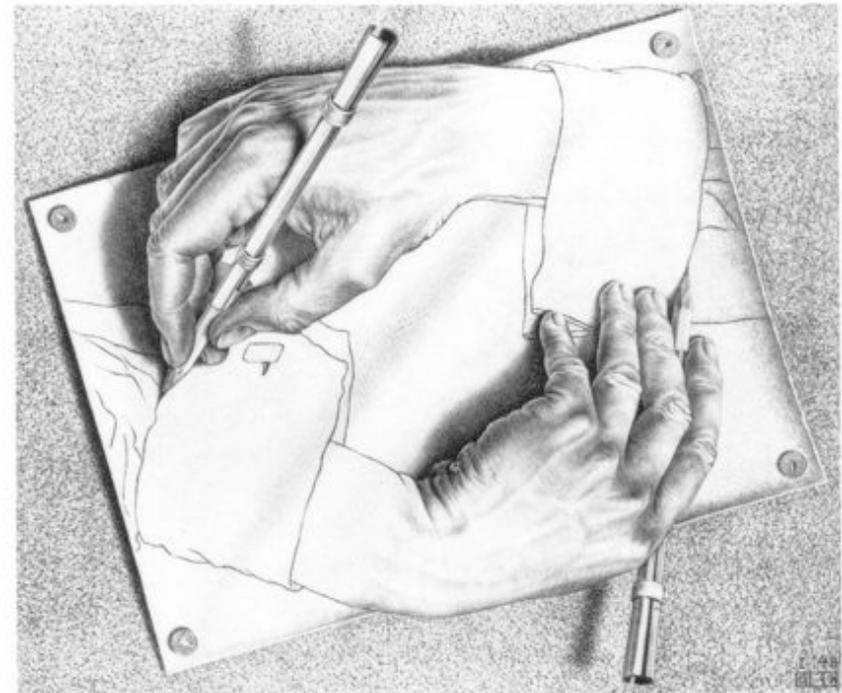


# Two-Handed Interaction









AGAIN

DELETE

FIND

COPY

SAME

MOVE

OPEN

PROP'S

---

## **But Most Interactions Today One-Hand**

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# What Else is Known about 2-Handed UIs?

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- Theory
- Magic Lenses
- T3 and Tape-Based UIs
- ToolStone

# Two-handed Input

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- Also known as Bimanual Input
  - Asymmetric
  - Symmetric

# Two-handed Input

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- Type 1: Asymmetric two-handed input
  - Non-dominant hand does coarse positioning
  - Dominant hand does fine work
  - Examples: Handwriting, eating
- Type 2: Symmetric
  - Both hands are equal partners
  - Examples: Driving
- Both types work best if task is integrated
  - Ex. Hammering a nail
  - Otherwise, divided attention



# Magic Lenses / Toolglasses

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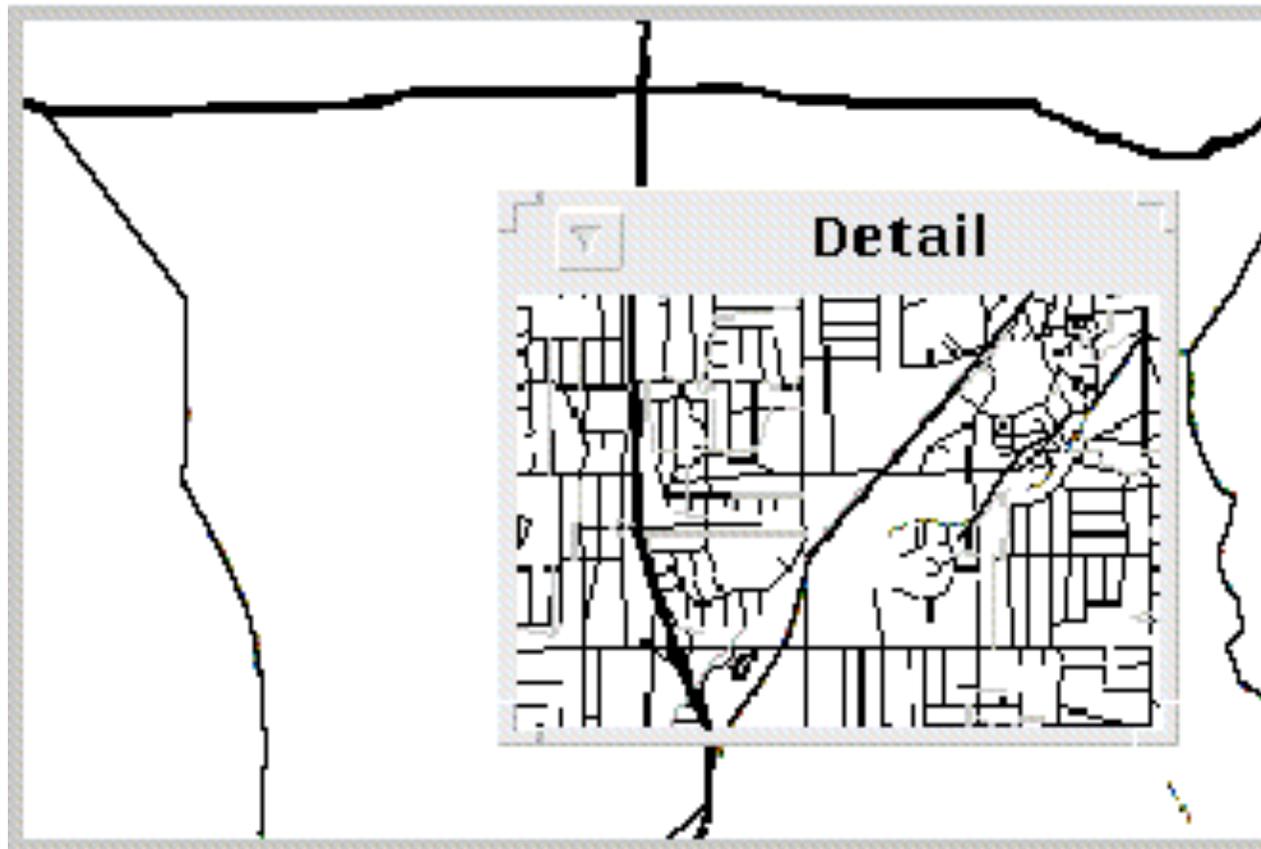
- Developed at PARC
- We saw a physical version previously:



