# Chapter 3:
# Interactive Tabletops and Surfaces

Vorlesung „Mensch-Maschine-Interaktion II”

Prof. Dr. Andreas Butz, Dr. Paul Holleis,

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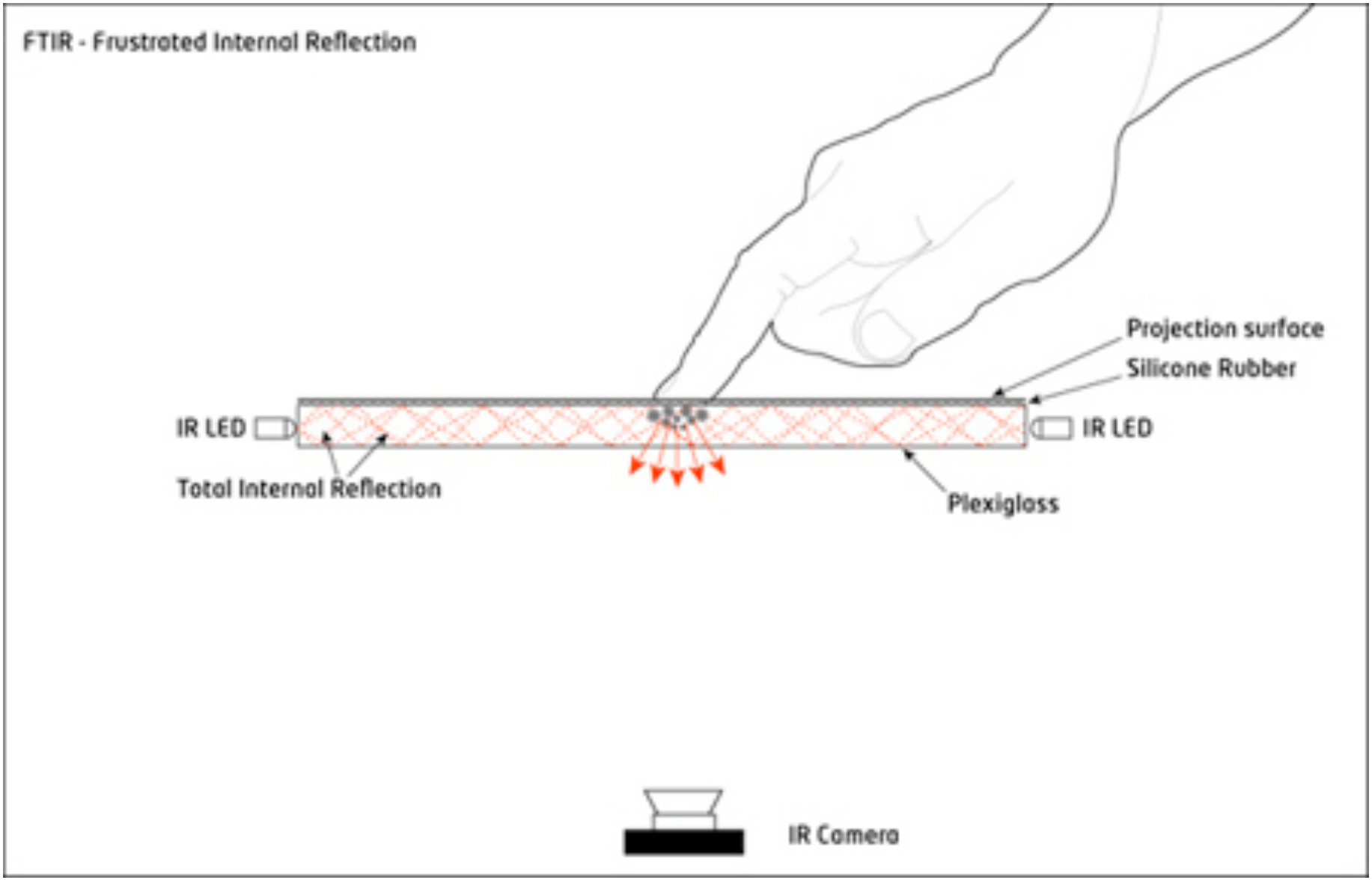
(slides today partly courtesy of Dr. Otmar Hilliges)

# Chapter 3: Interactive Tabletops and Surfaces

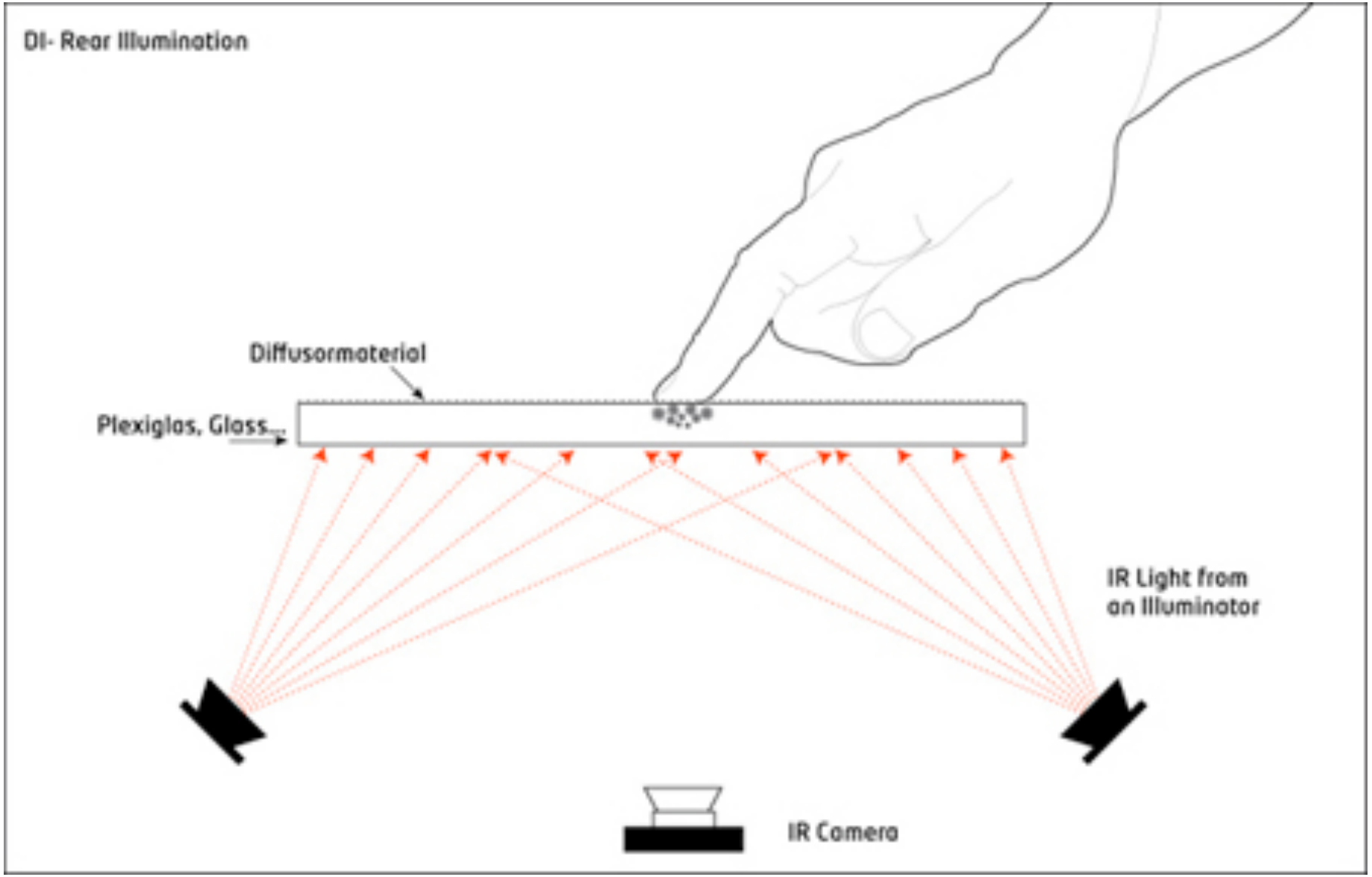
- Hardware for Interactive Surfaces
  - FTIR, DI, ...
- Software for Interactive Surfaces
- Interaction on Int. Surfaces

