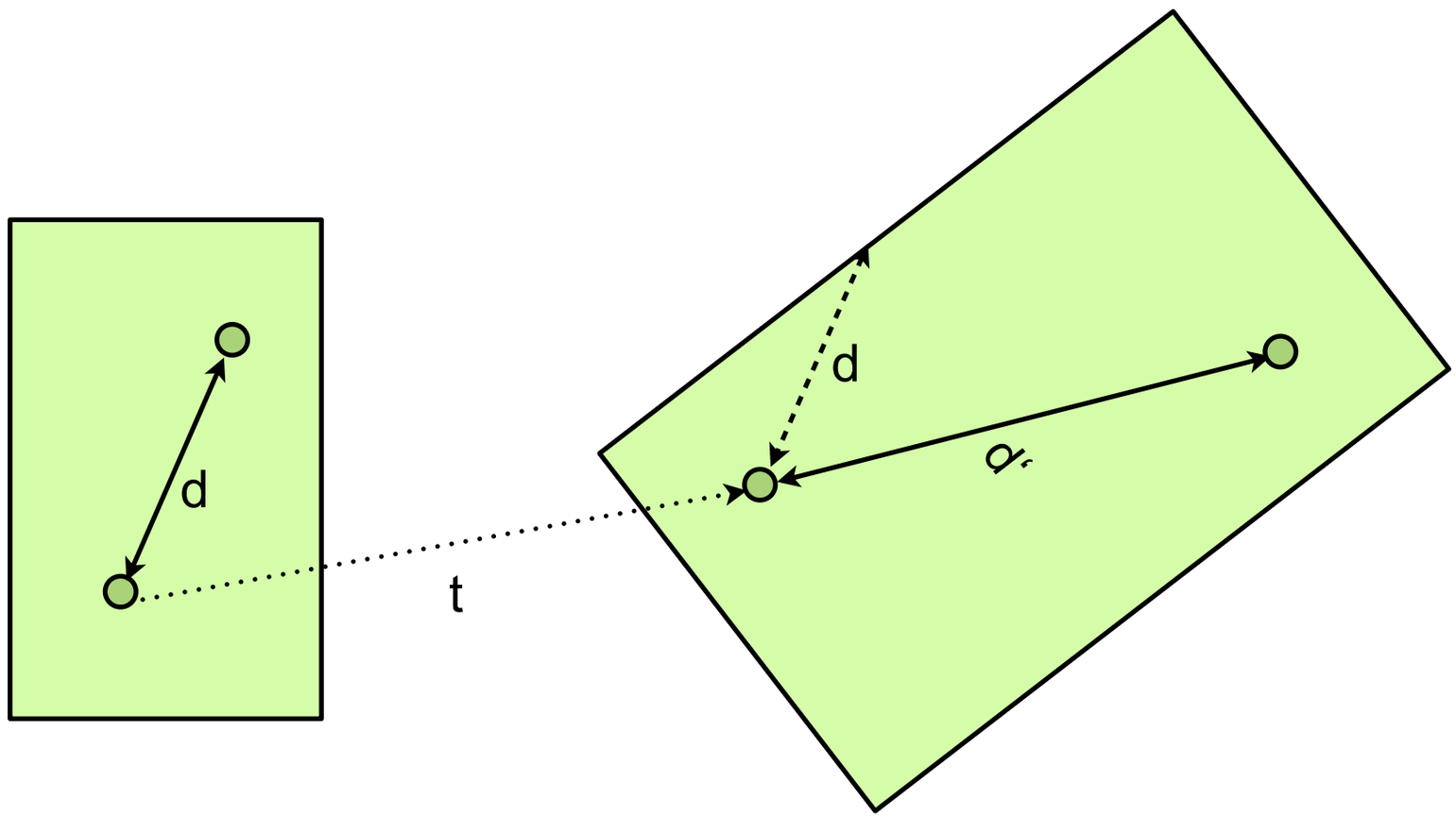
RNT - Rotate and Translate with 1 Touch Point

- 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



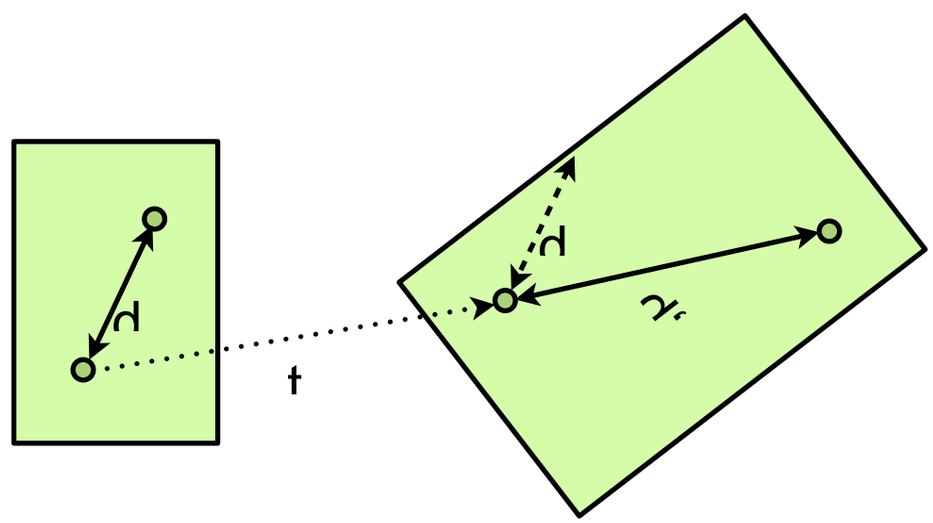
Rotate, Translate and Scale with 2 Touch Points

- 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?

