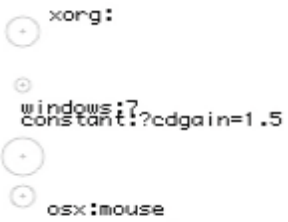
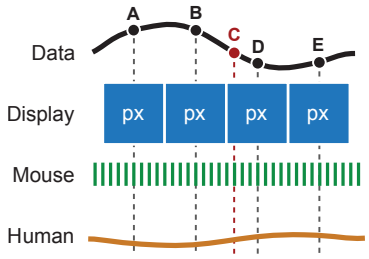
From movement to interaction and gesture: studies, techniques, tools and input devices

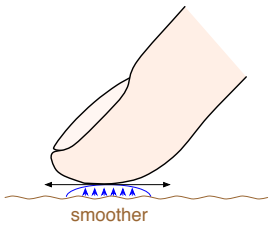
Géry Casiez

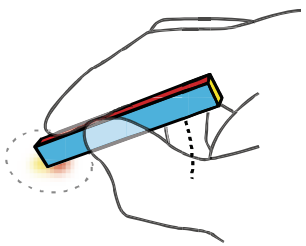
November 12th 2012

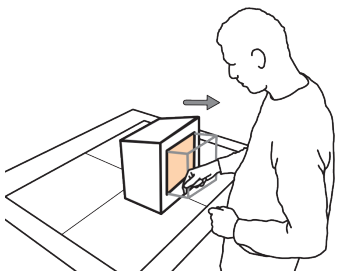
Habilitation à Diriger des Recherches

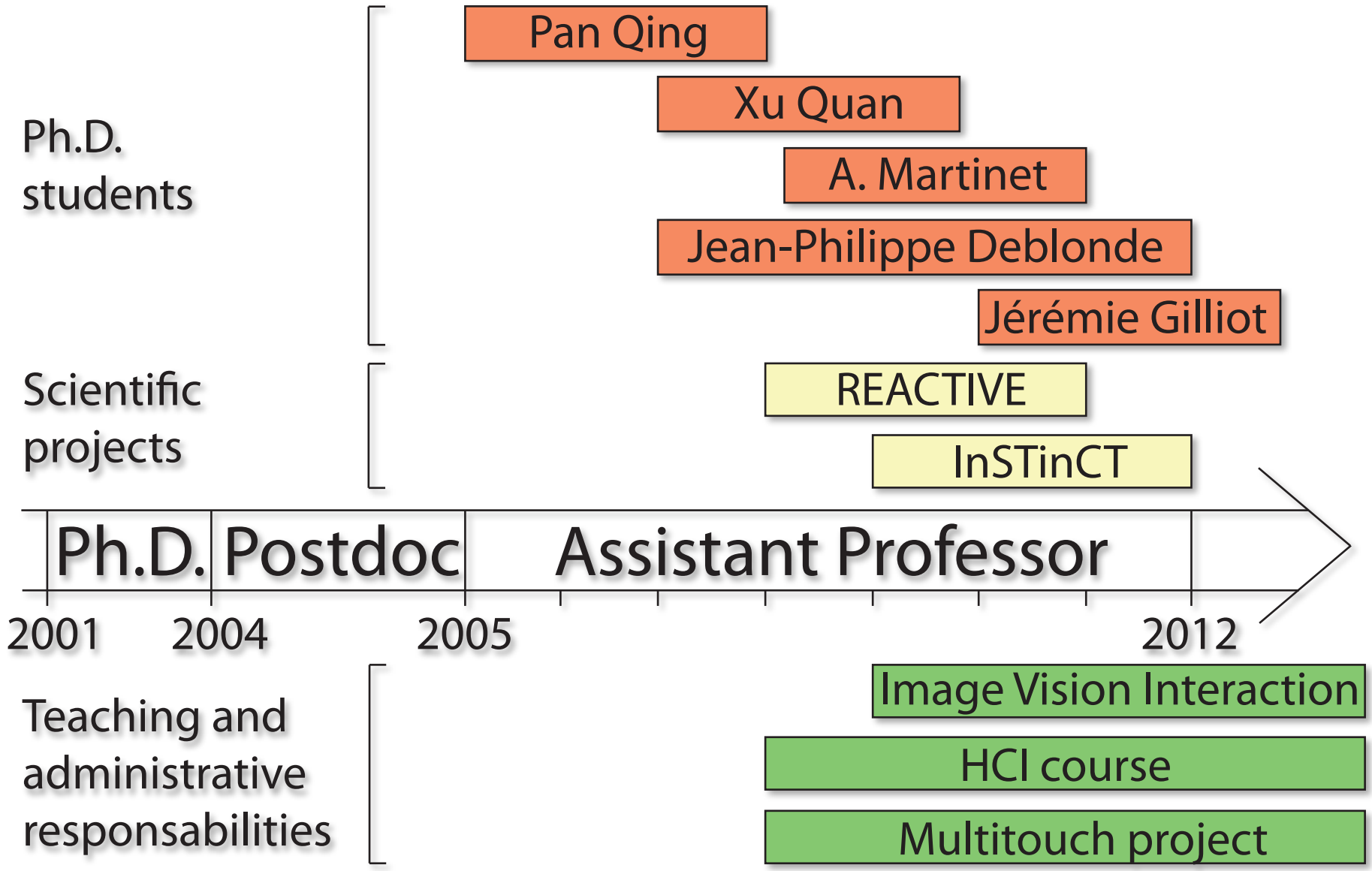




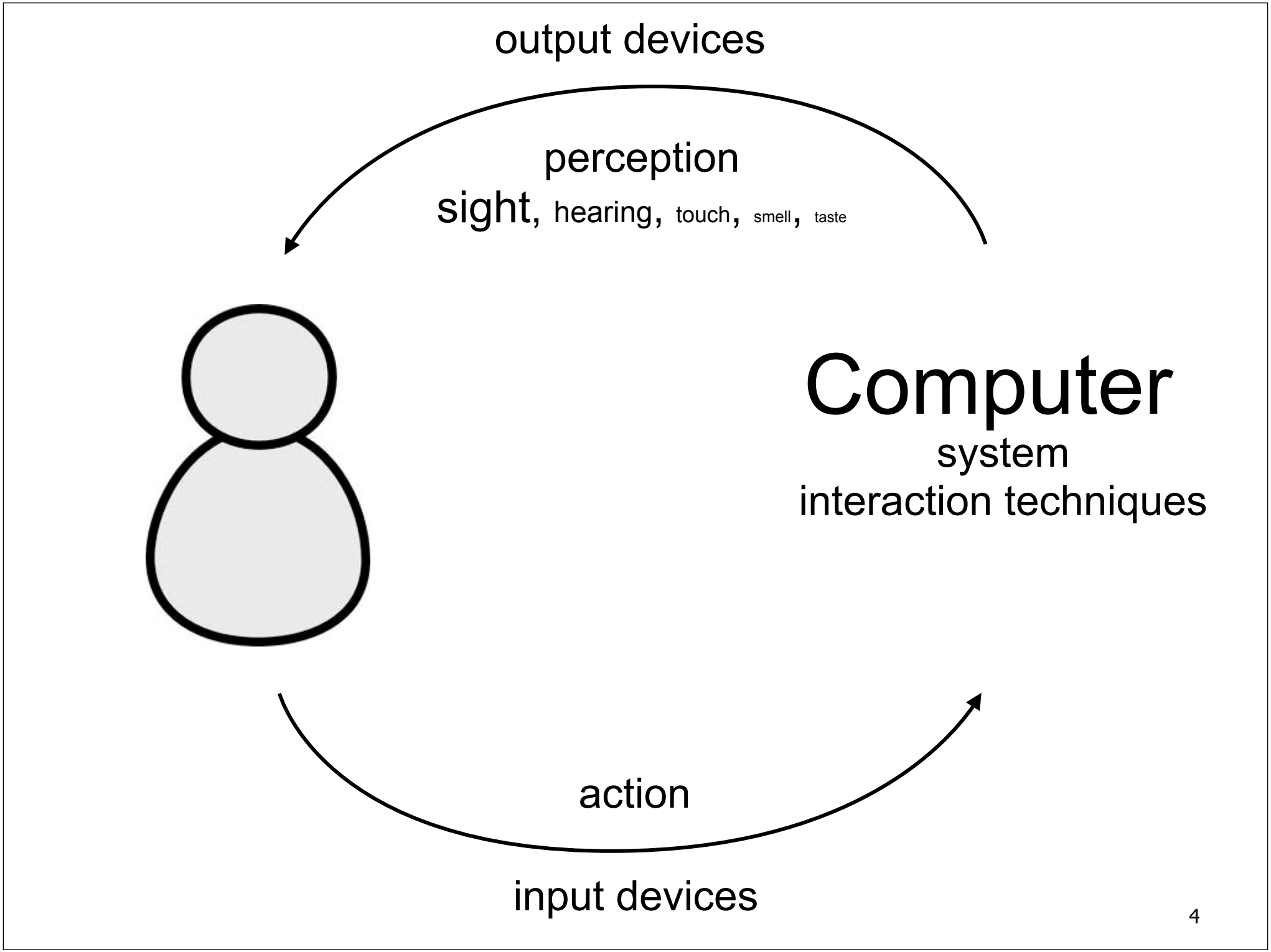


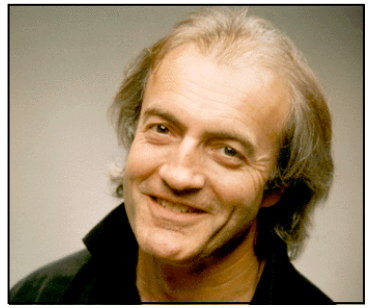