# Optical Sensing - FTIR




http://iad.projects.zhdk.ch/multitouch/

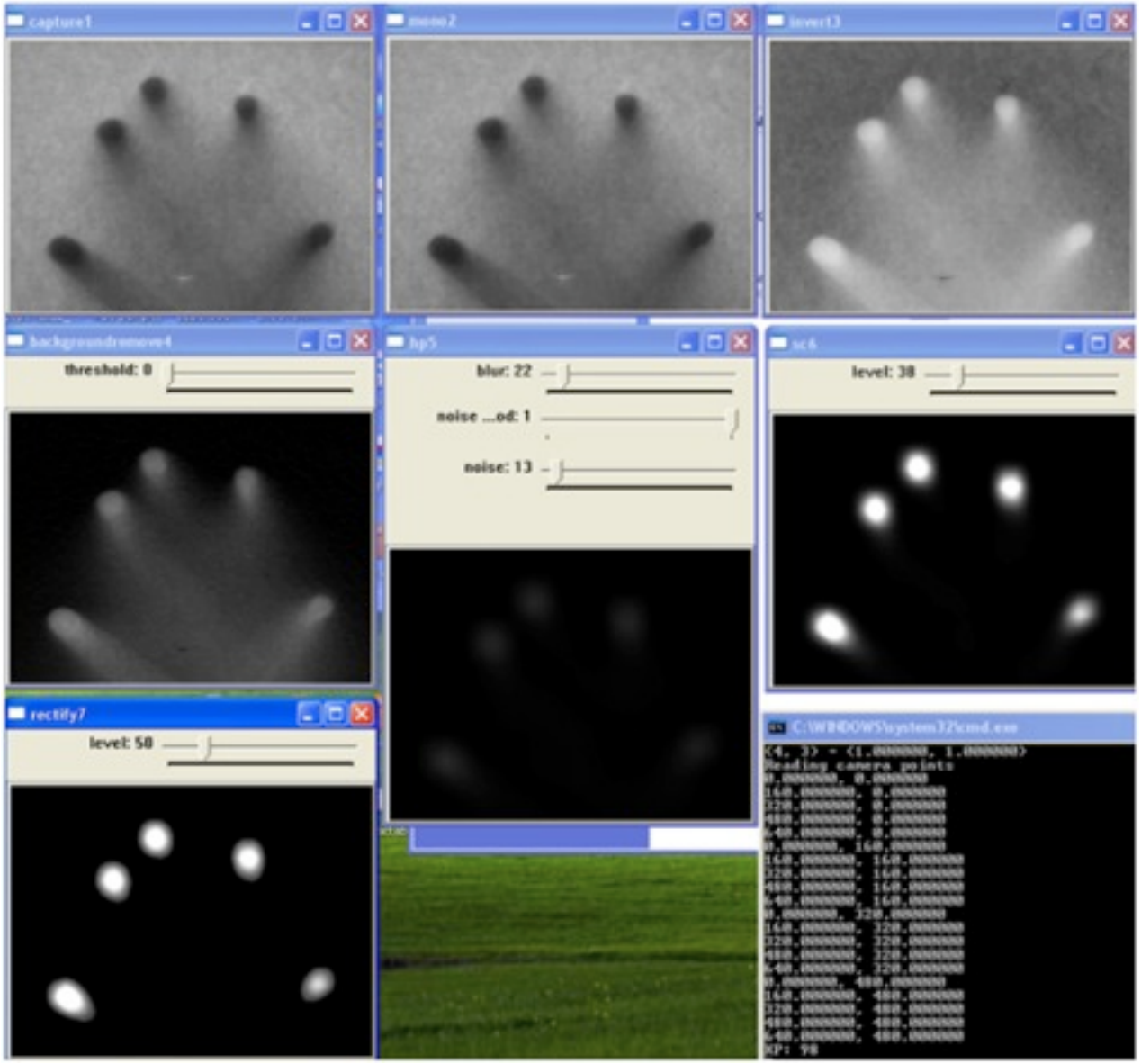
# Optical Sensing - DI




http://iad.projects.zhdk.ch/multitouch/

# Multitouch DIY project for the weekend!

# http://sethsandler.com/multitouch/mtmini/



# TouchLight


- Andy Wilson, ICMI 2004
- Projection onto Holofilm (transparent projection screen)
- imaging through the screen ==> funny effects possible