# Magic Lenses

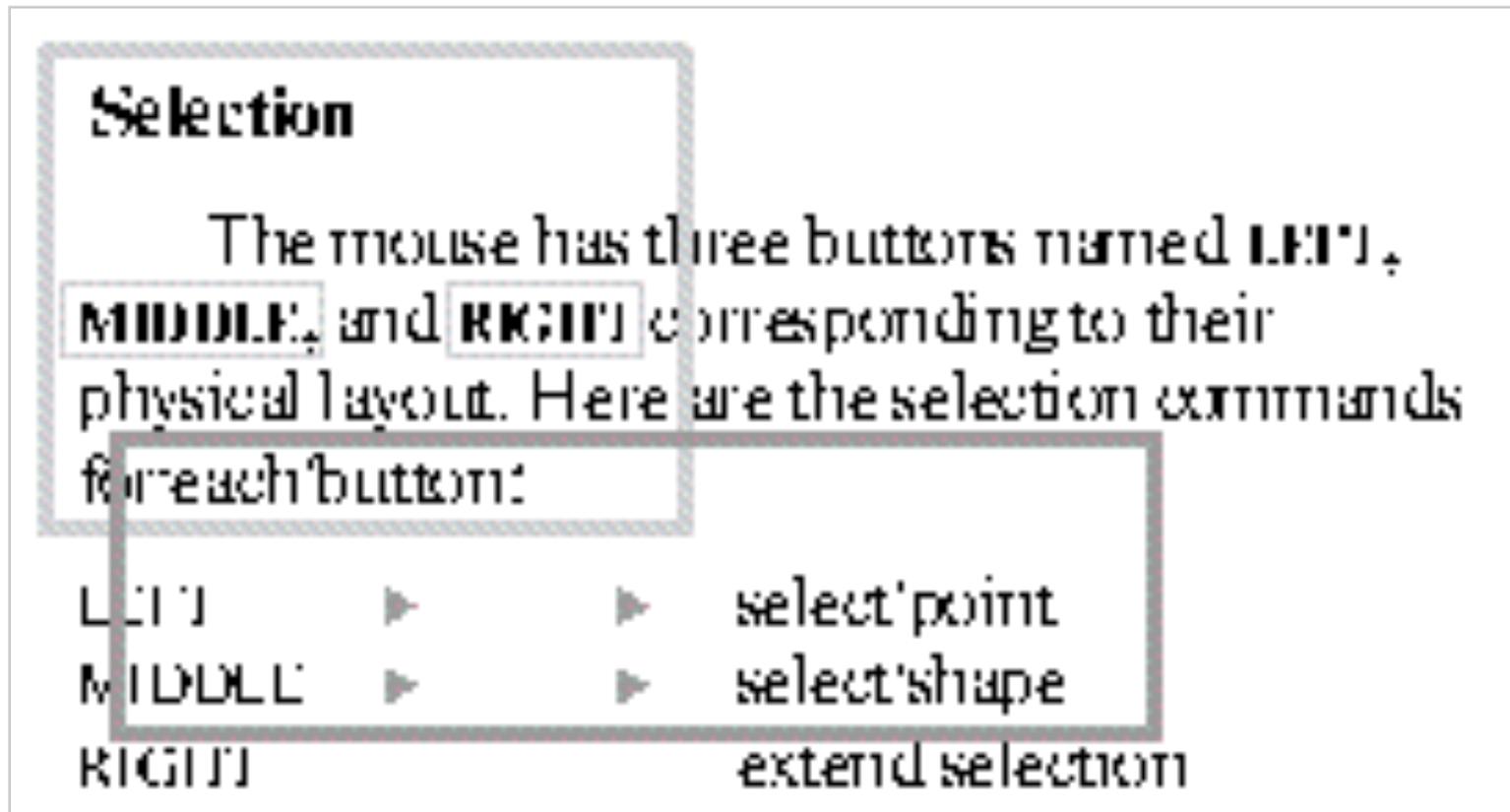
---

- Magic Lenses are a way of showing more info
  - Show more details



# Magic Lenses / Toolglasses

- Magic Lenses are a way of showing more info
  - Show hidden information



The image shows a screenshot of a Magic Lens window titled "Selection". The text inside the window explains that the mouse has three buttons: LEFT, MIDDLE, and RIGHT, and lists the selection commands for each. The text is in a monospaced font. The words "LEFT", "MIDDLE", and "RIGHT" are highlighted with a light blue box. The words "select'point", "select'shape", and "extend selection" are also highlighted with a light blue box. The entire content is enclosed in a rectangular frame with a dashed border.

**Selection**

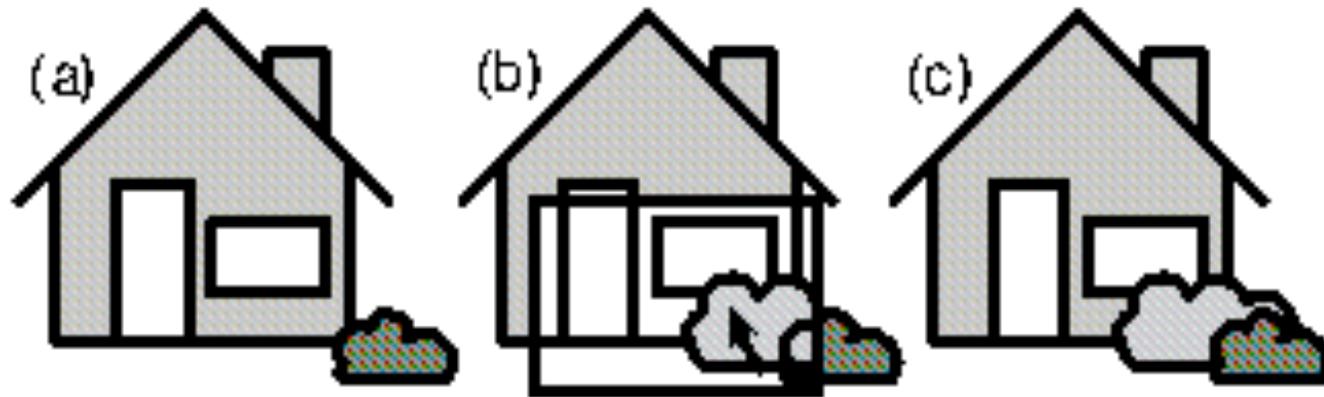
The mouse has three buttons named **LEFT**, **MIDDLE**, and **RIGHT** corresponding to their physical layout. Here are the selection commands for each button:

<b>LEFT</b>	▶	▶	select'point
<b>MIDDLE</b>	▶	▶	select'shape
<b>RIGHT</b>			extend selection