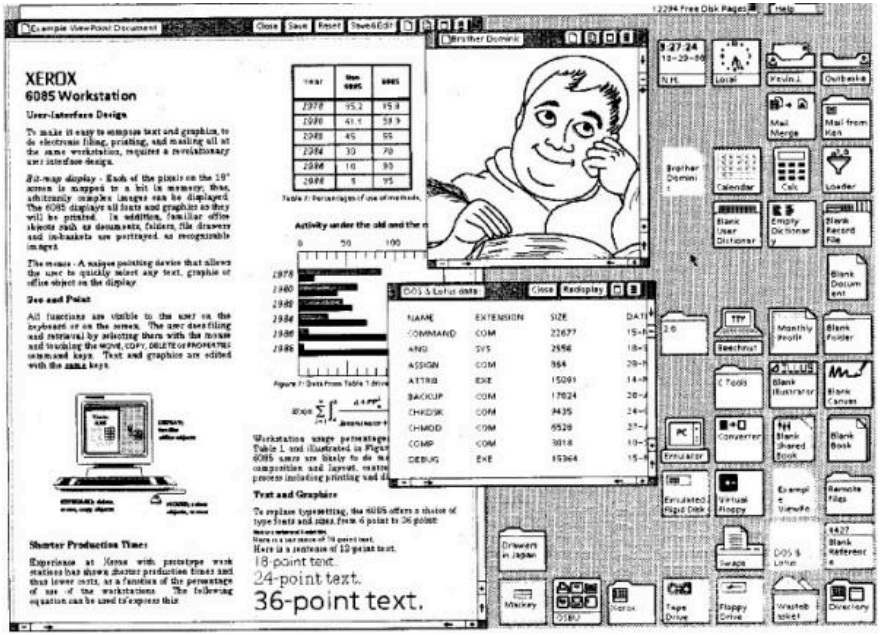

Ph.D. students
Pan Qing
Xu Quan
A. Martinet
Jean-Philippe Deblonde
Jérémie Gilliot
Scientific projects
REACTIVE
InSTinCT
Ph.D.
Postdoc
Assistant Professor
2001
2004
2005
2012
Teaching and administrative responsabilities
Image Vision Interaction
HCI course
Multitouch project

Human Computer Interaction


output devices
perception
sight, hearing, touch, smell, taste
Computer
system
interaction techniques
action
input devices