# Optical tracking from the side: SmartTech SmartBoard DViT

Figure 1: DViT Technology Camera

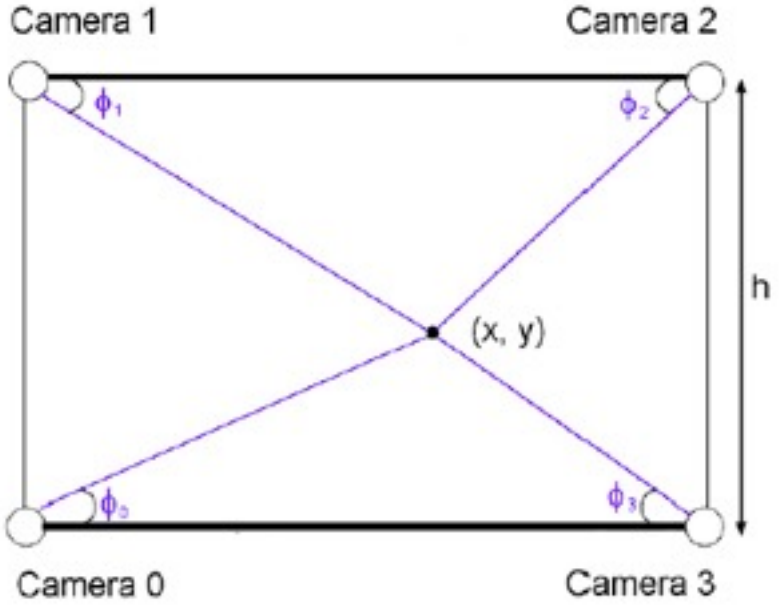
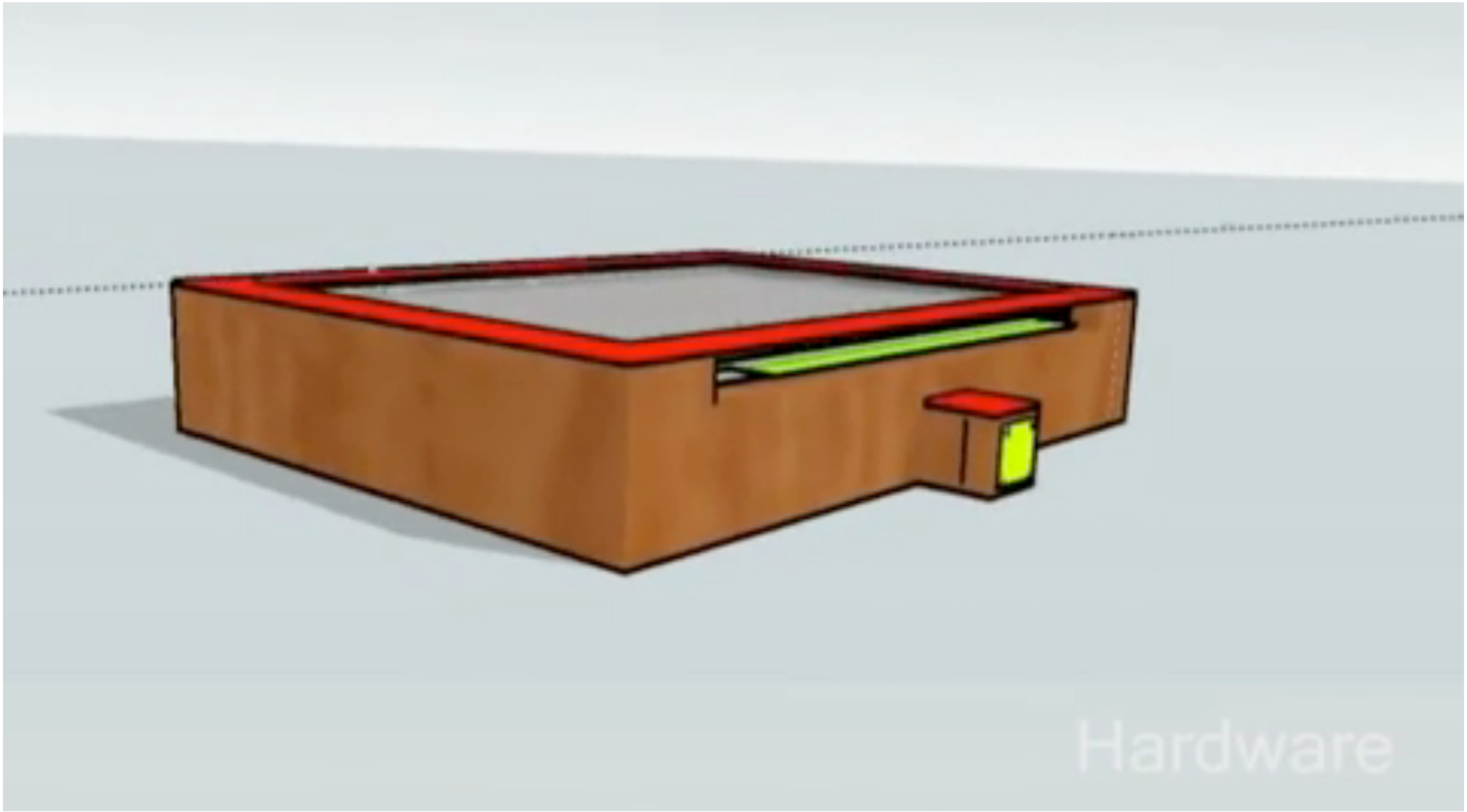



Figure 2: Camera Identification of a Contact Point

- 4 cameras, 100FPS
- can be overlaid to screens, projection surfaces etc..
- theoretically 4, practically 2 (narrow) contact points
- http://www.smarttech.com/dvit/index.asp

# Optical Tracking twisted: Fiberboard



# Commercial and semi-OTS Interactive tables

- MS surface http://www.microsoft.com/surface/
- Interactable http://www.ipsi.fraunhofer.de/ambiente/english/projekte/projekte/ineractable.html
- SmartTable http://www2.smarttech.com/st/en-US/Products/SMART+Table/
- Reactable http://www.reactable.com/
- Lemur http://www.jazzmutant.com/

# Microsoft Surface

## PHYSICAL DIMENSIONS

**Surface unit including display and housing (L x W x H)**

42.5 x 27 x 21 inches/108 x 69 x 54 cm

With metal panels: 180 pounds/82 kg
Available in U.S. and Canada only

With acrylic panels: 198 pounds/90 kg

**Shipping pallet and container (L x W x H)**

49 x 34 x 32.5 inches/124.5 x 86 x 82.5 cm

Pallet, box, foam: 80 pounds/36 kg

## TECHNICAL SPECIFICATIONS

**Display**

- Type: 30-inch XGA DLP® projector
- ATI X1650 graphics card with 256 MB of memory
- Maximum resolution: 1024 x 768
- Lamp mean-life expectancy: 6,000+ hours
- Maximum pressure on the display: 50 pounds per square inch/3.5 kg per cm
- Maximum load: 200 pounds

**Input Devices**

- Camera-based vision system with LED infrared direct illumination

**Computing System**

- 2.13-GHz Intel® Core™ 2 Duo processor
- Memory: 2 GB dual-channel DDR2
- Storage: Minimum 250 GB SATA hard-disk drive

**Network Protocols and Standards**

- Network adapter: Intel Gb LAN
- Wireless LAN connectivity supported: Yes
- Networking and Data Protocols: IEEE802.11b, IEEE802.11g, Bluetooth 2.0, Gigabit Ethernet

**I/O Connections**

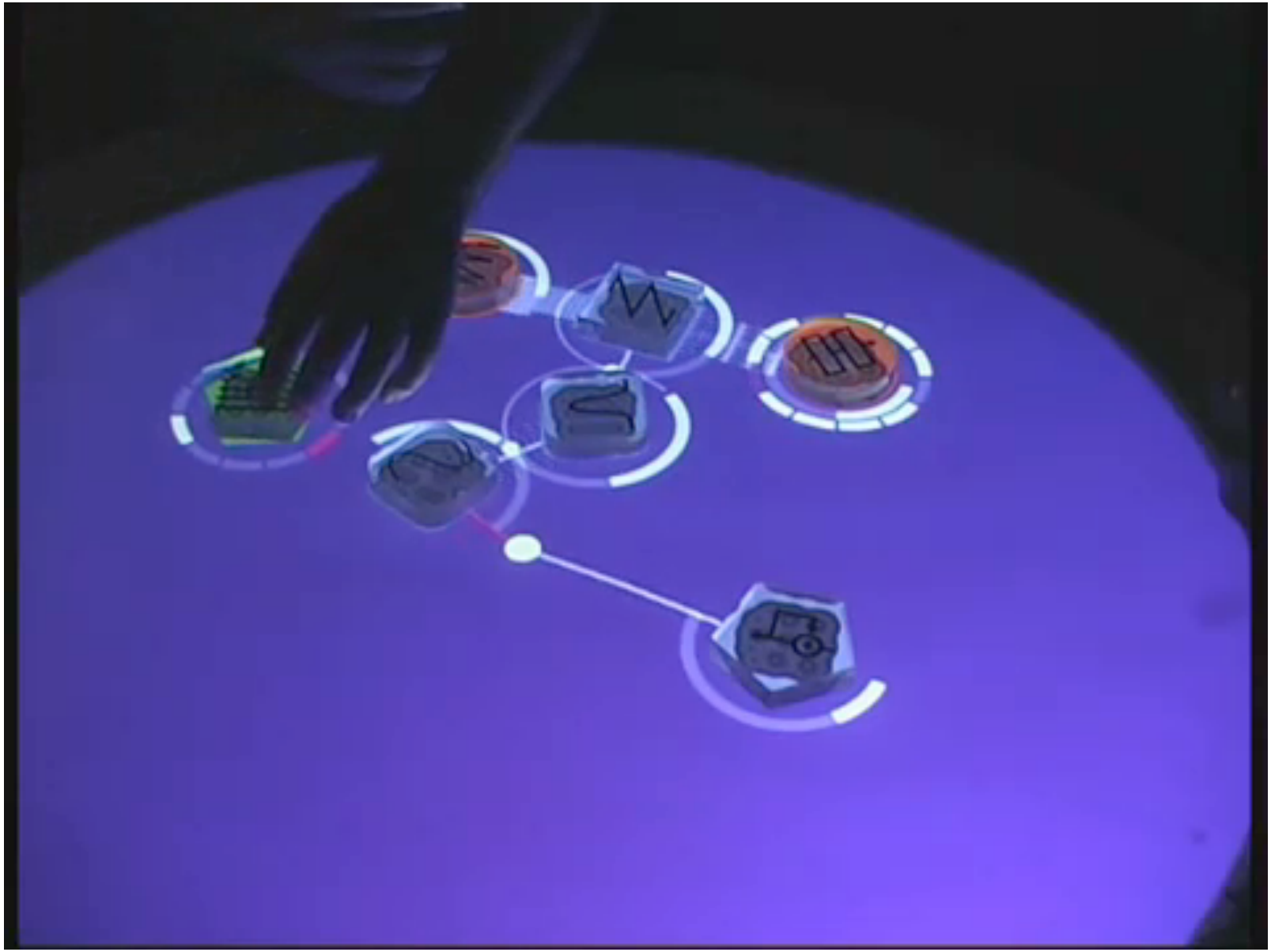
- 2 headphone jacks
- 6 USB 2.0 ports
- RGB component video
- S-VGA video (DB15 external VGA connector)
- Component audio
- Ethernet port (Gigabit Ethernet card [10/100/1000])
- External monitor port
- Bays for routing cables
- On/Standby power button