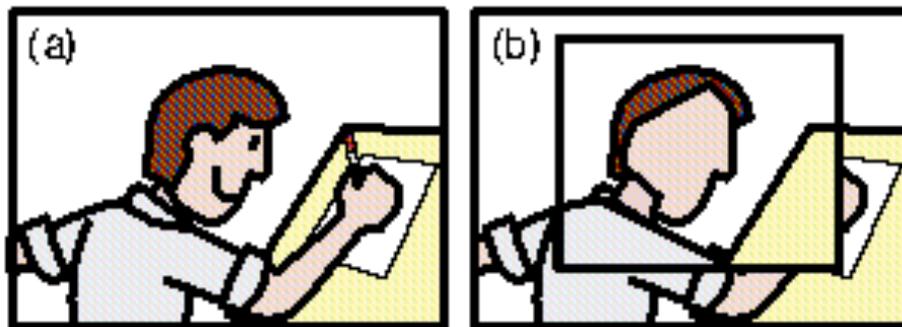
# Magic Lenses

---

- Show history



- Show reverse order



# Magic Lenses

---

- Magnification



# Toolglasses

---

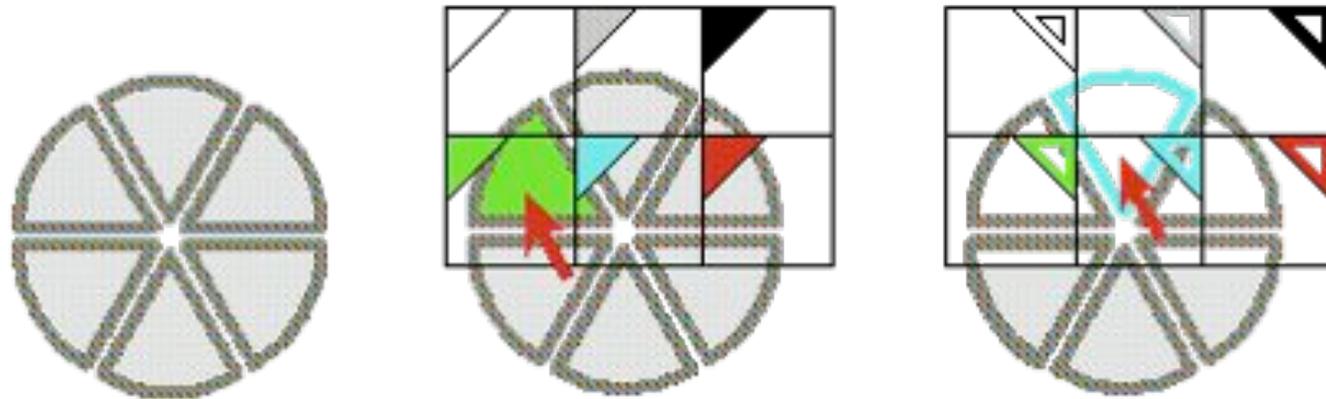
- Toolglasses more for input (though fuzzy distinction)
  - Toolglass manipulated by non-dominant hand
- Font selection

temporal modes and modes created

regular	by holding down a keyboard key with
<i>italic</i>	<i>spatial modes</i> . Because these spatial
<b>bold</b>	modes can be changed <u>directly</u> in the
<b><i>bold italic</i></b>	application work area, the cursor and the user's attention can remain on the

# Toolglasses

- Selecting colors from a palette

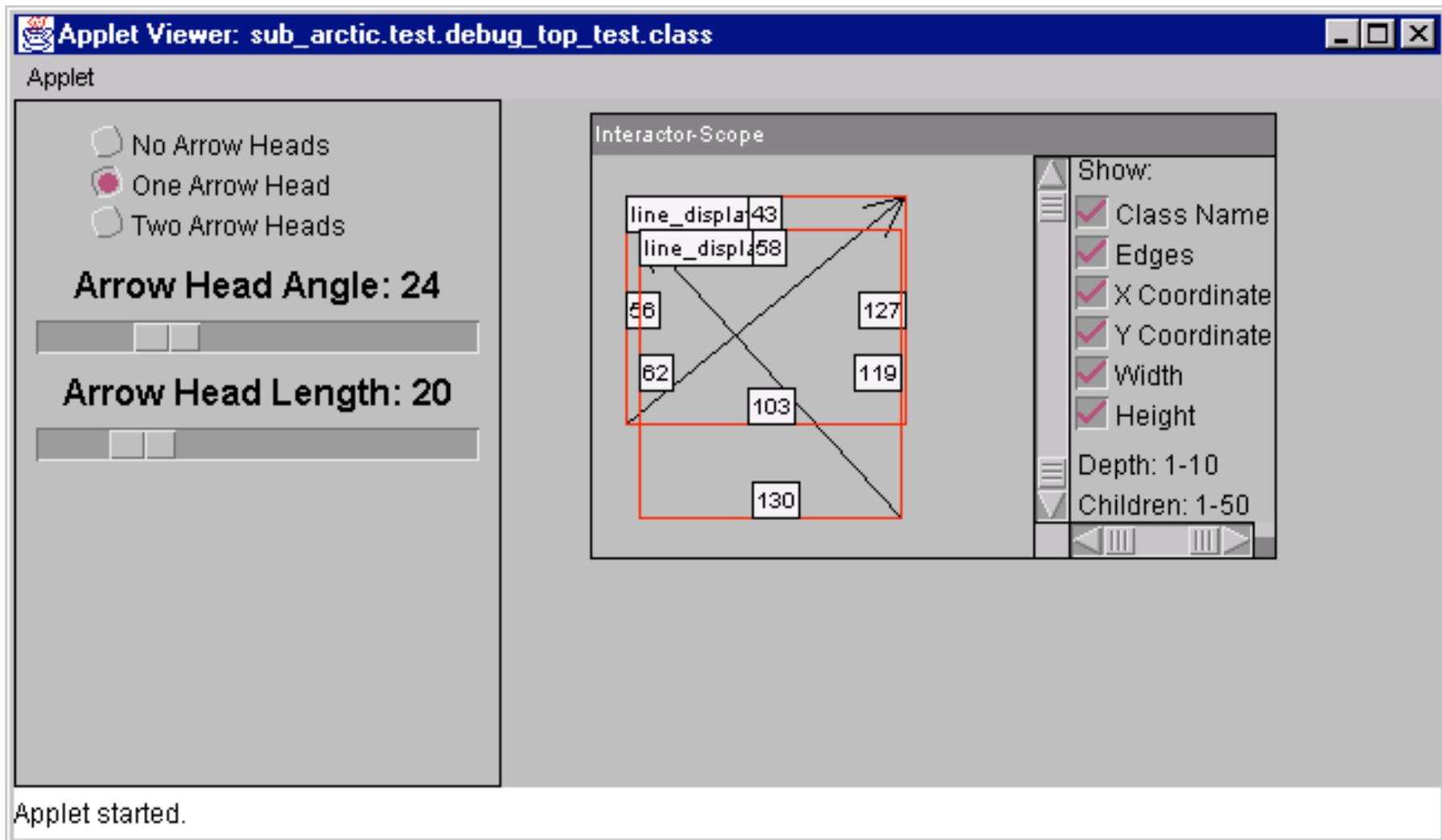


- Selecting shapes from a palette



# Magic Lenses / Toolglasses

- GUI Debugging Lens



# Magic Lens / Toolglass Video

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# Magic Lenses / Toolglasses