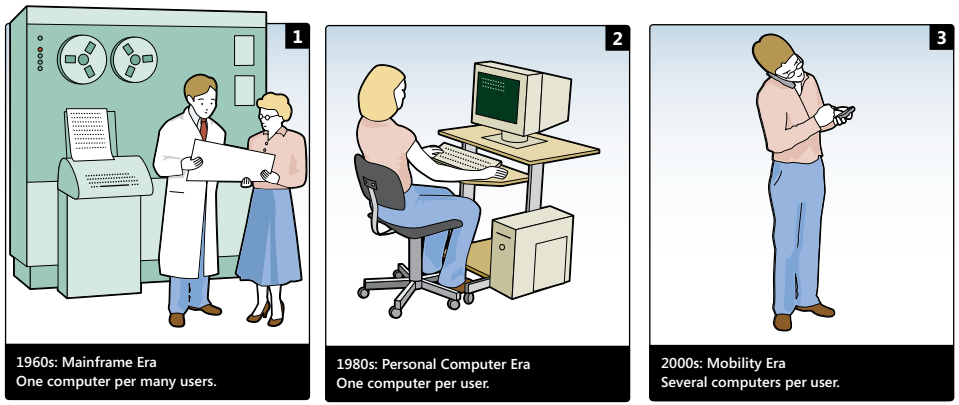
"*We are ocular centric, and displays are therefore much more mature. Input is still primitive, and wide open for improvement.*" **Bill Buxton, 2007**


XEROX
6085 Workstation
User-Interface Design
See and Point
Shorter Production Times
Text and Graphics
18-point text.
24-point text.
36-point text.


Notes
Terminal
Microsoft Word
Firefox
Sublime Text 2
Preview
LibreOffice
Mail
Keynote
Calendar
TweetDeck
Finder

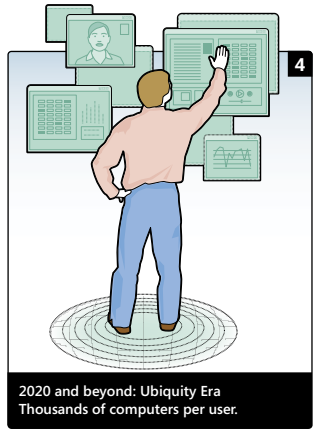
Wii remote (Nintendo, 2006)

iPhone (Apple, 2007)



Being human: Human-Computer Interaction in the year 2020
Harper, Sellen, Rodden & Rogers, editors

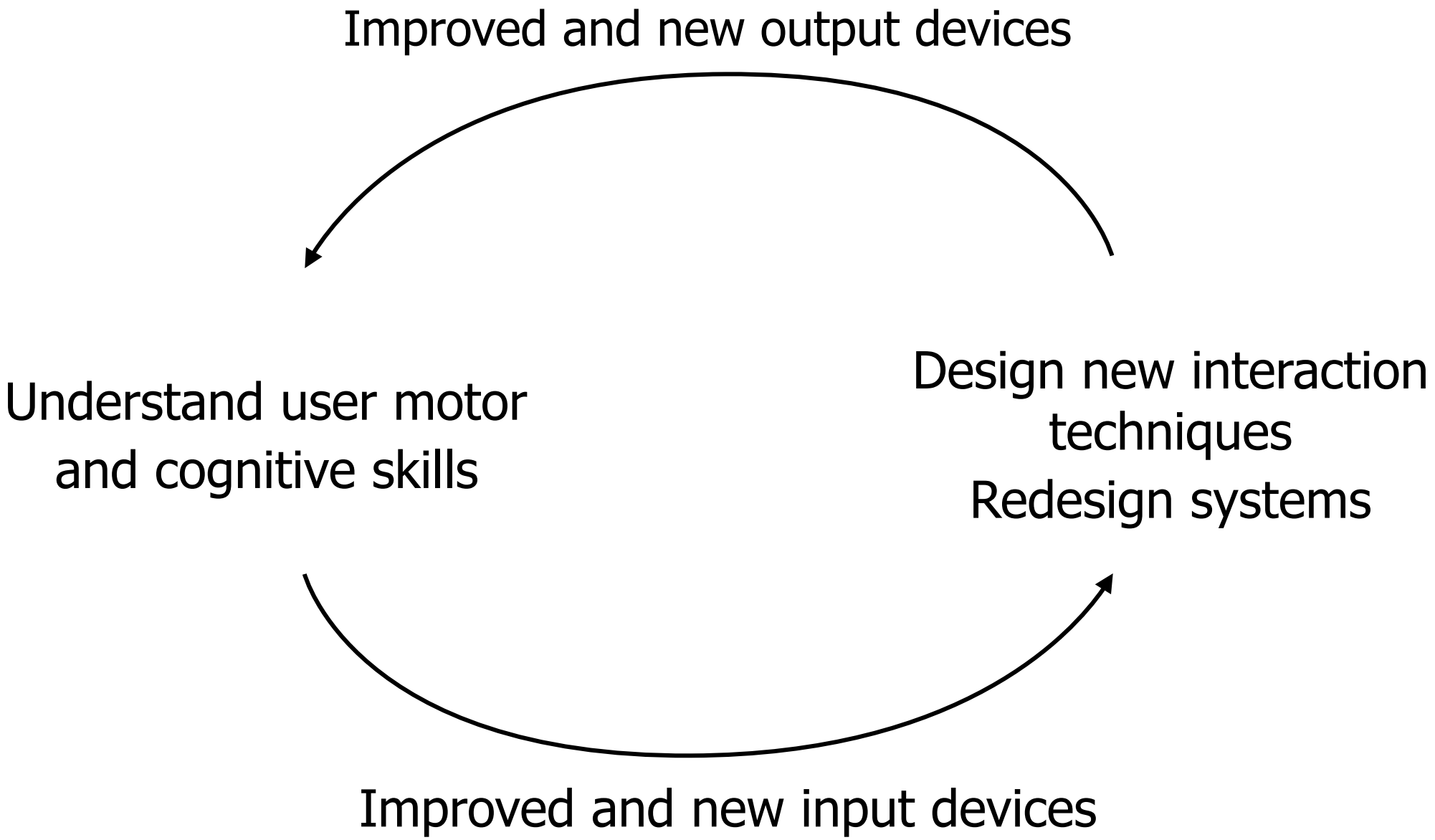
Surface (Microsoft, 2008)



iPad (Apple, 2010)

Kinect (Microsoft, 2010)

Challenges


Improved and new output devices
Understand user motor and cognitive skills
Design new interaction techniques
Redesign systems
Improved and new input devices