# FhG Interactable

- The new InteracTable® is 90 cm high with a display size of 70 cm x 125 cm. The horizontal workspace is realized with a touch-sensitive plasma-display (PDP) which is integrated into the table top of the InteracTable.
- People can use pens and fingers for gesture-based interaction with information objects. The IT components are mounted below. The margin of the table surface can be used to lean on it and to place additional material or coffee cups and the like.
- SmartTech DViT sensing: dual touch

# SMART Technologies SmartTable

# Reactable

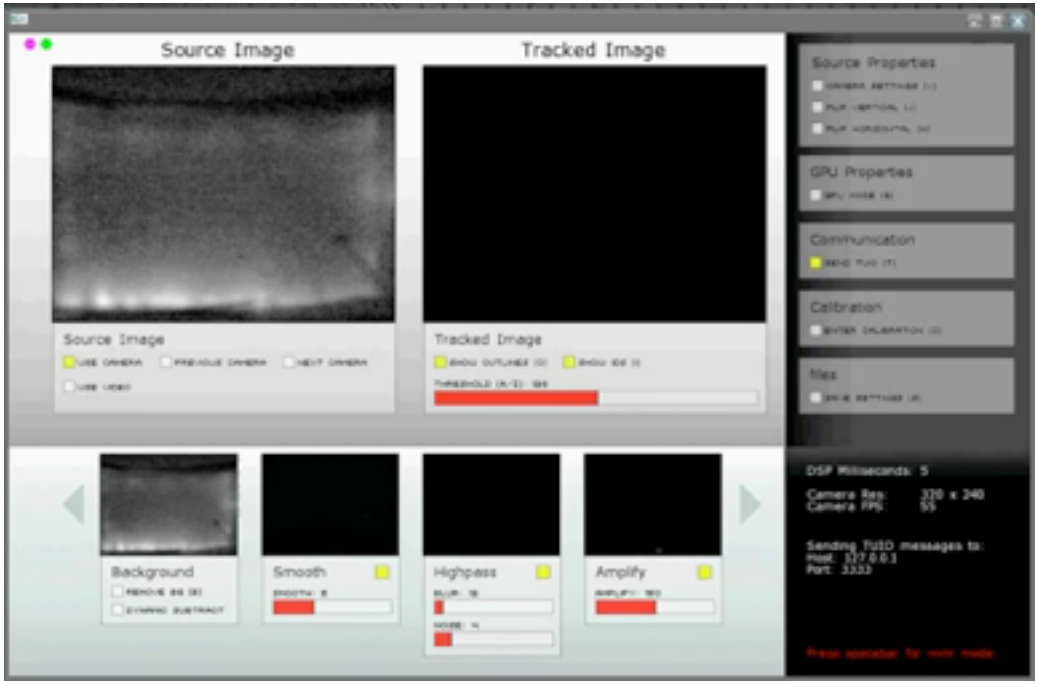


# Jazzmutant Lemur


# Software for Interactive Surfaces

- Touchlib http://nuigroup.com/touchlib/
- Reactivision http://reactivision.sourceforge.net/
- the TUIO protocol http://www.tuio.org/
- Squidy http://www.squidy-lib.de/