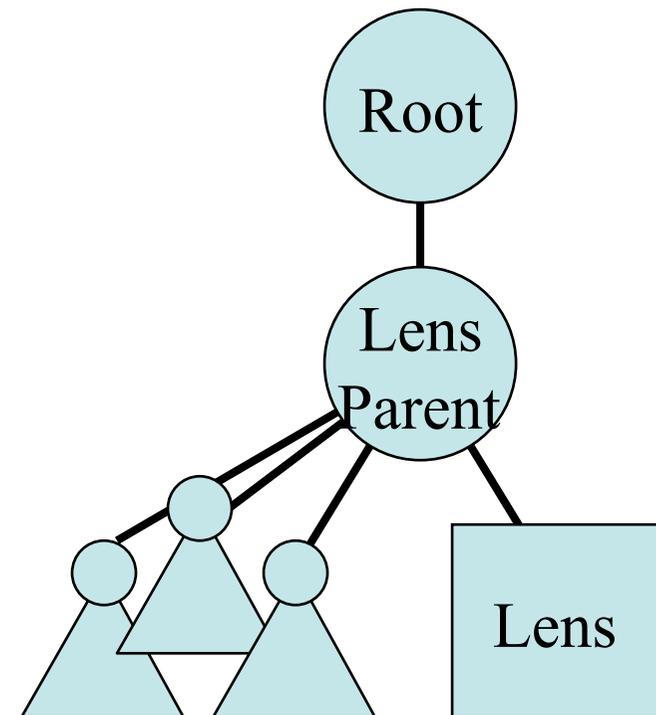
---

- Magic lenses and Toolglasses useful for:
  - Showing extra details or context without clutter
  - Modifying input with little or no shift in attention
    - Don't have to travel up to toolbar and back down
    - Ex. Property palettes
    - Ex. Clipboards (usually invisible)
    - Ex. Selection tools (make it easy to get hard things)
- Currently patented by Xerox
  - Can get a license if you want to use the technique

# Magic Lenses / Toolglasses

---

- Implemented as node right above or below root of interactor tree
  - Rendered last (syntactic things easy, semantic harder)
  - Modifies dispatch too (all events must go thru lens)



# What Else is Known about 2-Handed UIs?

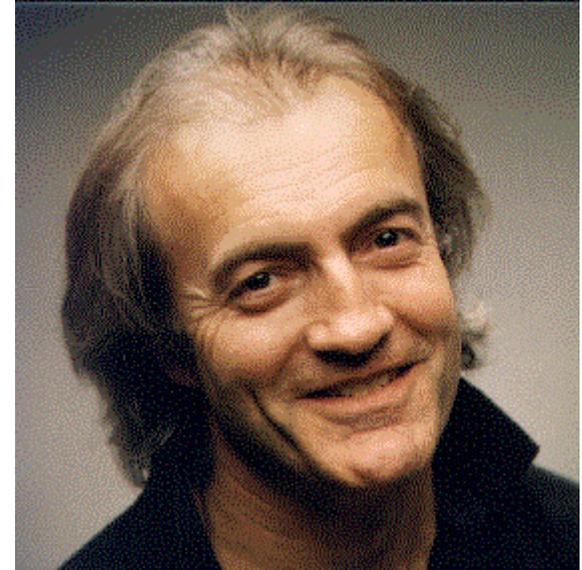
---

- Theory
- Magic Lenses
- T3 and Tape-Based UIs ←
- ToolStone

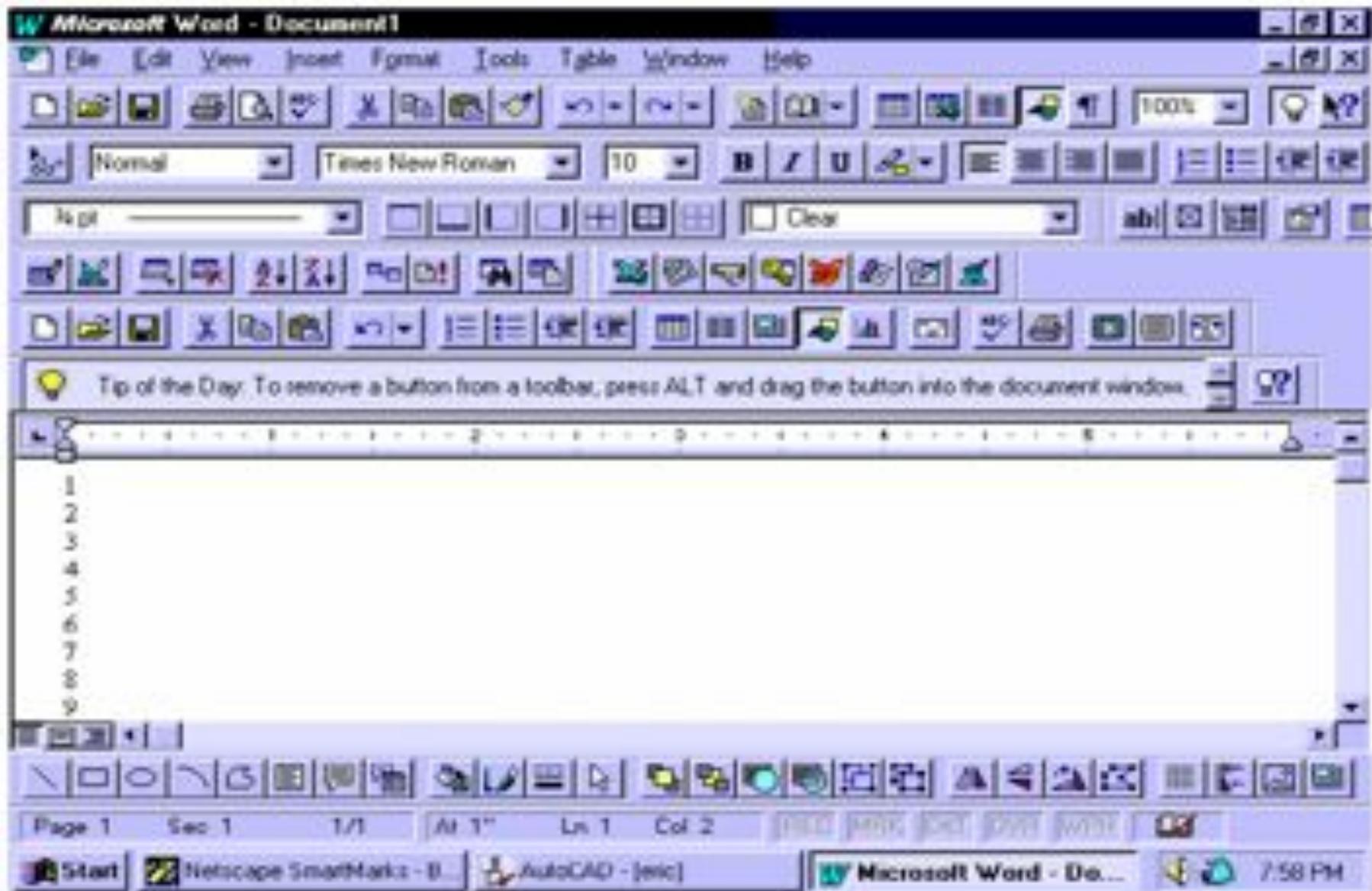
# Bill Buxton

---

- Bill Buxton
  - Was Alias / Wavefront and UToronto
  - Now Microsoft Research
- High-end design tools
  - Efficiency and “flow” very important
  - Close coupling with car designers