Jonathan Aceituno

Michel Amberg

Fabrice Aubert

Mélisande Biet

Ali Choumane

Andy Cockburn

Samuel Degrande

Rémi Cozot

Mathieu Cudmore

Bruno De Araùjo

Jean-Philippe Deblonde

Jérémie Gilliot

Frédéric Giraud

Laurent Grisoni

Carl Gutwin

Martin Hachet

Sébastien Hillaire

Joaquim Jorge

Anatole Lécuyer

Fabien Lotte

Damien Marchal

Antony Martinet

Paolo Olivo

Quin Pan

Thomas Pietrzak

Ludovic Potier

Philip Quinn

Nicolas Roussel

Jean-Baptiste Sauvan

Betty Semail

Romuald Vanbelleghem

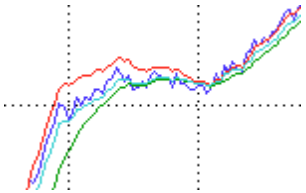
Radu Vatavu

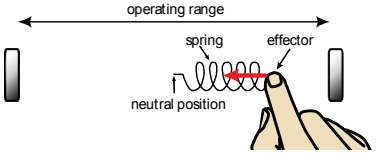
Daniel Vogel

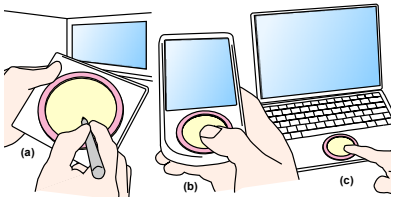
Quan Xu

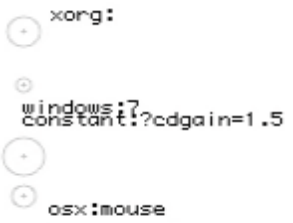


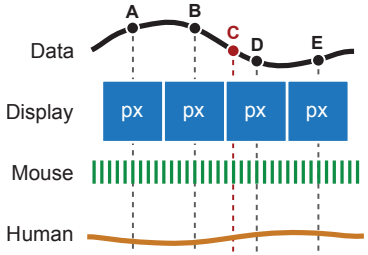

Indirect interaction, filtering and transfer functions



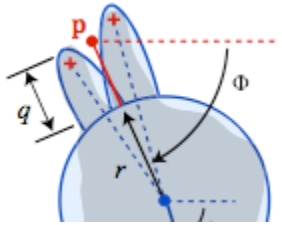


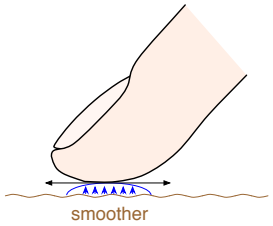


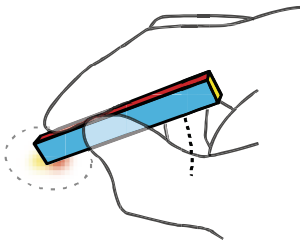


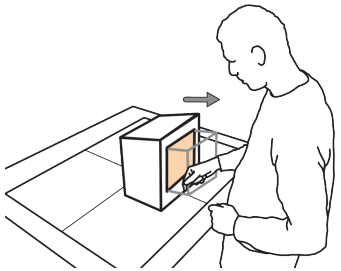


Touch and gesture based interaction





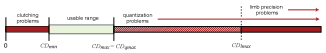




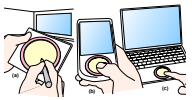
Indirect interaction, filtering and transfer functions

REACTIVE

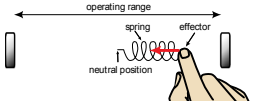
HCI Journal



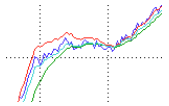
UIST



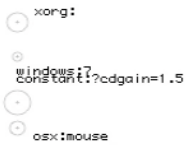
CHI



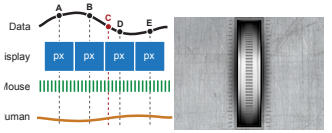
CHI



UIST



UIST x 2



2005 2006 2007 2008 2009 2010 2011 2012

Touch and gesture based interaction

IEEE HS

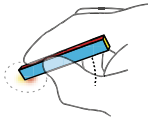
3DUI

Interact

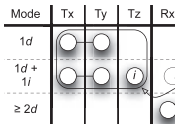
GI

VRST

UIST



TVCG



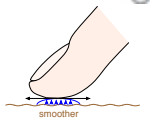
ANR InSTinCT

IEEE HS

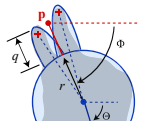
CHI

VR

CHI

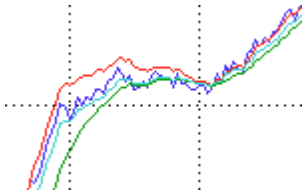


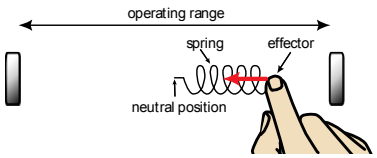
CHI

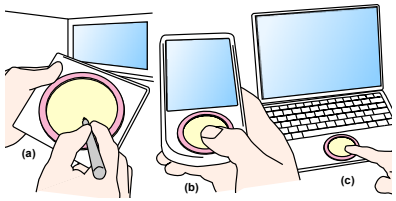


2005 2006 2007 2008 2009 2010 2011 2012

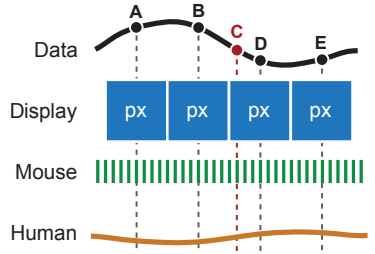
Indirect interaction, filtering and transfer functions

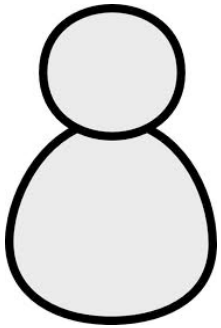







```
xorg:

windows:?
constant:?cdgain=1.5

osx:mouse
```