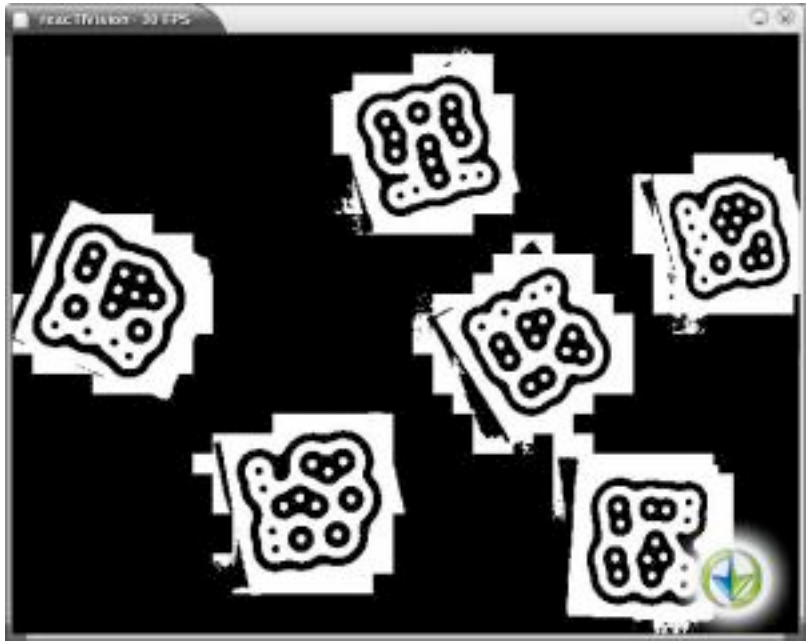
# Touchlib and CCV

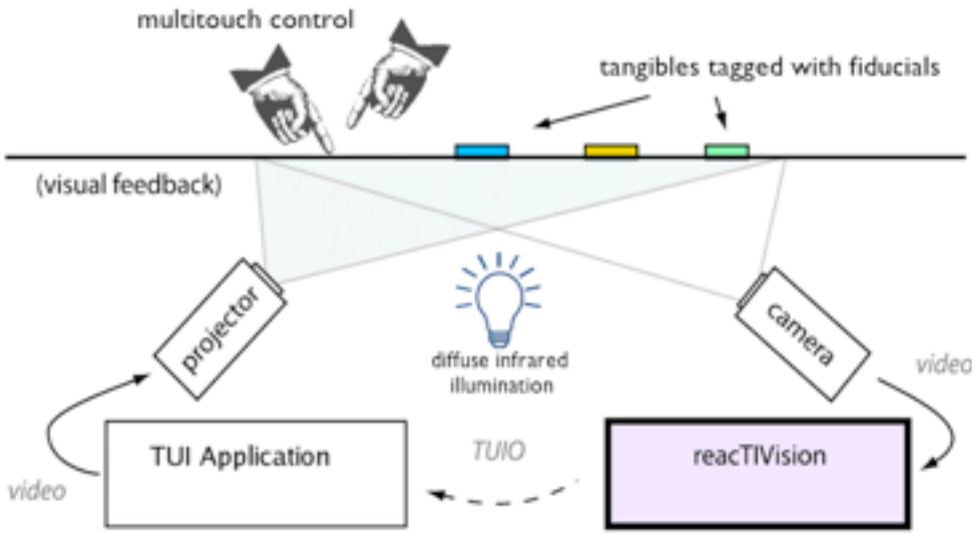



- The „classic“
- Touchlib is windows only
- CCV also Linux + OSX
- library for finger touch
- works w. diff. technologies
- also comes with a calibration app and several demos
- flame demos often seen in multi touch demo videos

# Reactivision

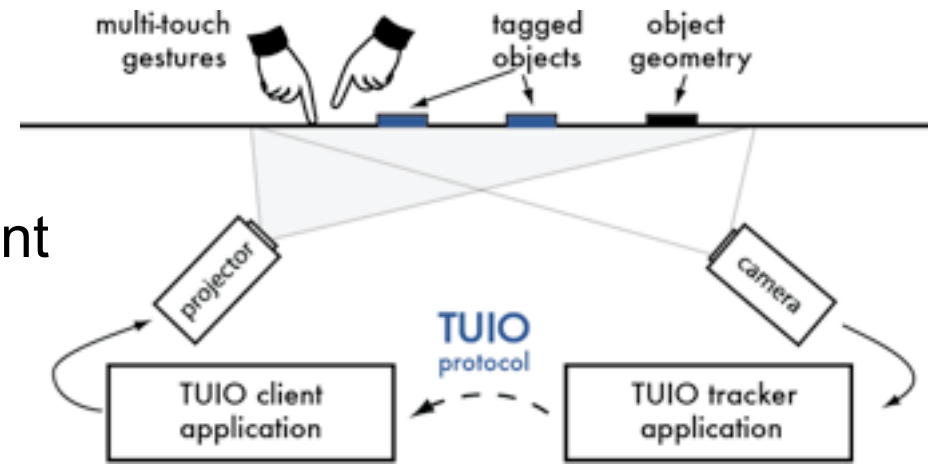
- includes marker (aka fiducial) tracking
- uses the TUIO protocol
- originally built for the ReacTable musical instrument
- used in research for various purposes





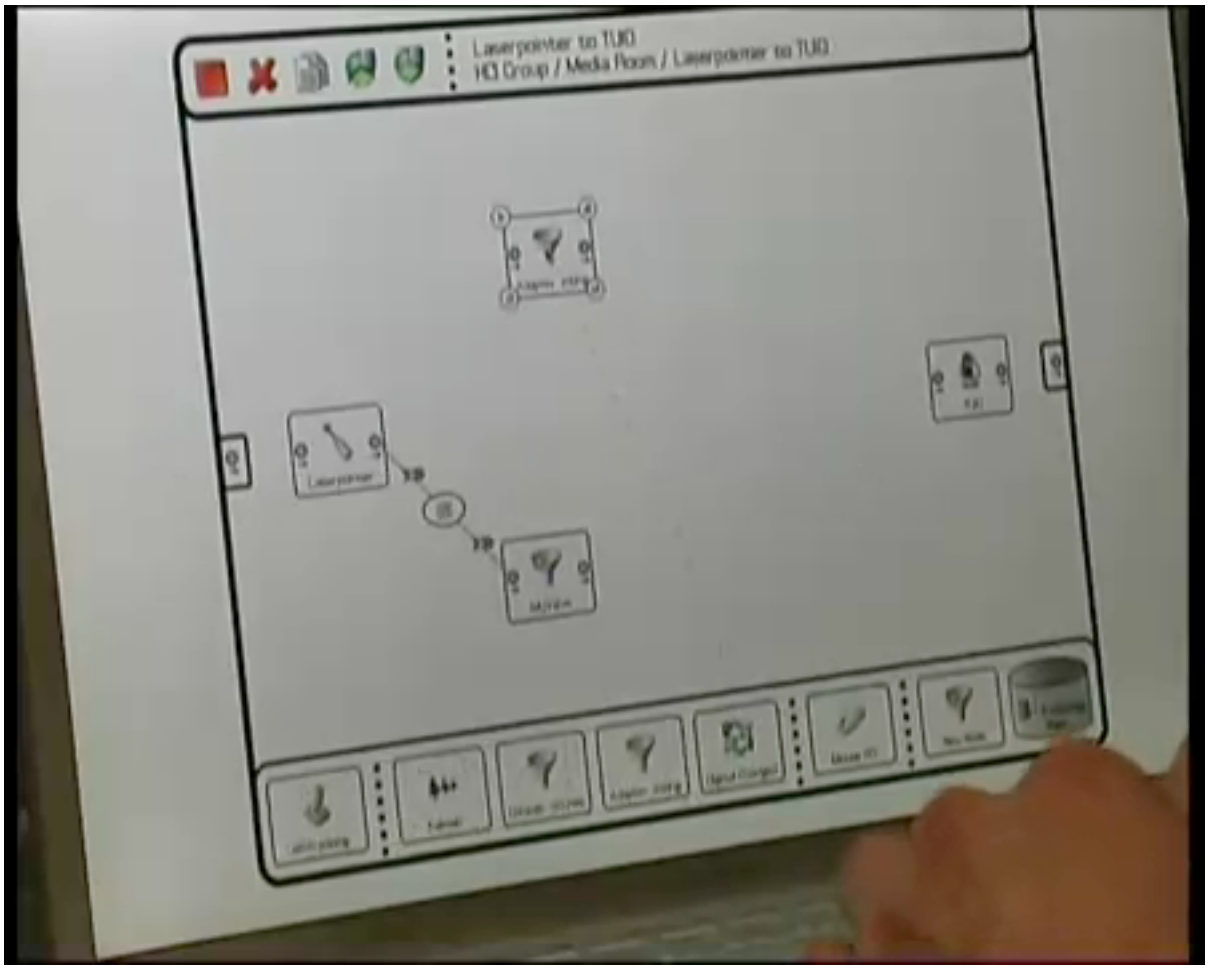
# TUIO protocol

- Standardized protocol to send touch events
  - can describe fingers, shapes and visual markers
  - Sent over a network socket (often UDP packets on port 3333)
  - input can also be simulated
  - platform independent
- Various implementations (e.g., reactivision + CCV)
- Various demo clients available
- current version 1.1
- version 2.0 in preparation
  - extensions to the message content
  - new capabilities



# Squidy

- visual interface for application programming
- pipe and filter paradigm, comes with predefined filters