# T3: Tablets, Two-hands, Transparency



## T3: Tablets, Two-hands, Transparency

---



# T3: Tablets, Two-hands, Transparency

---

- Combined lots of ideas we've seen before:
  - T3 + marking menus
  - Applied to high-end design
  - Pushes further, very few “standard” menus
- Mixes asymmetric and symmetric bimanual input
  - Toolglass (asymmetric)
  - Sizing a shape (symmetric)
- Business model
  - High-end designers (and companies) willing to pay for better tools

# 2D Digital Tapedrawing

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# Tool Stone

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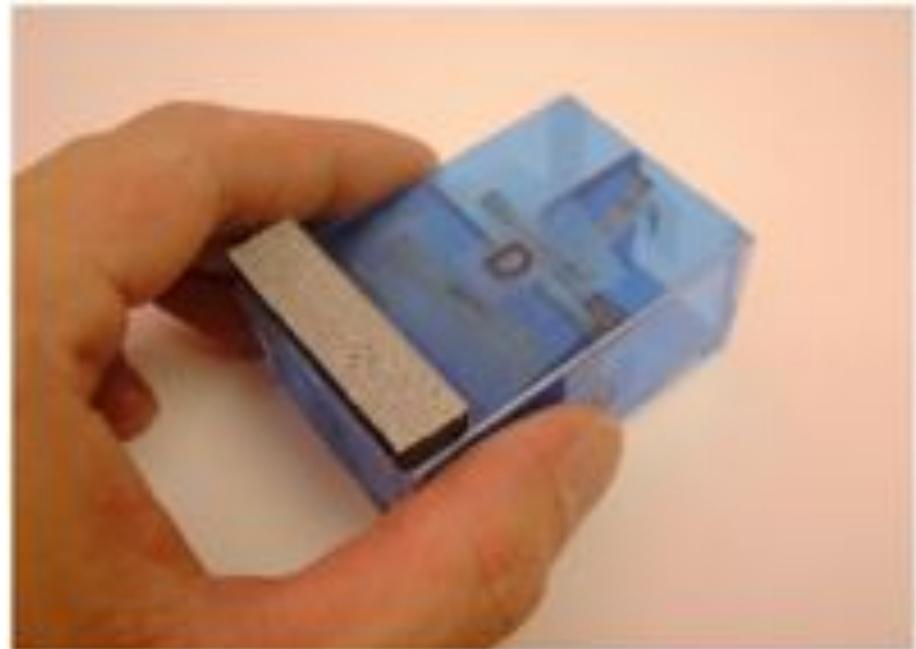
- Jun Rekimoto
  - Currently head of Sony CSL
  
- Also did:
  - DataTiles
  - Pick and Drop



# Tool Stone

---

- Multiple degree-of-freedom (*MDOF*) input device
- Senses rotating, flipping, or tilting
- Used by non-dominant hand
- Includes useful interaction techniques:
  - Toolglass
  - Zooming
  - 3D rotation
  - Virtual camera control



---

# Video



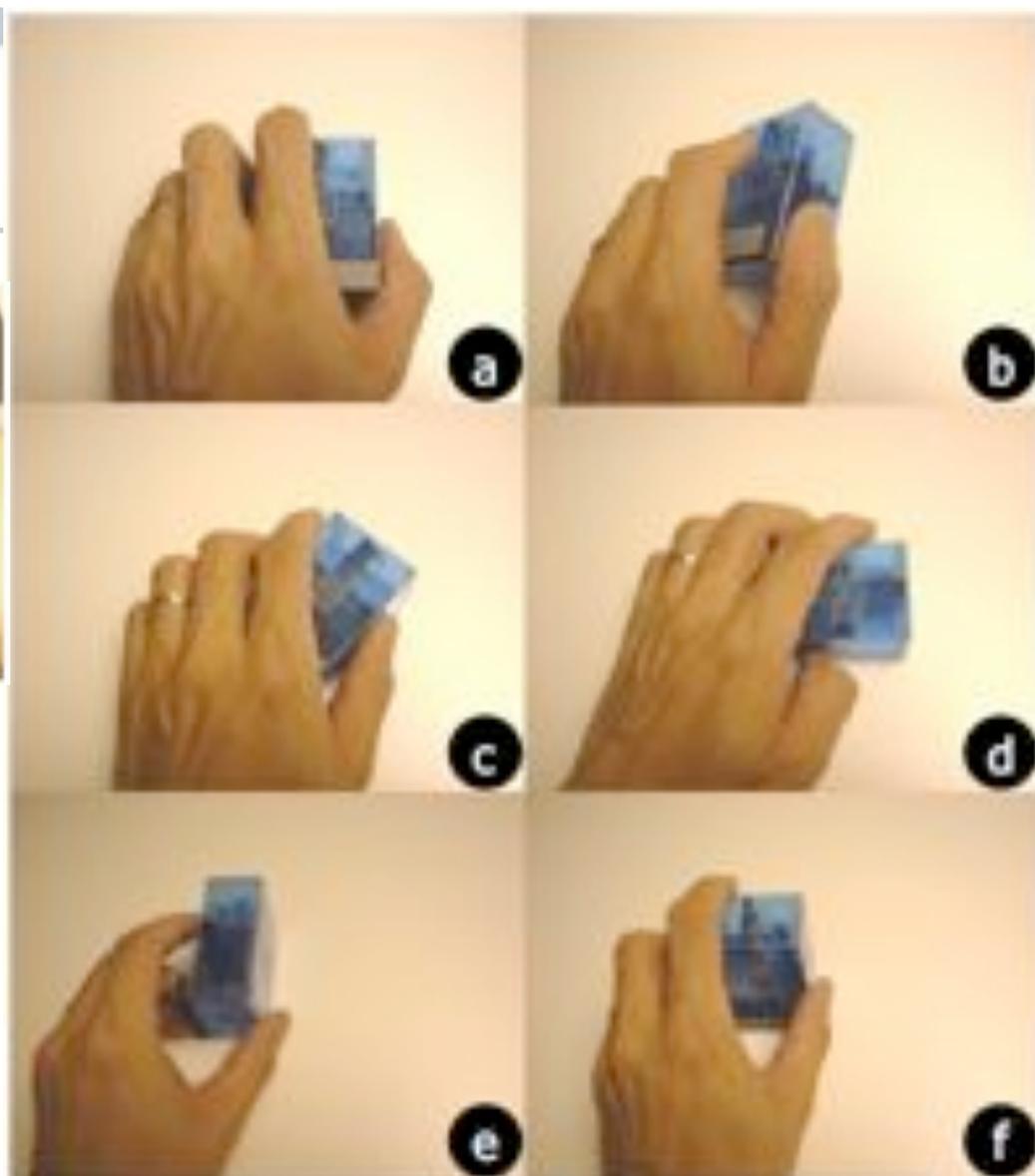


Figure 5: Several possible ways of holding the Tool-Stone: (a) Normal mode (Note: a projection attached near the lower edge of the upper face can be felt by the hand). (b) Tilting while one edge is contacting the tablet (c, d) Rotating, and (e, f) Flipping to select other faces.