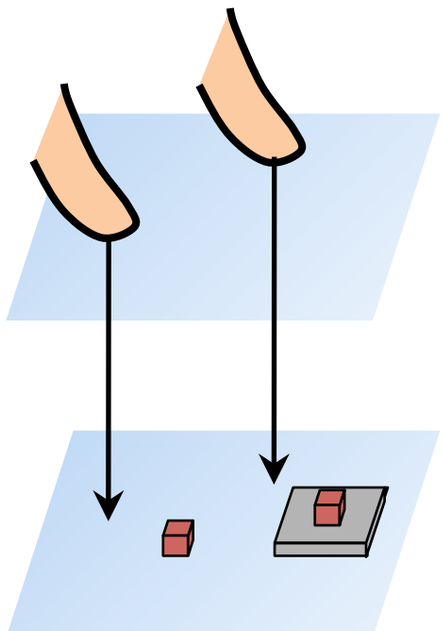
- Remember the lava lamp in Jeff Han‘s TED talk?
- Seriously: How can we do useful stuff with this?

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

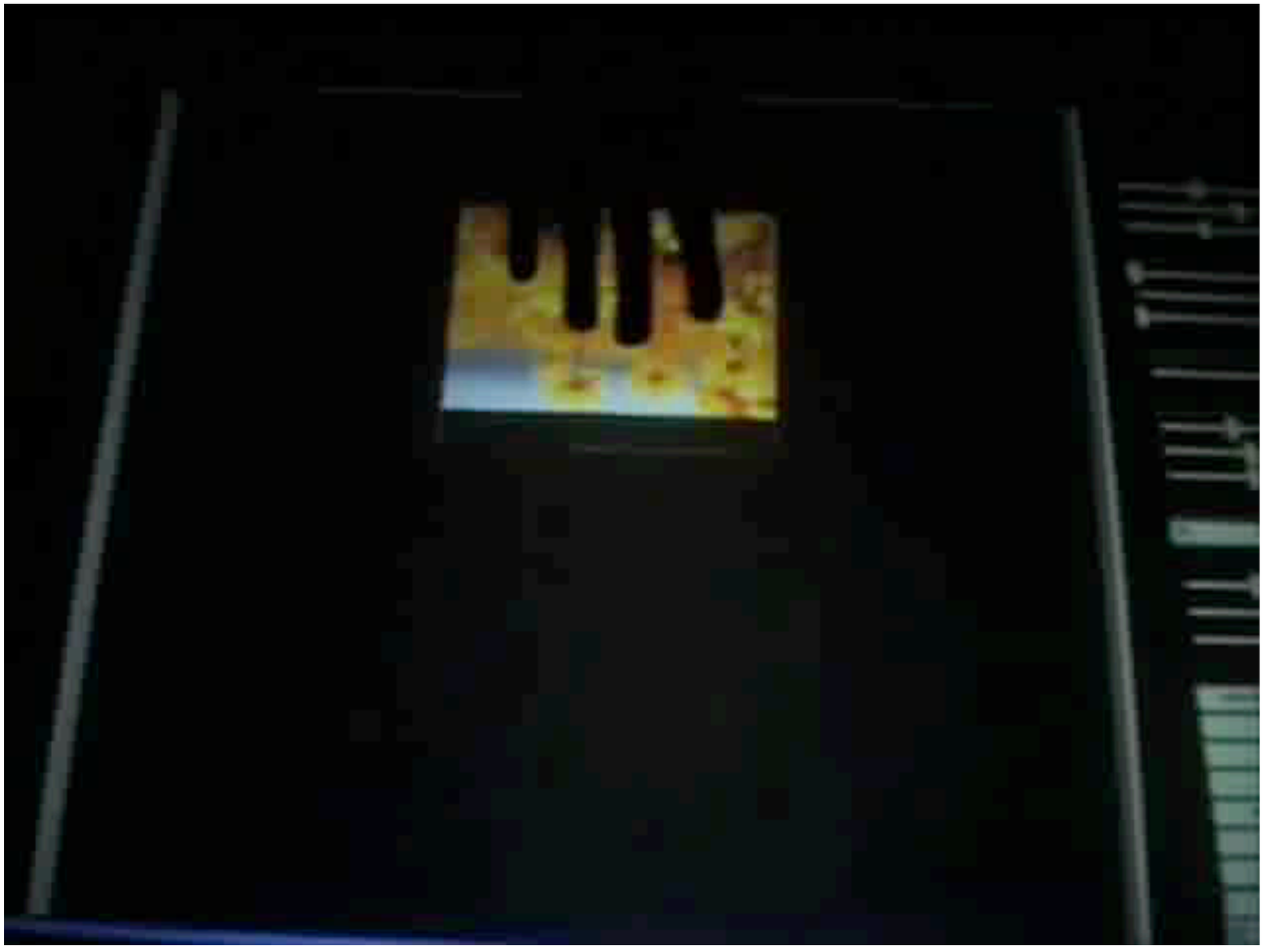


- Special objects introduced into the simulation per contact point
- Incarnation of fingertips in the virtual world

- Collide with other objects and push them aside.