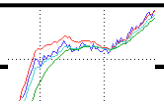
Physical world

Device resistance

isotonic

position

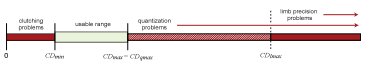
velocity



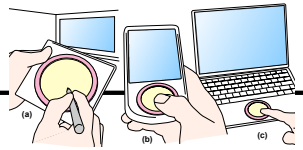
elastic / isometric

force

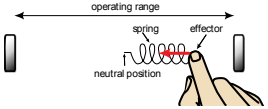
Transfer function



position control

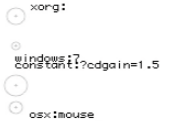


rate control

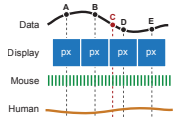


Tasks

pointing

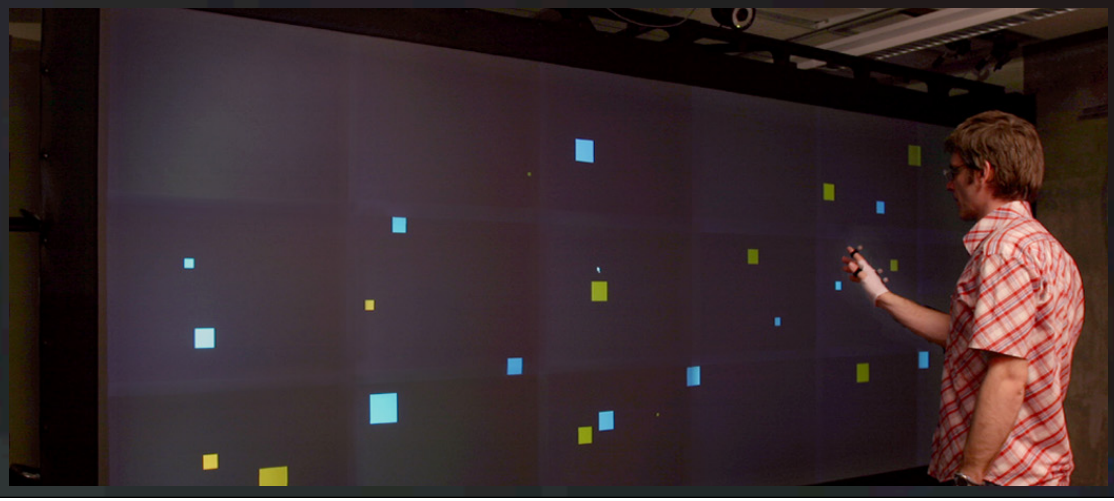


manipulation

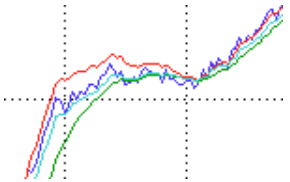


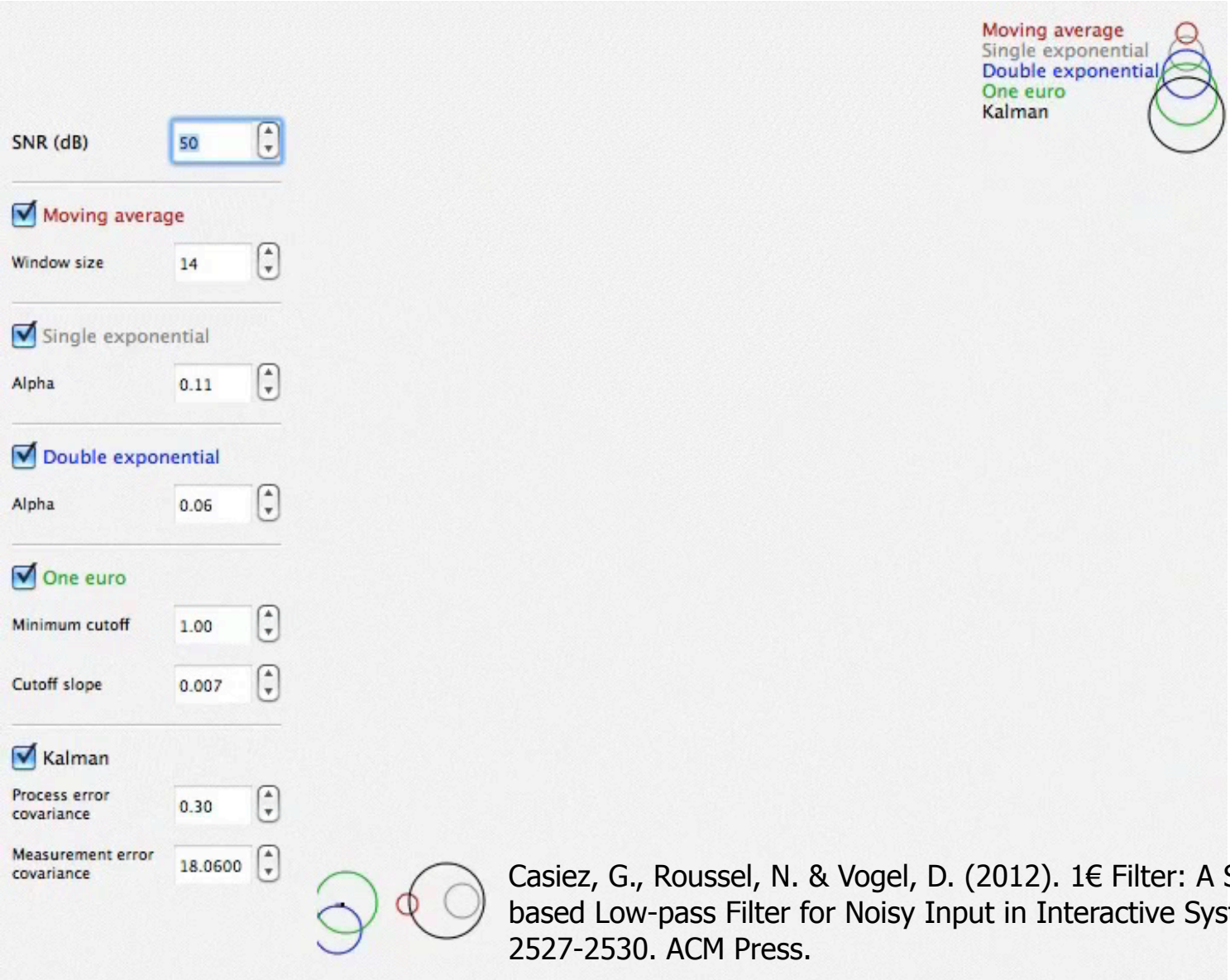
scrolling

1€ filter



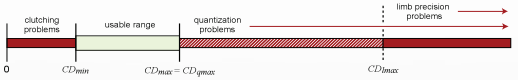
1€ filter

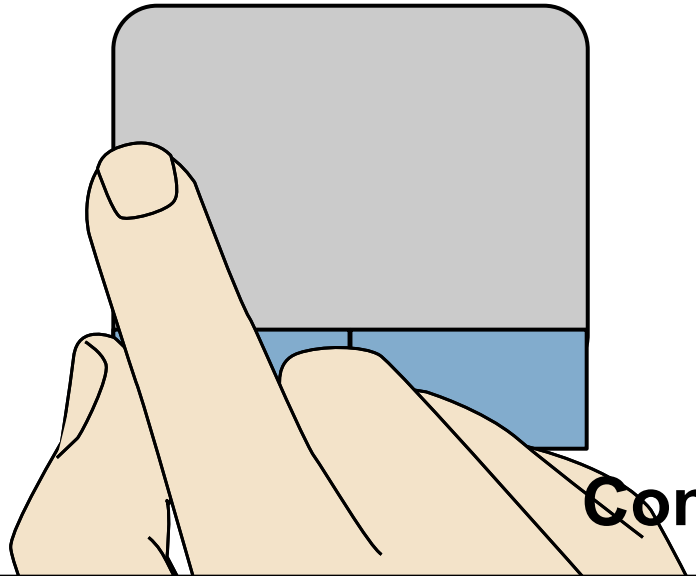




Casiez, G., Roussel, N. & Vogel, D. (2012). 1€ Filter: A Simple Speed-based Low-pass Filter for Noisy Input in Interactive Systems. In CHI'12, 2527-2530. ACM Press.