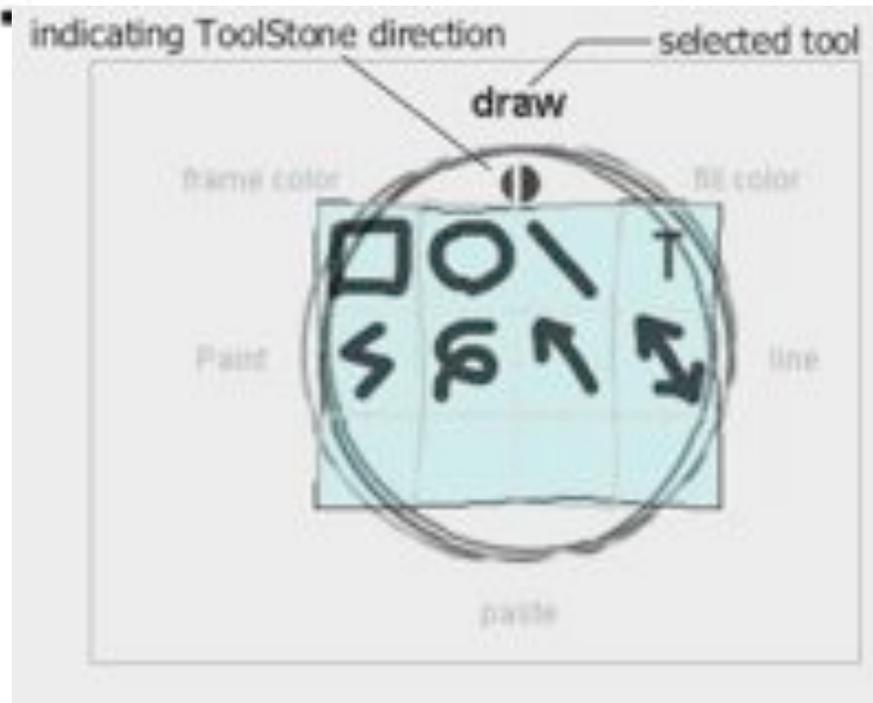
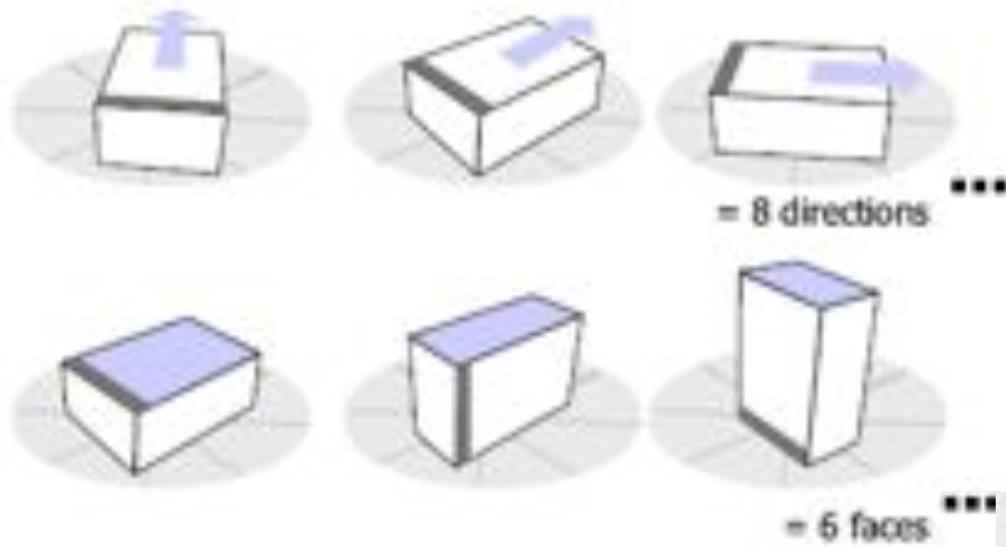
# Tool Stone

---

- Added a bar to one side
  - Want users to be able to differentiate via touch rather than having to look at it
  - Probably better if they had ridges or bumps
    - Ex. Braille, Scrabble, Mahjong
- Another variant