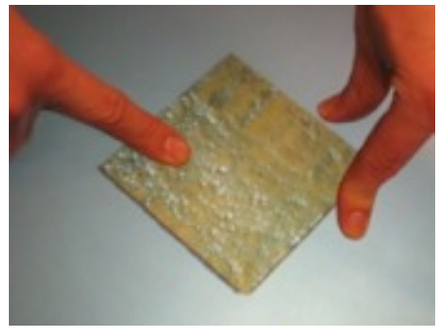
Leveraging Collision Forces

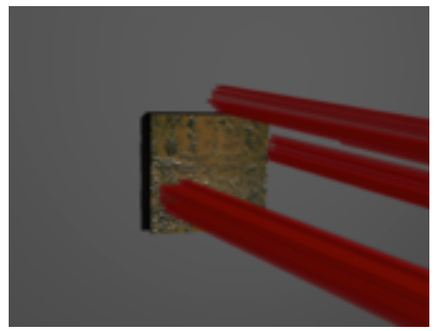
Leveraging Friction Forces

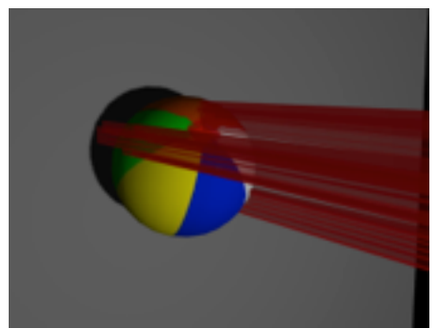


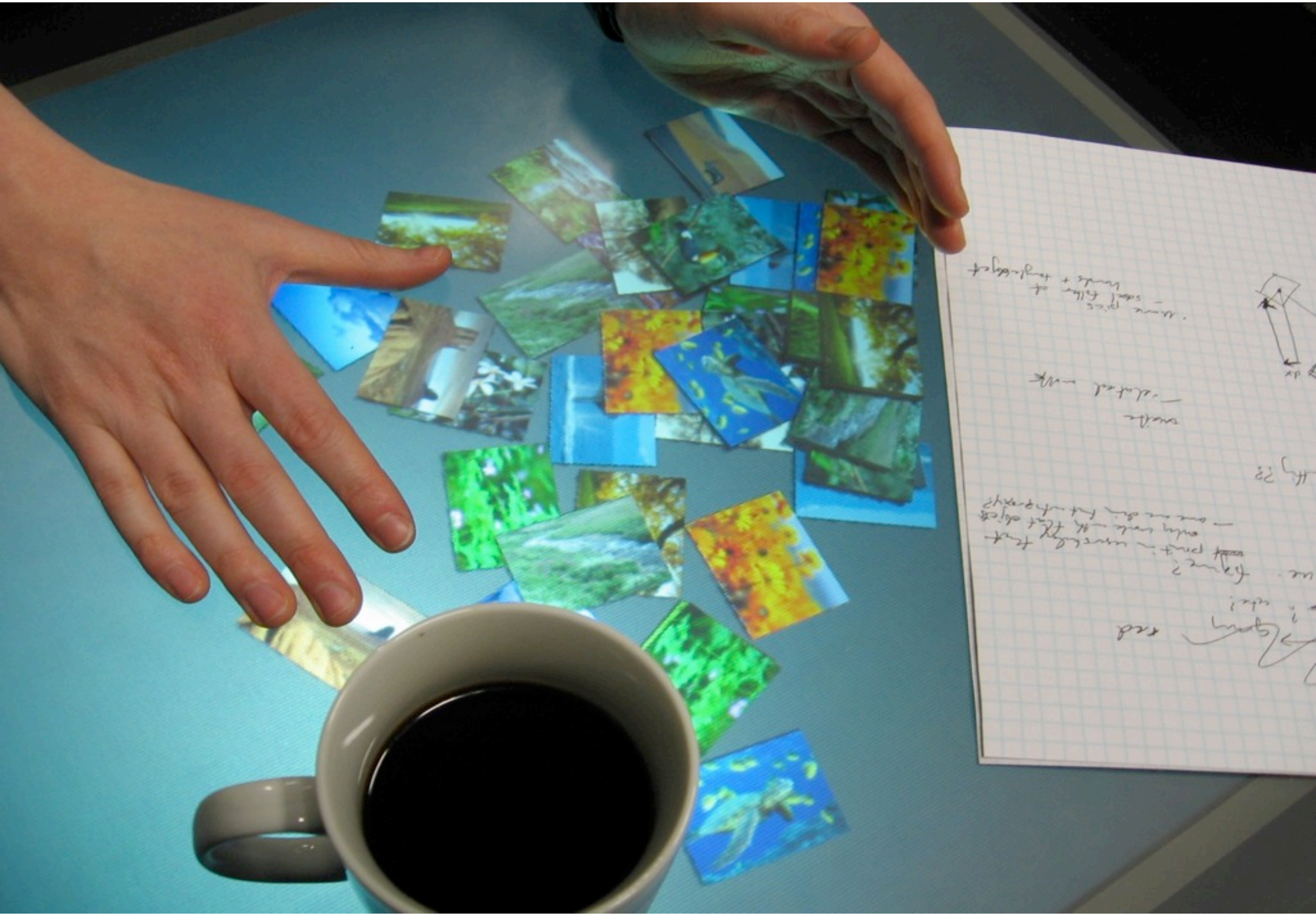
Particle Proxies

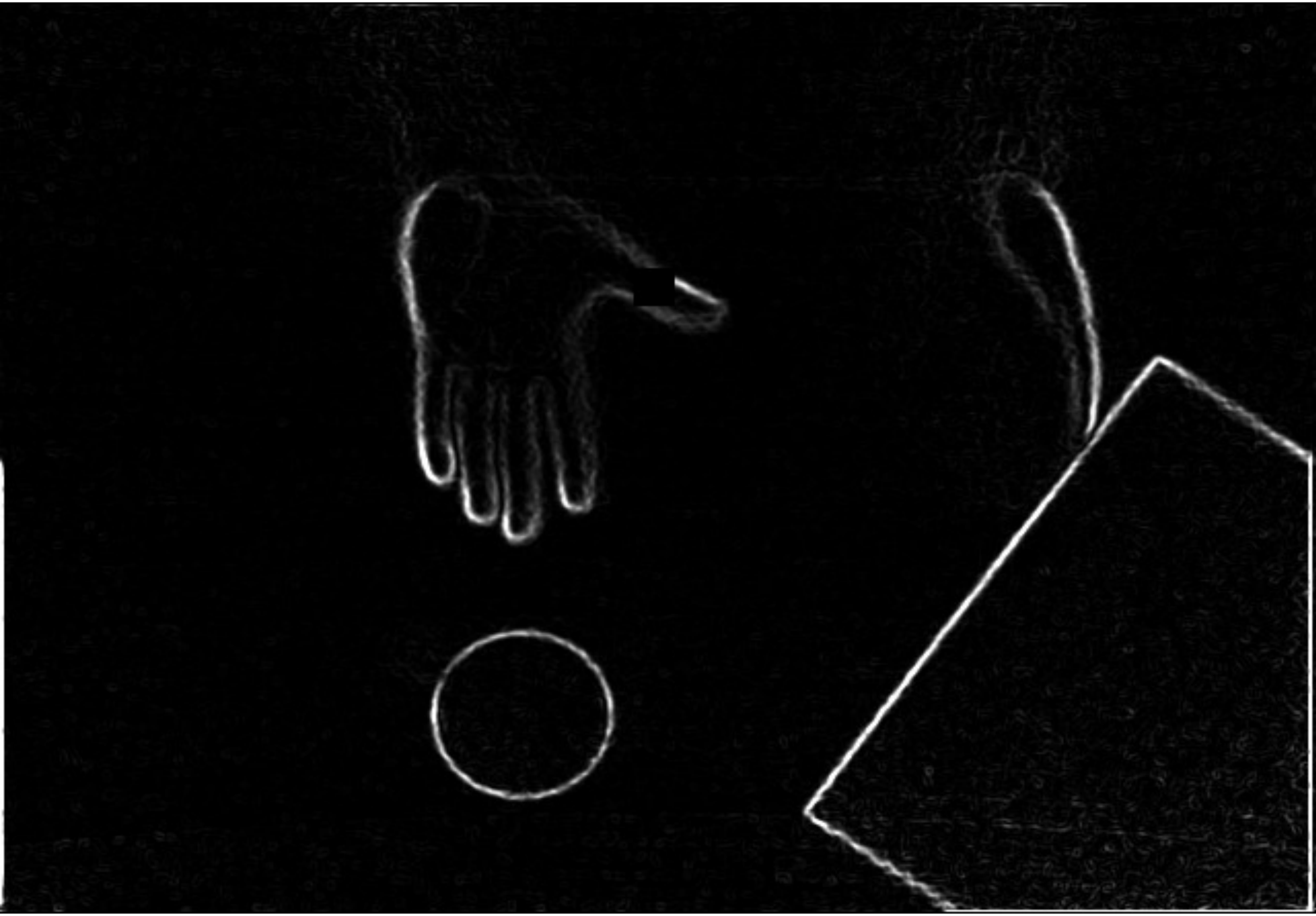
- Idea: model contact shape with many proxy objects (particles)
- Collisions obey shape of the contact (e.g., flat or side of the hand)
- Distribution of forces is modeled more accurately (e.g., conforms to 3D shape)