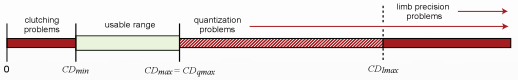
Simple linear functions

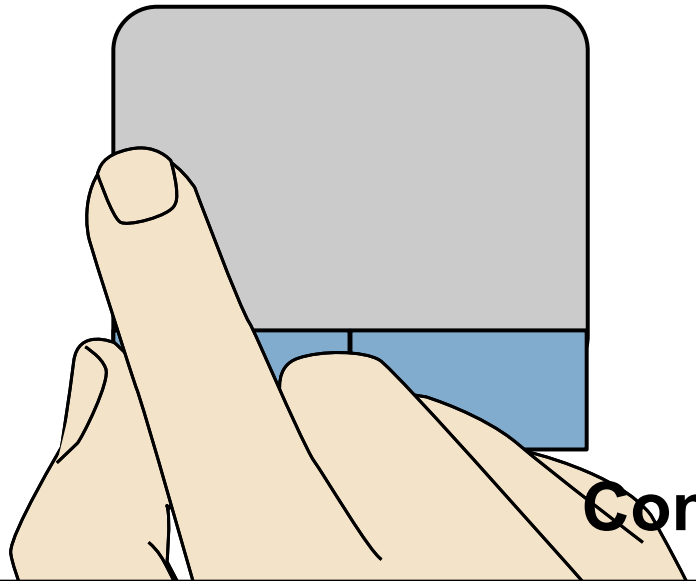




Control-Display Gain = 1

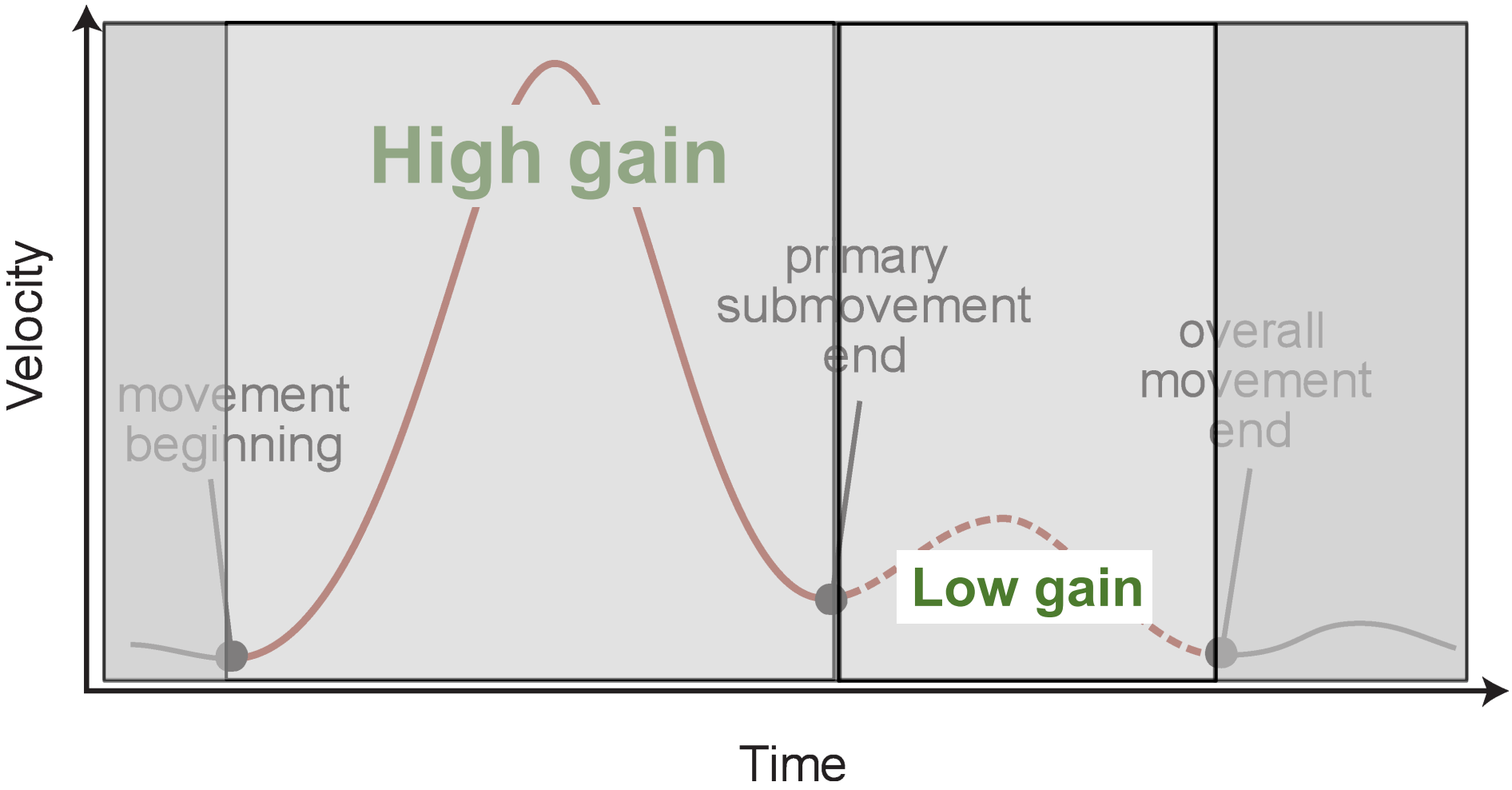
Simple linear functions





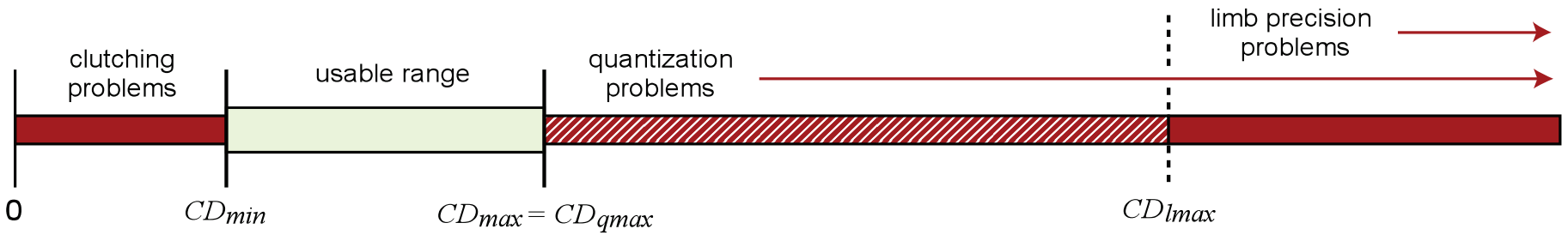
Control-Display Gain = 4

Dynamic functions



Optimized initial impulse model [Meyer et al.]

Constant CD gain

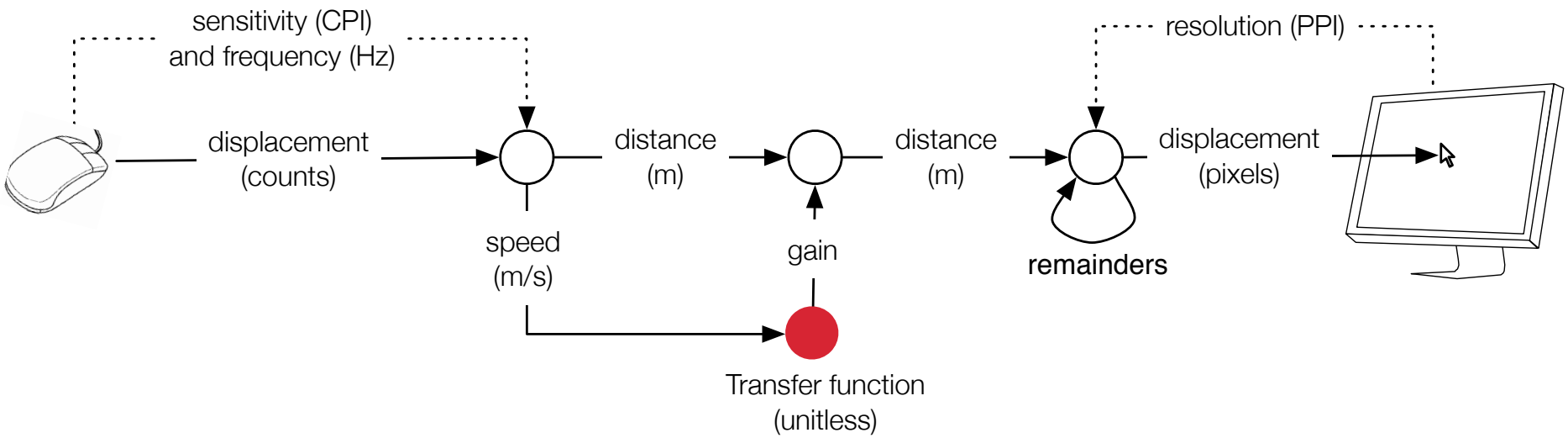