# Tool Stone



# Tool Stone

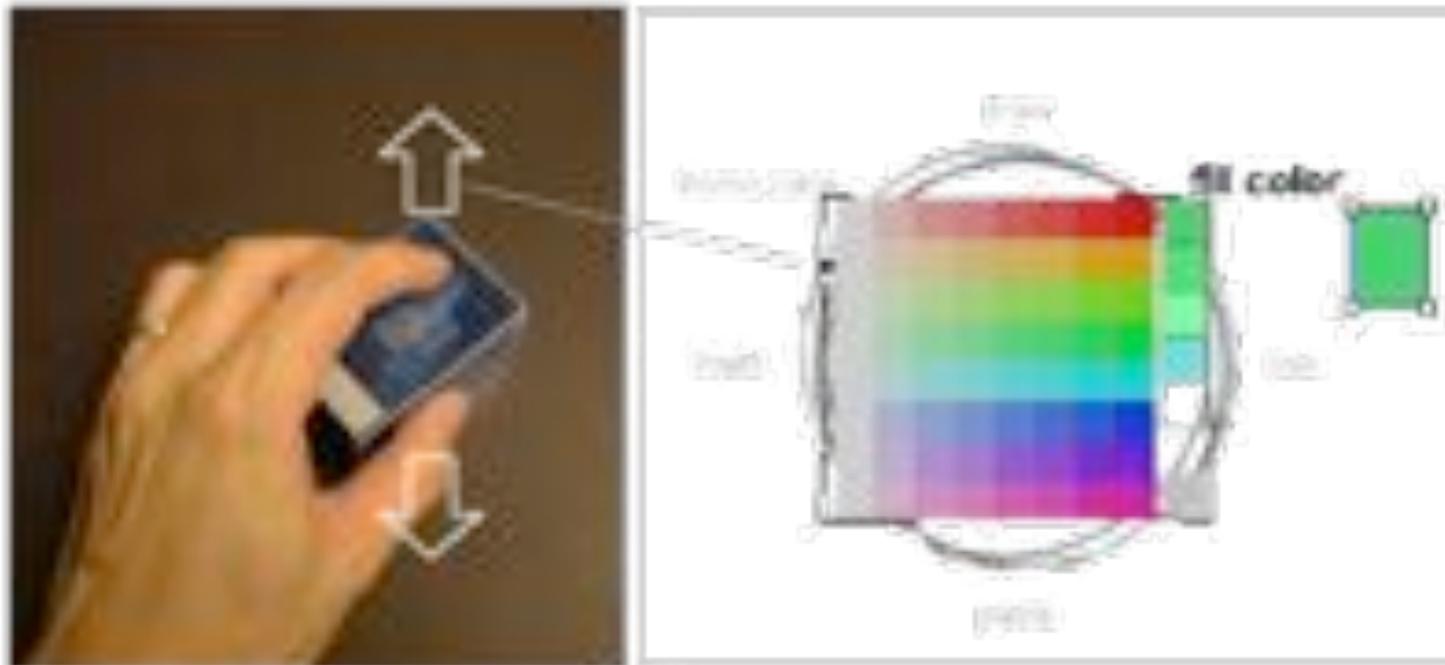


Figure 8: A color selection tool example: ToolStone's vertical motion controls the brightness parameter of the color space, while two other parameters (hue and saturation) are mapped according to the x and y axes of a 2D palette. A user can dynamically navigate through the color space before selecting a color instance. Note that the direction of the ToolStone is used to select the color selection tool.

# Tool Stone

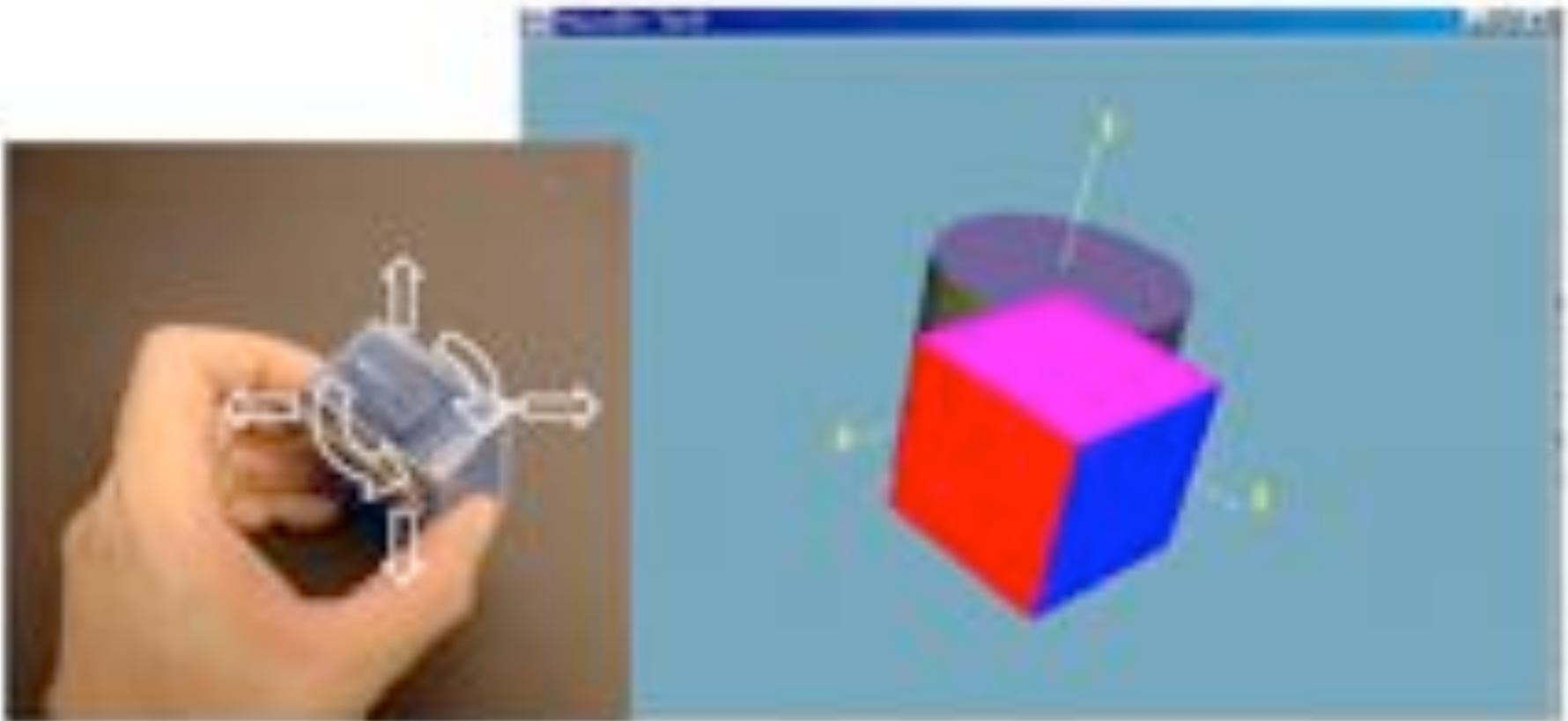
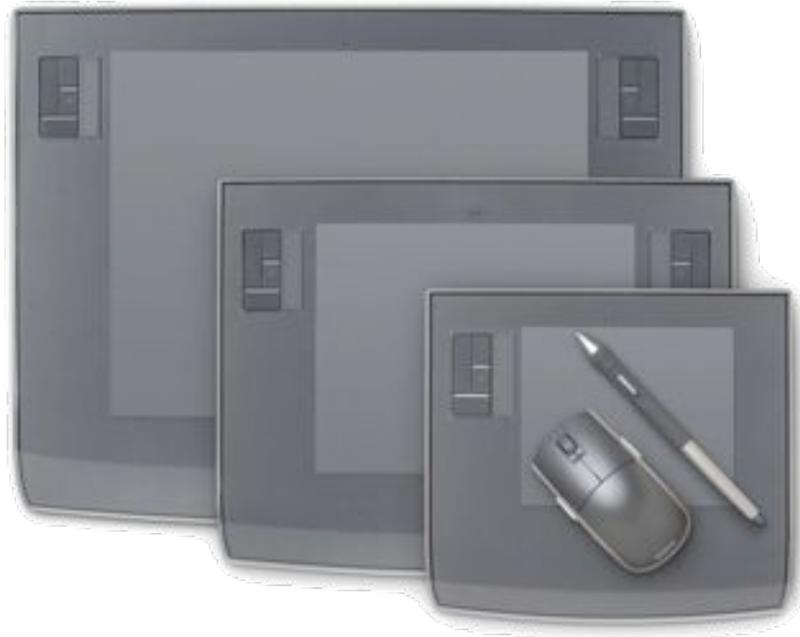


Figure 10: 6DOF movement of the ToolStone can be mapped for 3D object control.