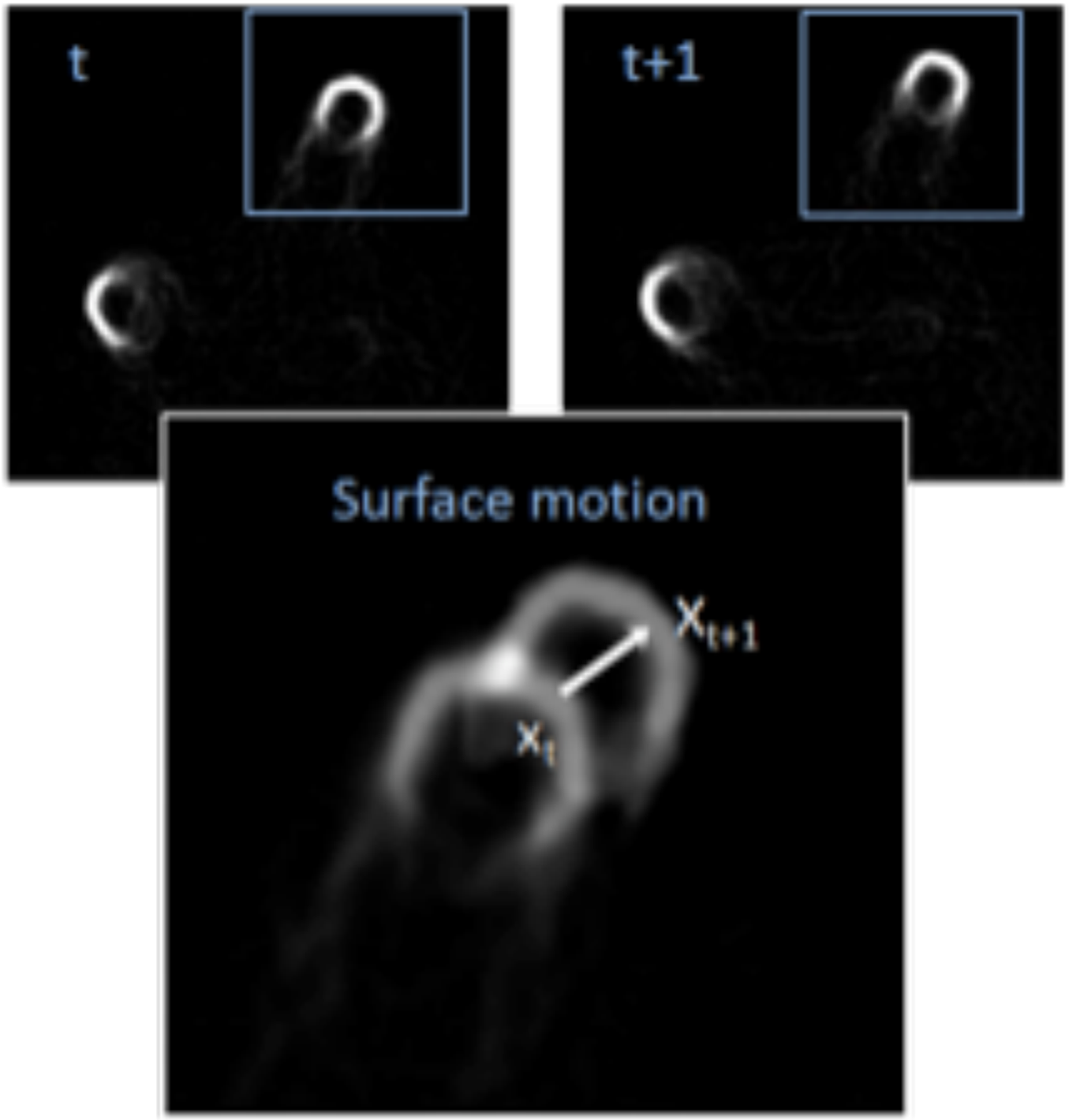


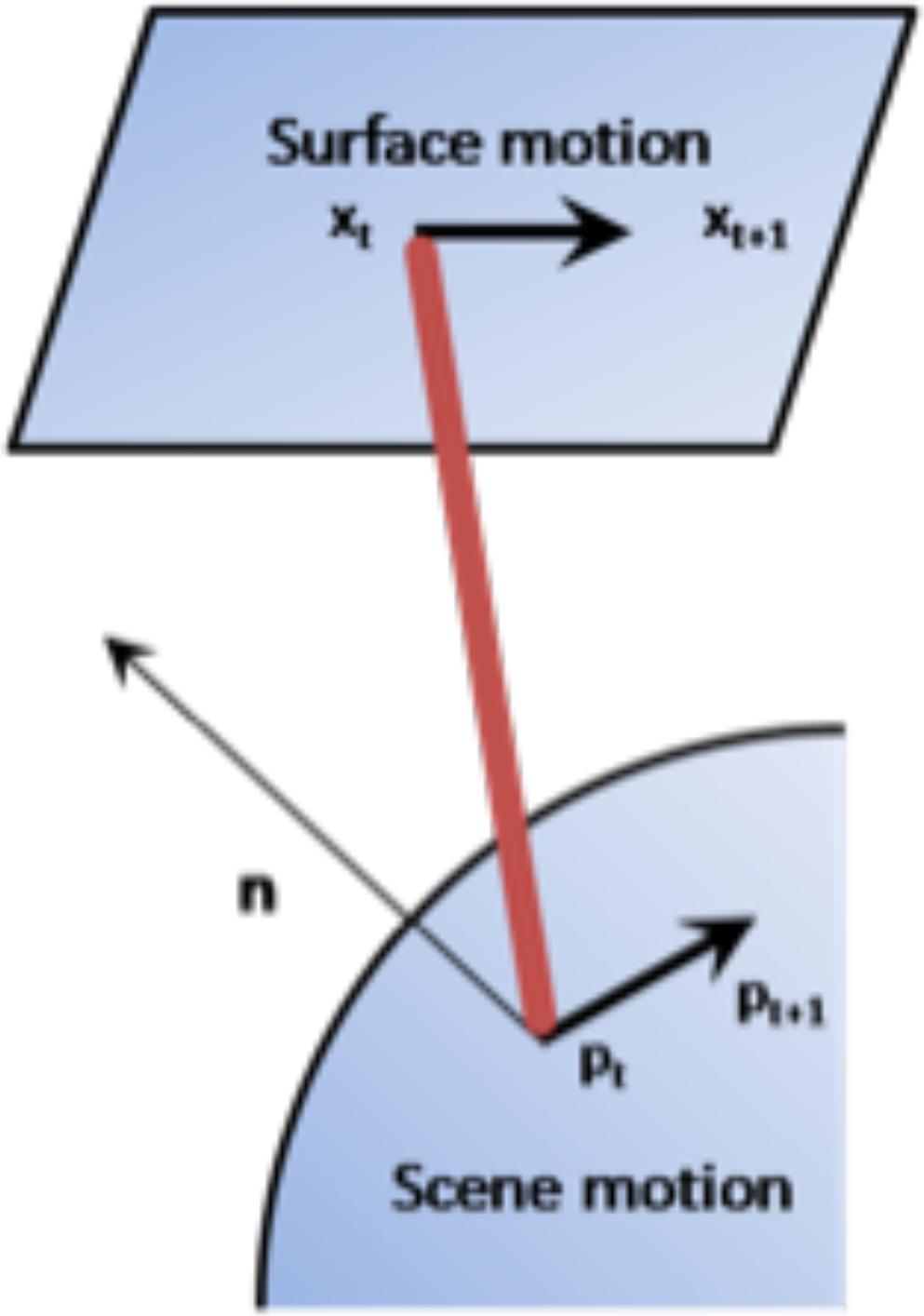


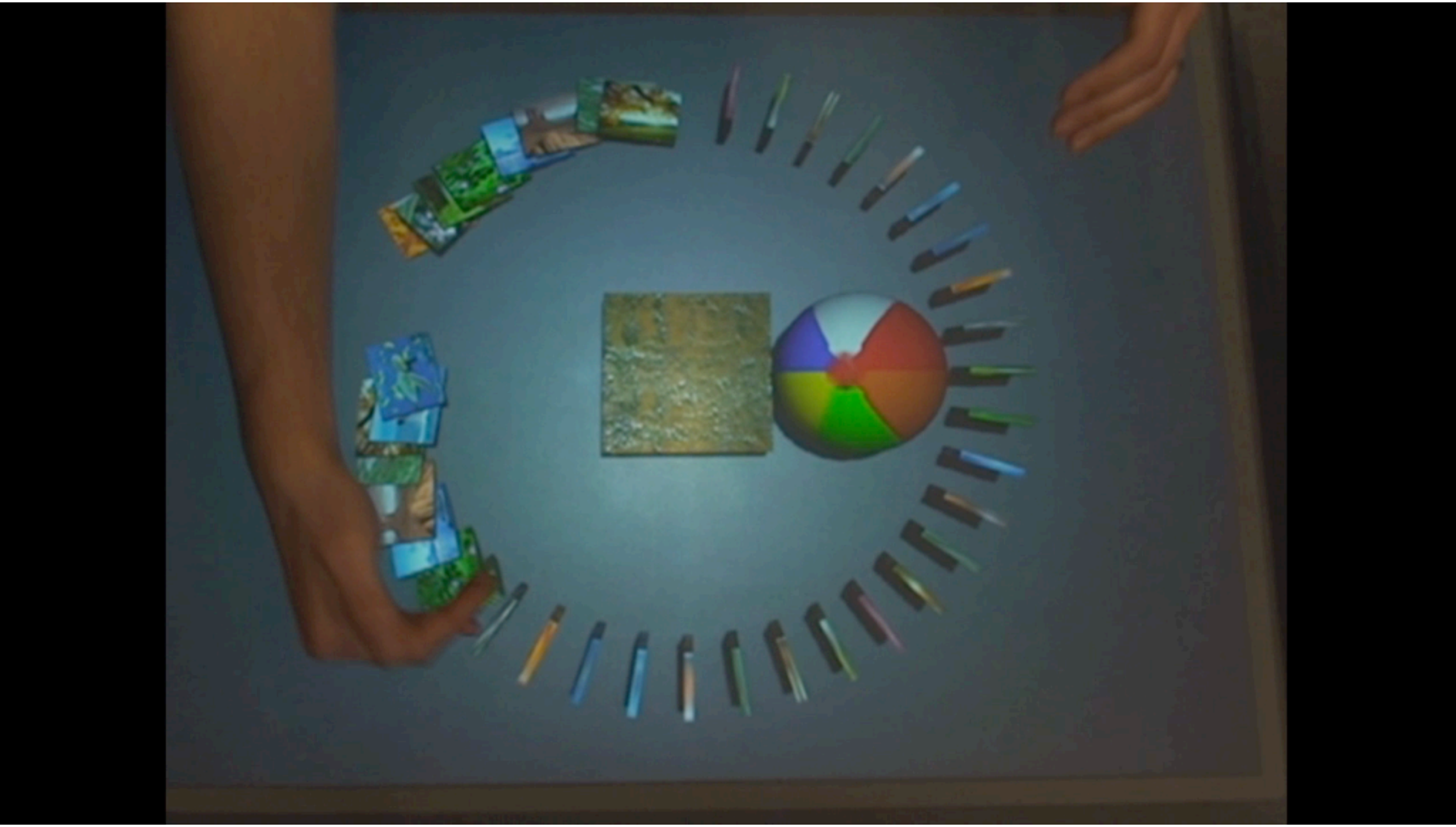




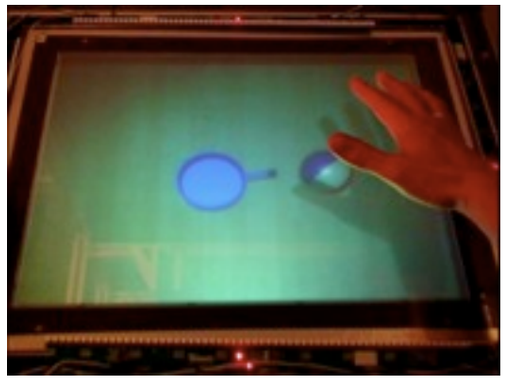