$$CD_{\min} = \frac{D_{\max}}{OR_{\max}} \qquad CD_{\max} = \min\left(CD_{q\max} = \frac{Mouse_{res}(DPI)}{Screen_{res}(DPI)}, CD_{l\max} = \frac{W_{\min}}{Hand_{res}} \right)$$

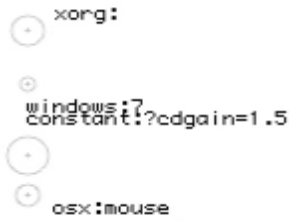
Casiez, G., Vogel, D., Balakrishnan, R., & Cockburn, A. (2008). The Impact of Control-Display Gain on User Performance in Pointing Tasks. Human-Computer Interaction. Taylor and Francis, volume 23, issue 3, 215-250.

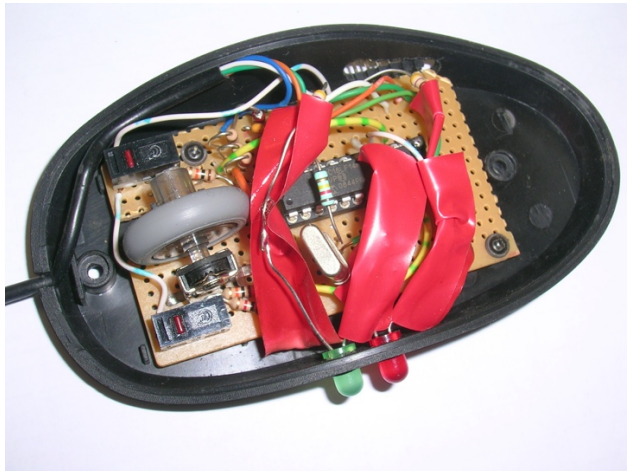
No more Bricolage!