# Tool Stone

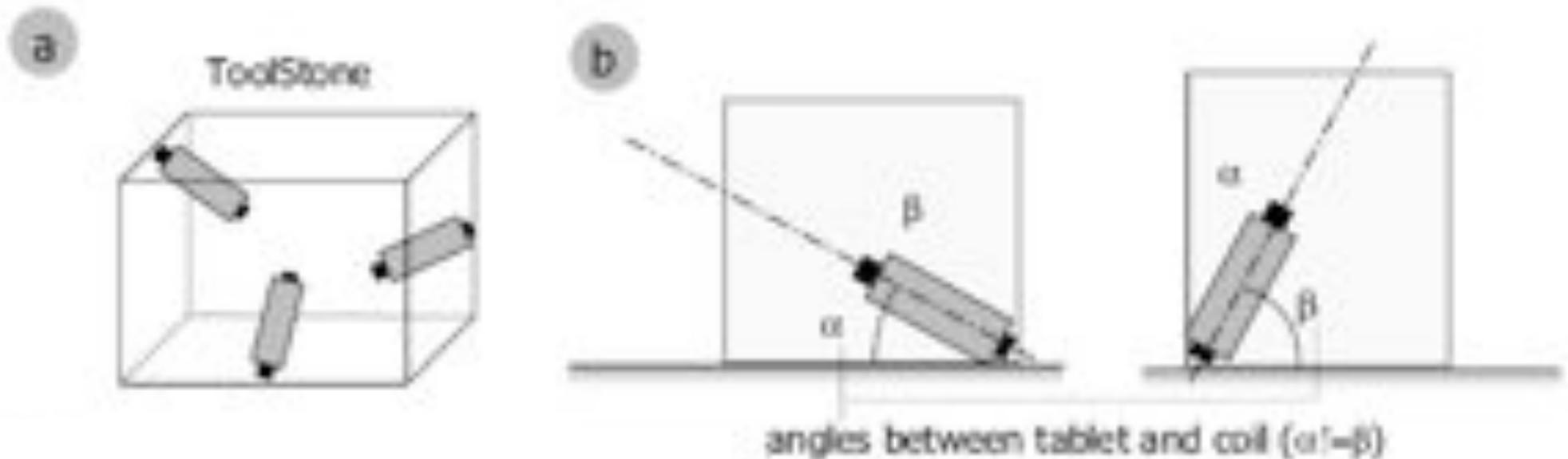
---

- First implementation used computer vision
  - Put visual codes on each side
  - Use a transparent table
  - Too big to use well
- Second implementation hacked up a Wacom tablet



# Tool Stone Implementation

- Tablet emits a weak electromagnetic field with signal
- Specially built coils respond to this signal
  - These coils are in the pen



# Tool Stone Implementation

---

- Tablet emits a weak electromagnetic field with signal
- Specially built coils respond to this signal
  - These coils are in the pen
- By measuring response, can determine:
  - Location
  - Orientation
  - Angle
- Embed coils into the toolstone
  - Can actually use three rather than six
  - Modified coils to return different “pressure”, to differentiate

# Tool Stone

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- Very clever hack
  - Wacom tablets are at commodity costs now
- Seems to be a UI for intermediates and experts
- Provides richer interaction beyond menus
- Better use for non-dominant hand than just pointing and clicking

# Tool Stone

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- Other prototypes
  - How a person touches might give different functions



# Tool Stone

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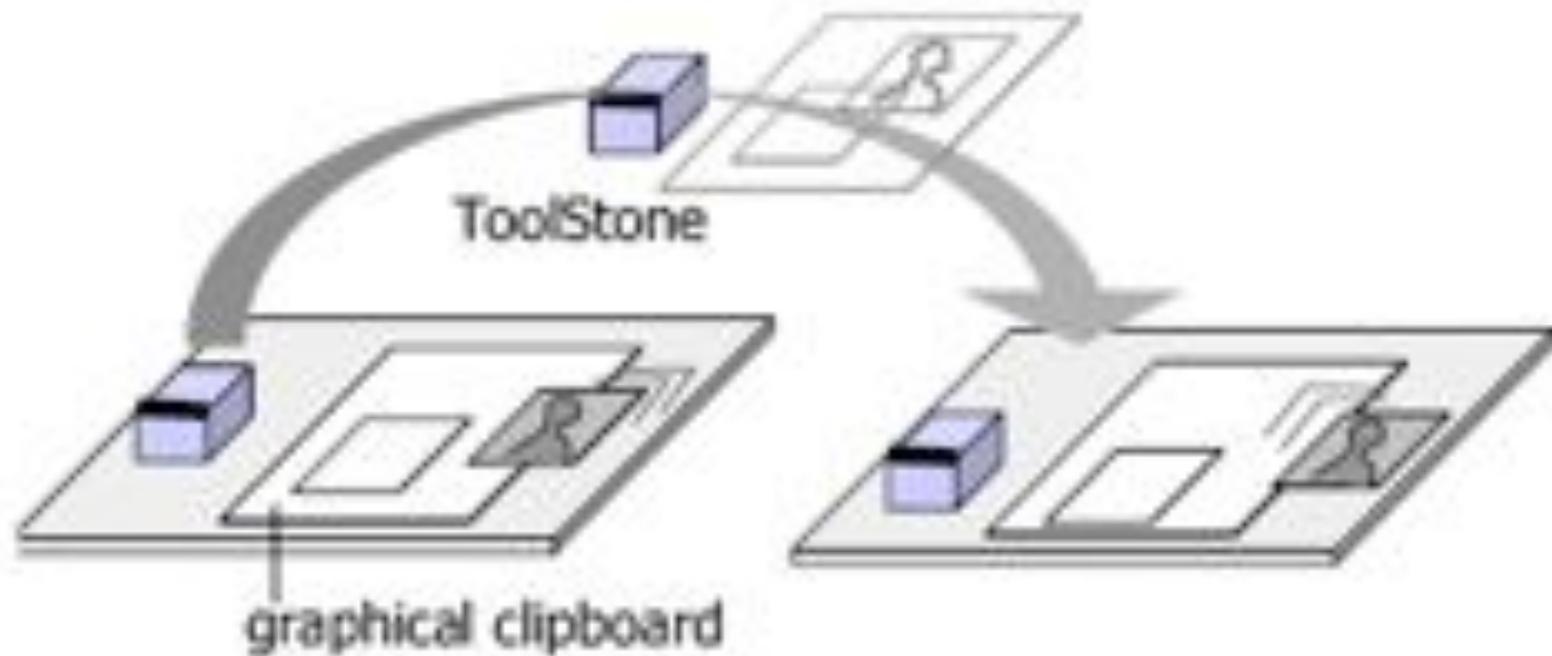
- Other prototypes



# Tool Stone

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- Other ideas: pick and drop



# Digression: Actual Impact of Research

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- Yet another area of research that has only somewhat panned out in practice
  - GUI is “good enough” for most tasks
  - Though high-end designers willing to pay and learn for higher performance

# Summary

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- Bimanual Input
  - Symmetric and asymmetric
- Magic Lenses and Tool Glasses
  - Lenses that modify input and output
- Tool Stone
  - Physical tool for two-handed interaction
  - Side, Orientation, Position all act as input