From Tracking to Flow

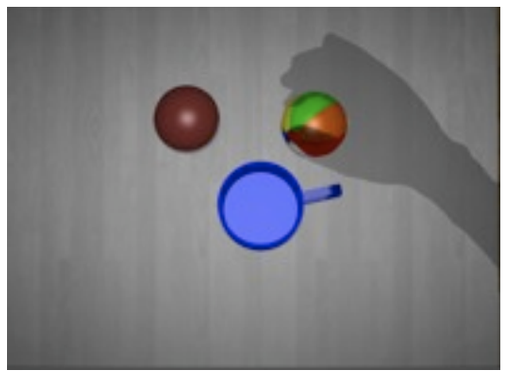


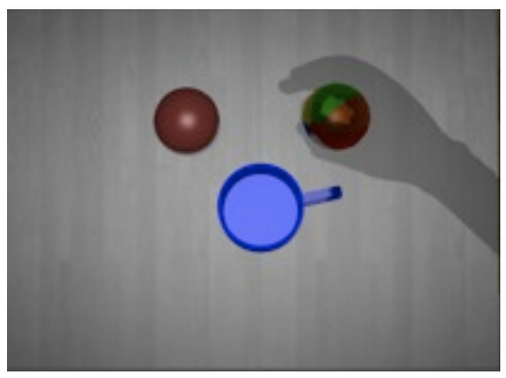


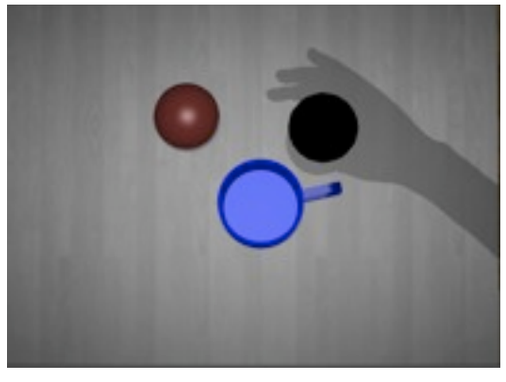