# Interaction Techniques on Int. Surfaces

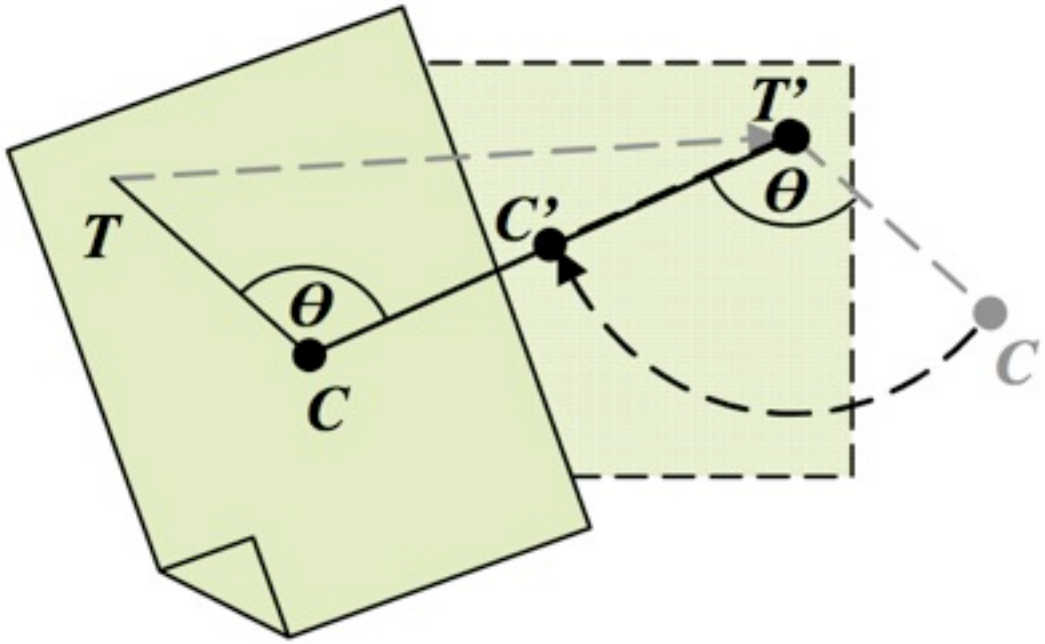
- Motivation: thinking about bumptop
- Single touch
  - RNT
- Dual touch
  - The Pinch etc.
- Multi touch
  - possible contradictions
- Shape-based
  - Bringing physics to the surface
- Tangible UIs on surfaces
  - URP, illuminating light
  - recent TUI examples

# Bumptop - the original video

# Making fun of Bumptop - discussion

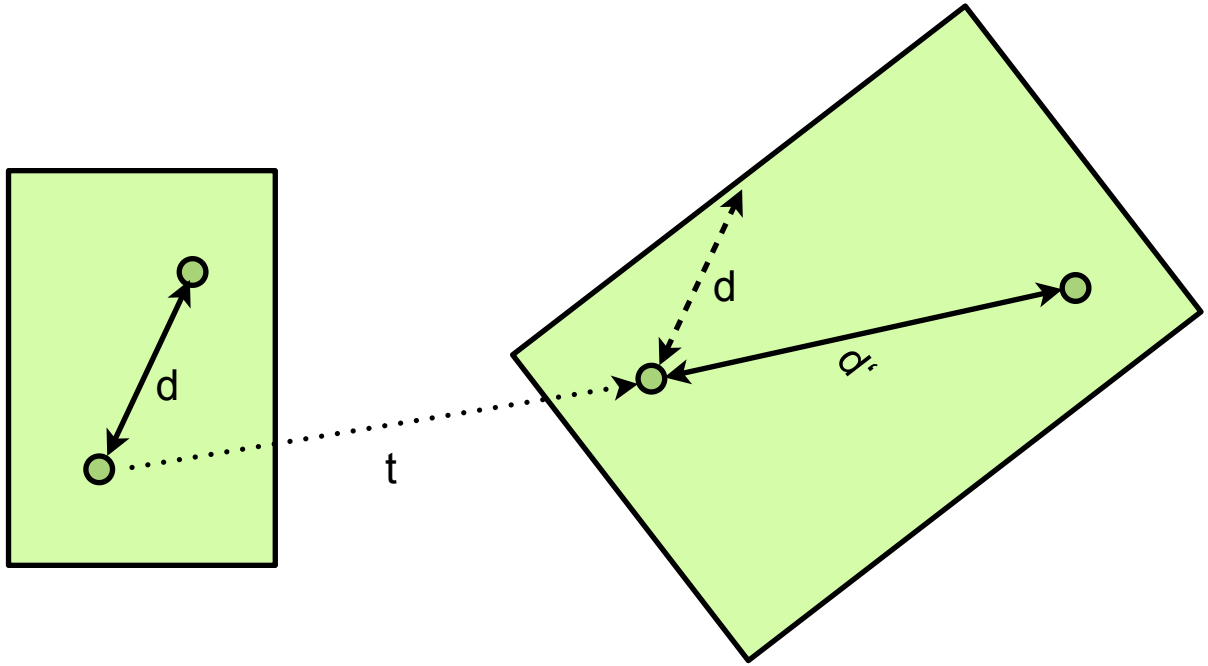
# RNT - Rotate and Translate with 1 Touch Point

- 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



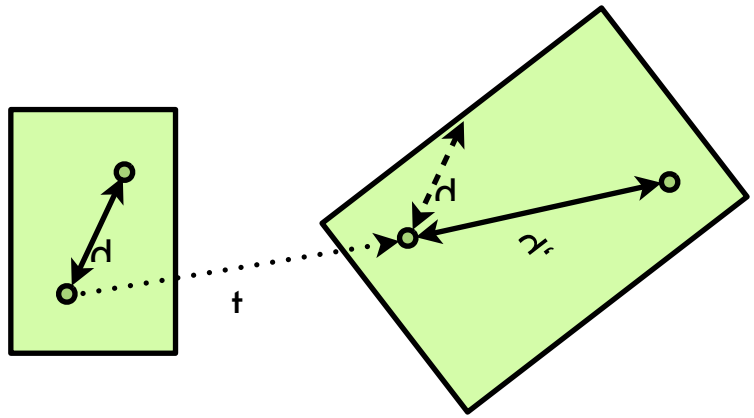
# Rotate, Translate and Scale with 2 Touch Points

- 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?

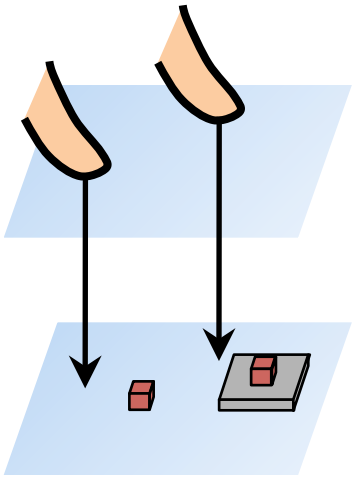
- Remember the lava lamp in Jeff Han‘s TED talk?
- Seriously: How can we do useful stuff with this?

# 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



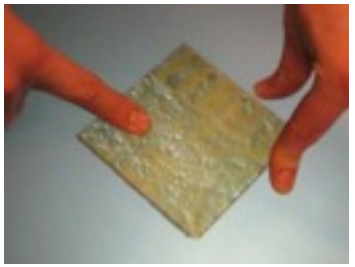
- Special objects introduced into the simulation per contact point
- Incarnation of fingertips in the virtual world
- Collide with other objects and push them aside.