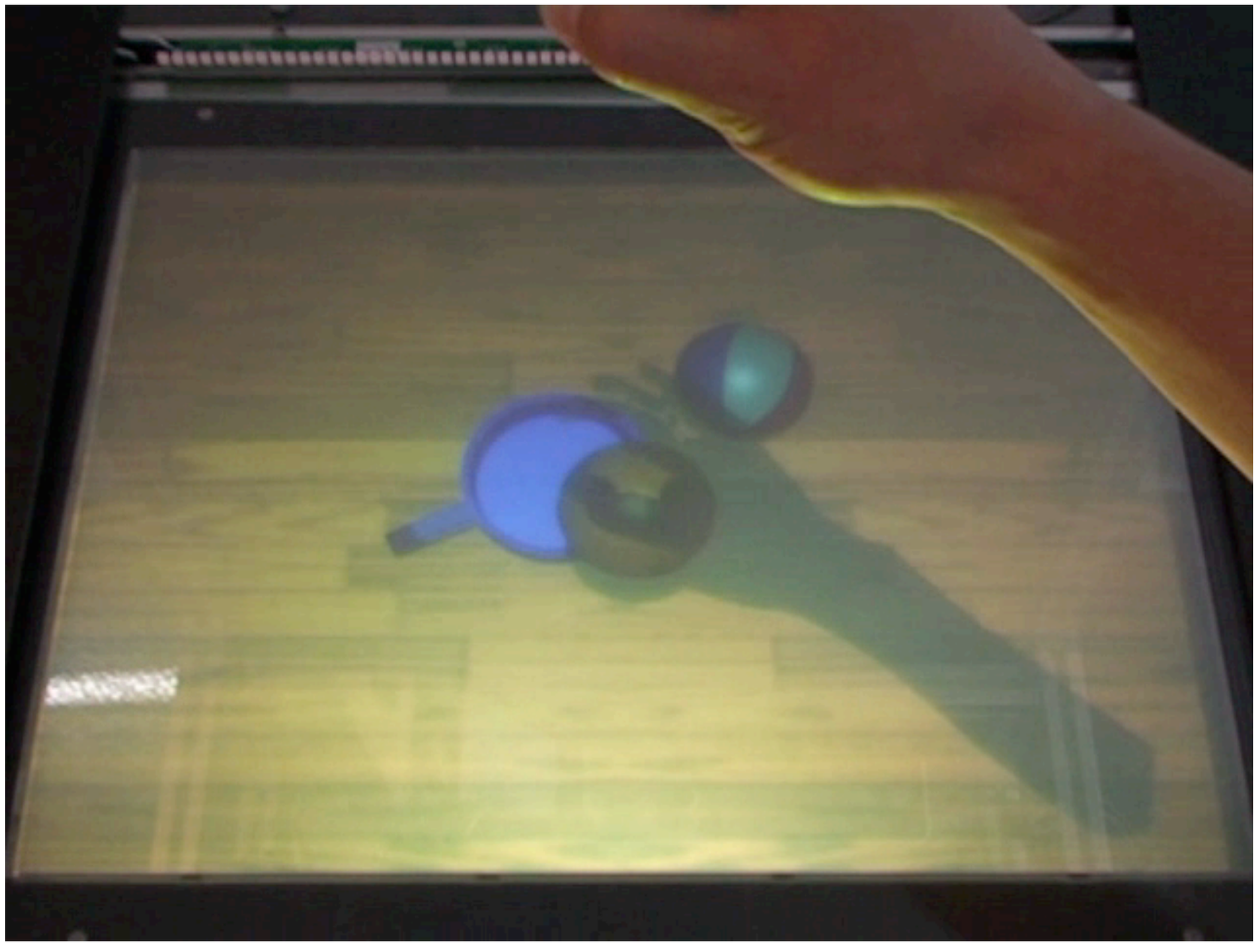
Interactions in the Air (Hilliges 2009)











Tangible UIs on Interactive Surfaces

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

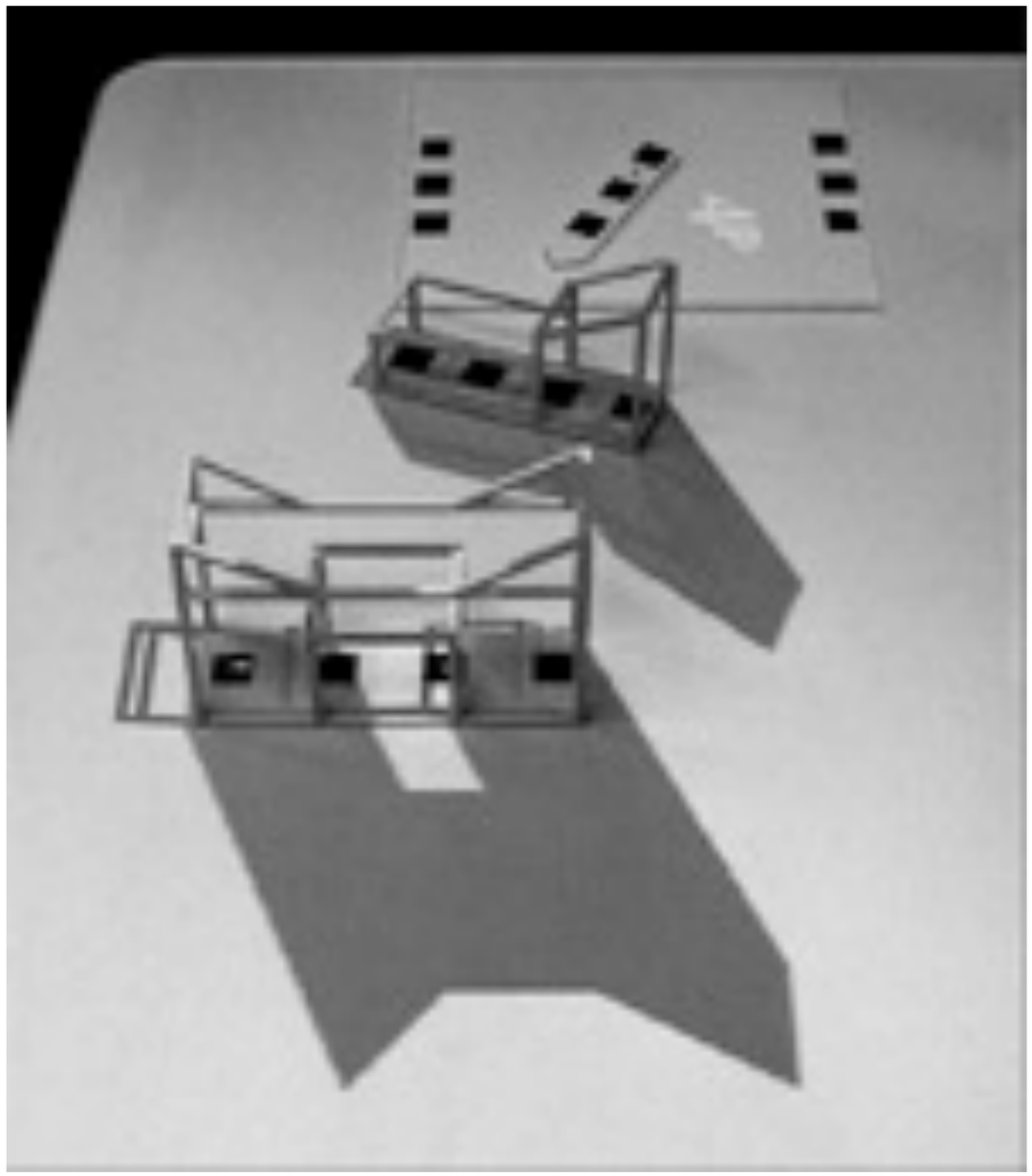
- examples already seen (hence not repeated):
  - MetaDesk
  - PhotoHelix