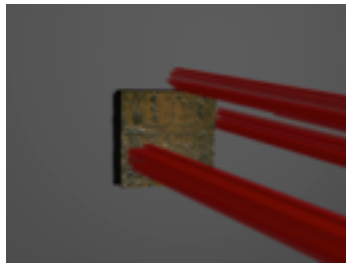
# Leveraging Collision Forces

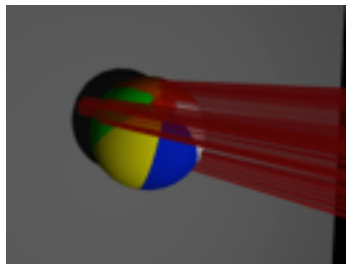
# Leveraging Friction Forces

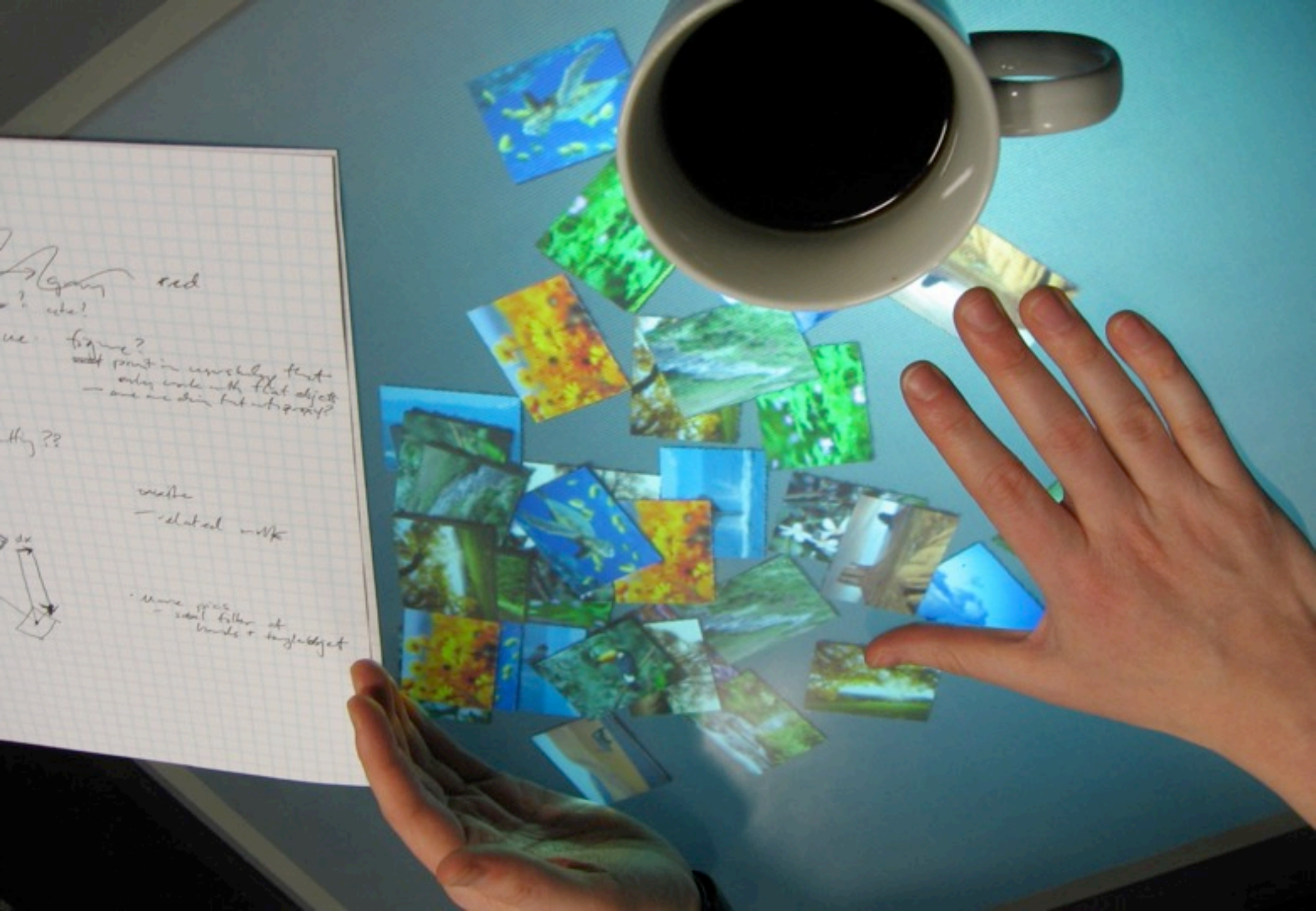
# Particle Proxies

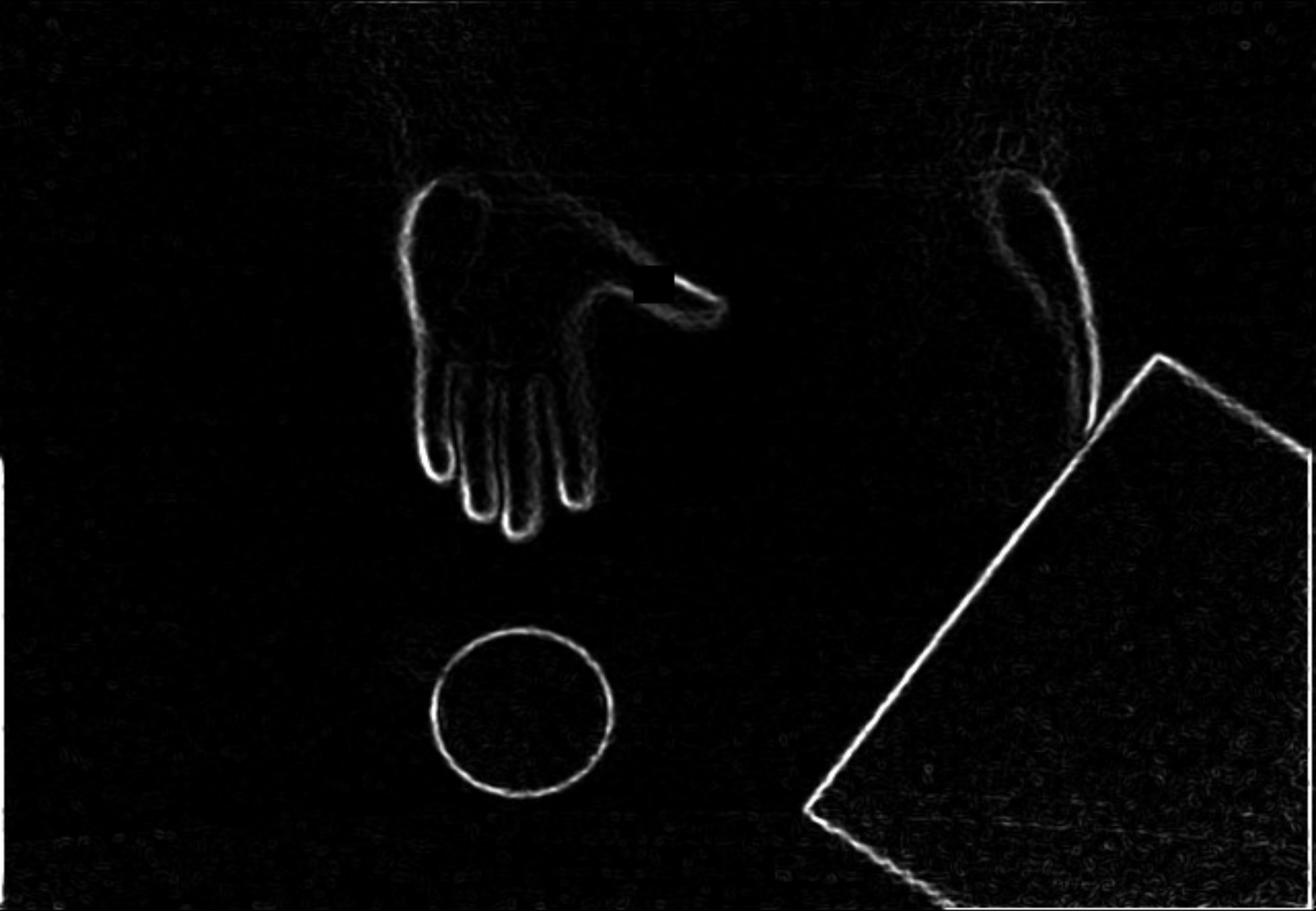
- Idea: model contact shape with many proxy objects (particles)
- Collisions obey shape of the contact (e.g., flat or side of the hand)
- Distribution of forces is modeled more accurately (e.g., conforms to 3D shape)