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



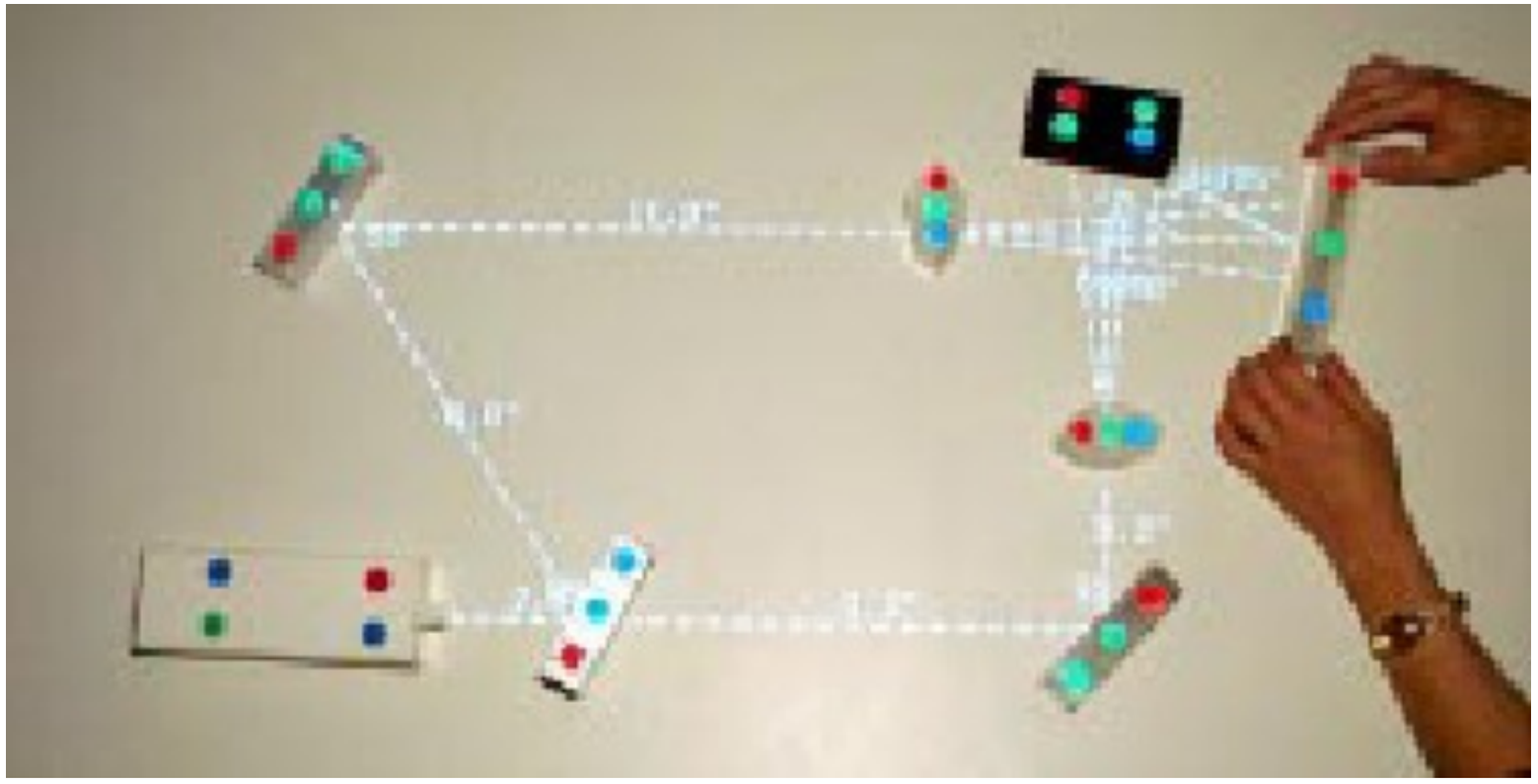
urp:

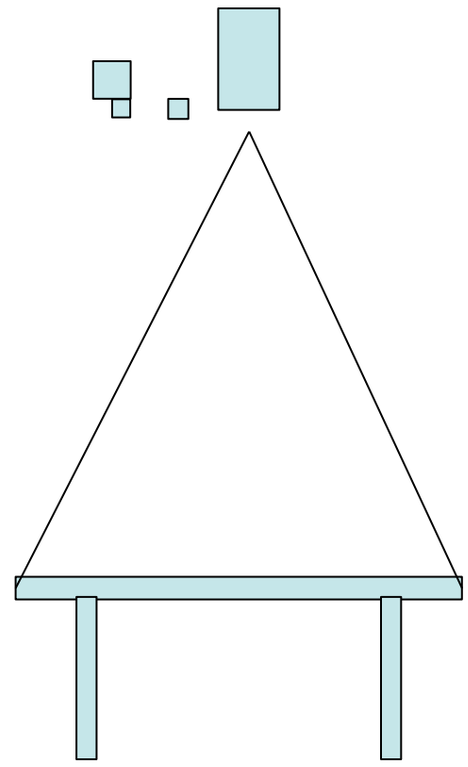
an integrated
urban planning tool
with a physical interface

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

- Rotation and translation mechanisms for tabletop interaction. Mark S. Hancock, Frédéric Vernier, Daniel Wigdor and Sheelagh Carpendale, and Chia Shen. In Proc. Tabletop, pp. 79-86, 2006.
  - (also the source of the image on slide 25)
- A. D. Wilson, S. Izadi, O. Hilliges, A. Garcia-Mendoza, D. Kirk: „Bringing Physics to the Surface“, ACM UIST 2008