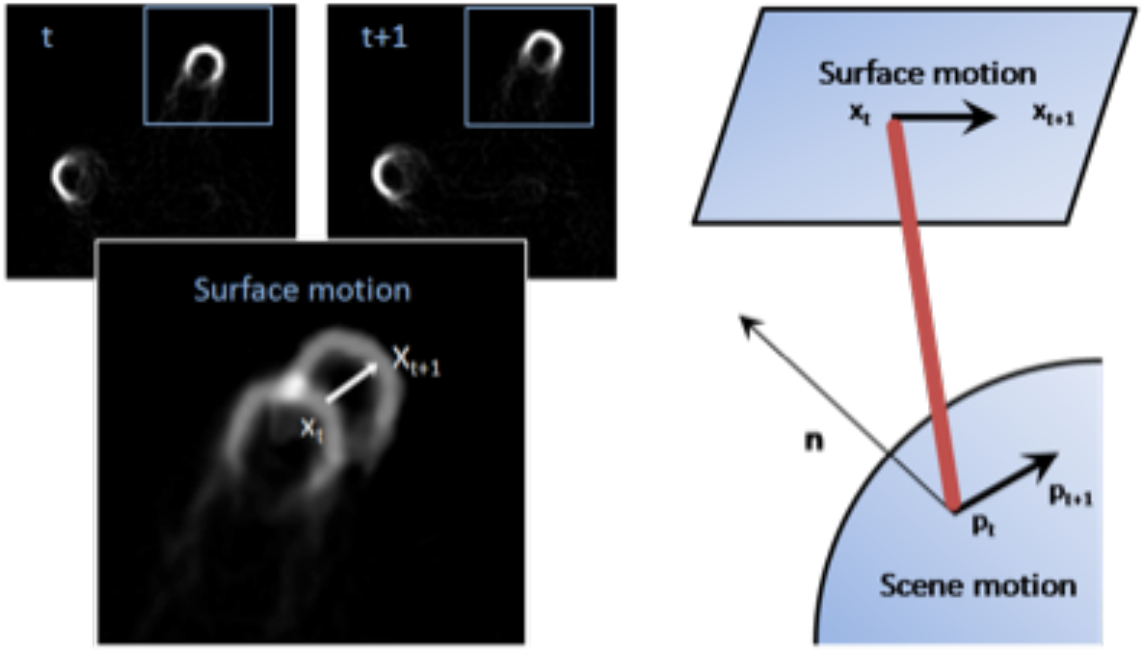


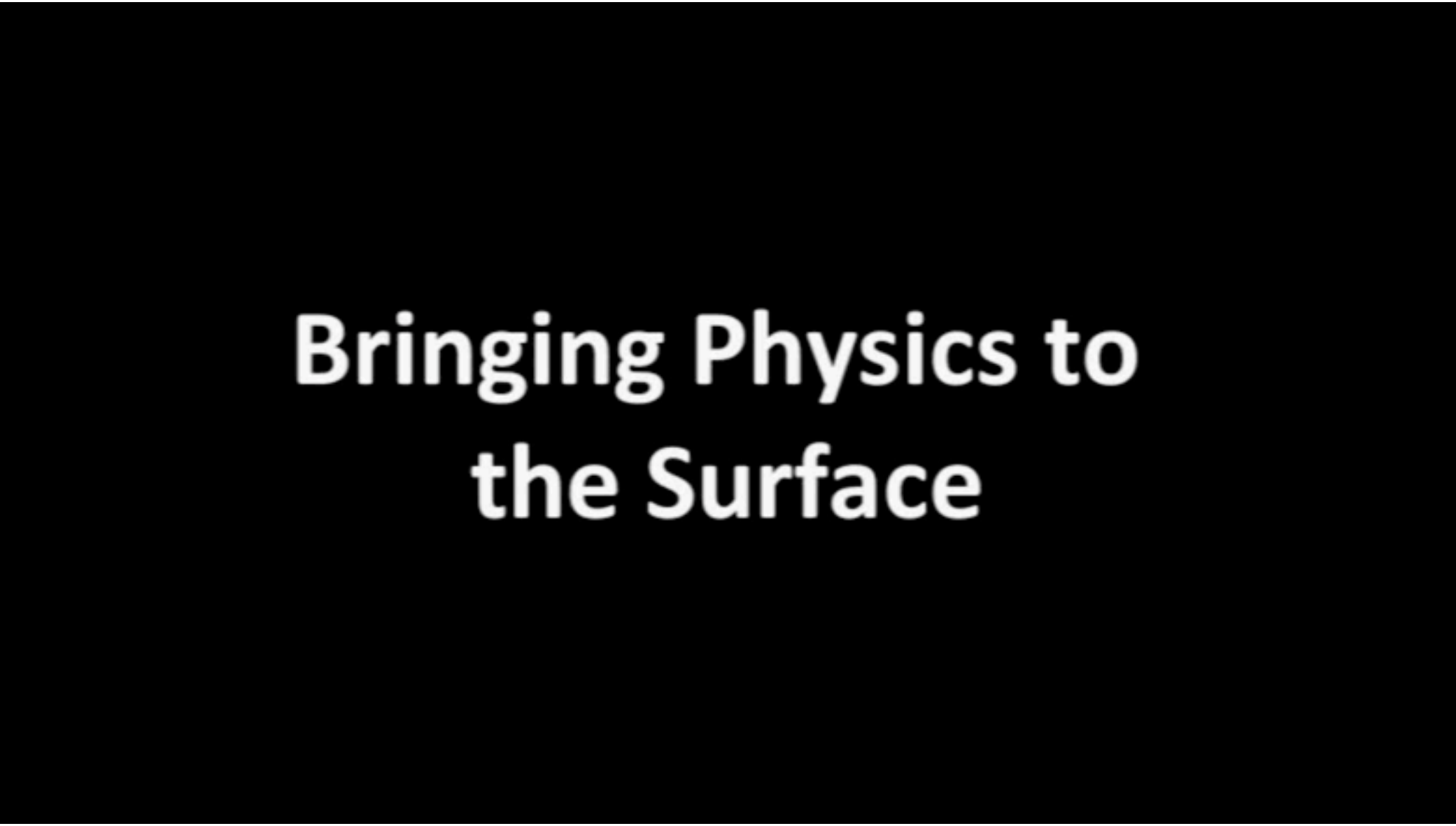






# From Tracking to Flow




Bringing Physics to
the Surface

# 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