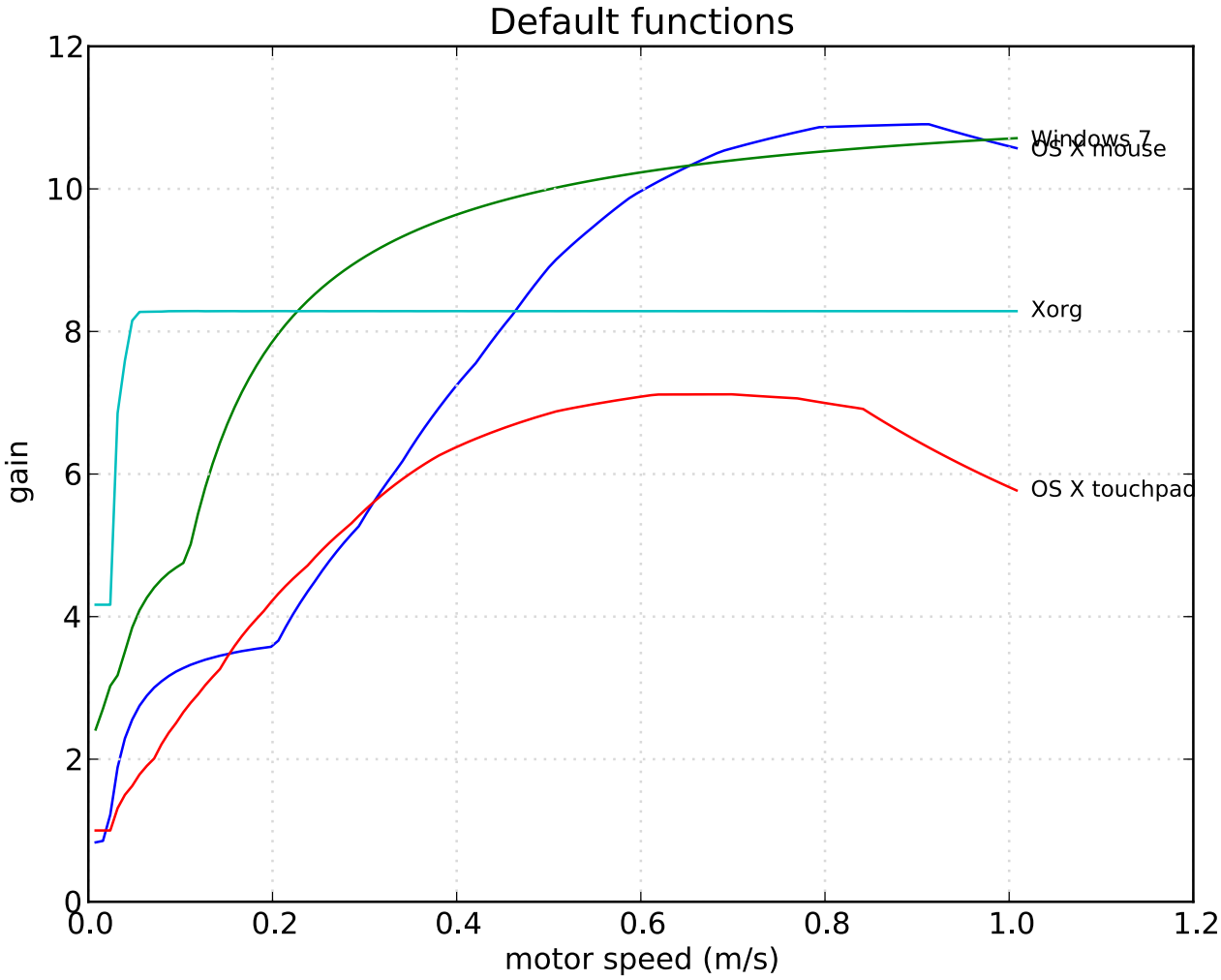
```
xorg:

windows:?
constant:?cdgain=1.5

osx:mouse
```



EchoMouse and Libpointing

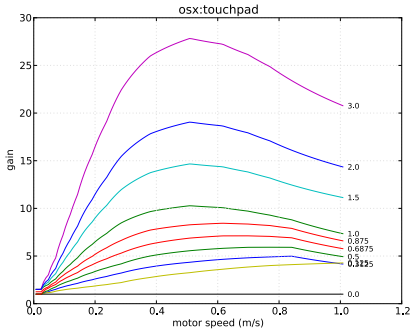


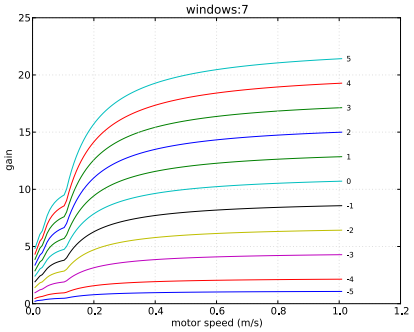


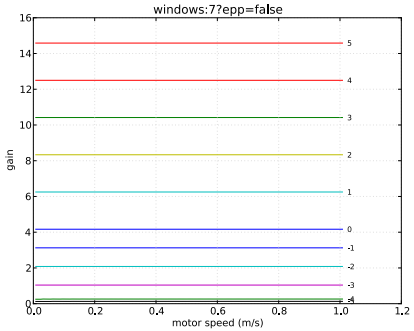


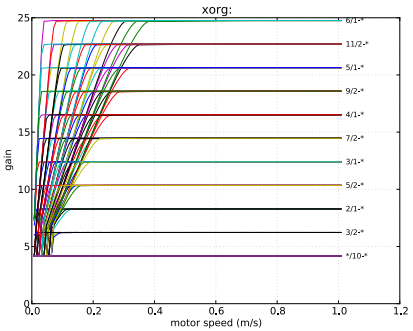

constant:?cdgain=1.5
xorg:
osx:mouse
windows:7

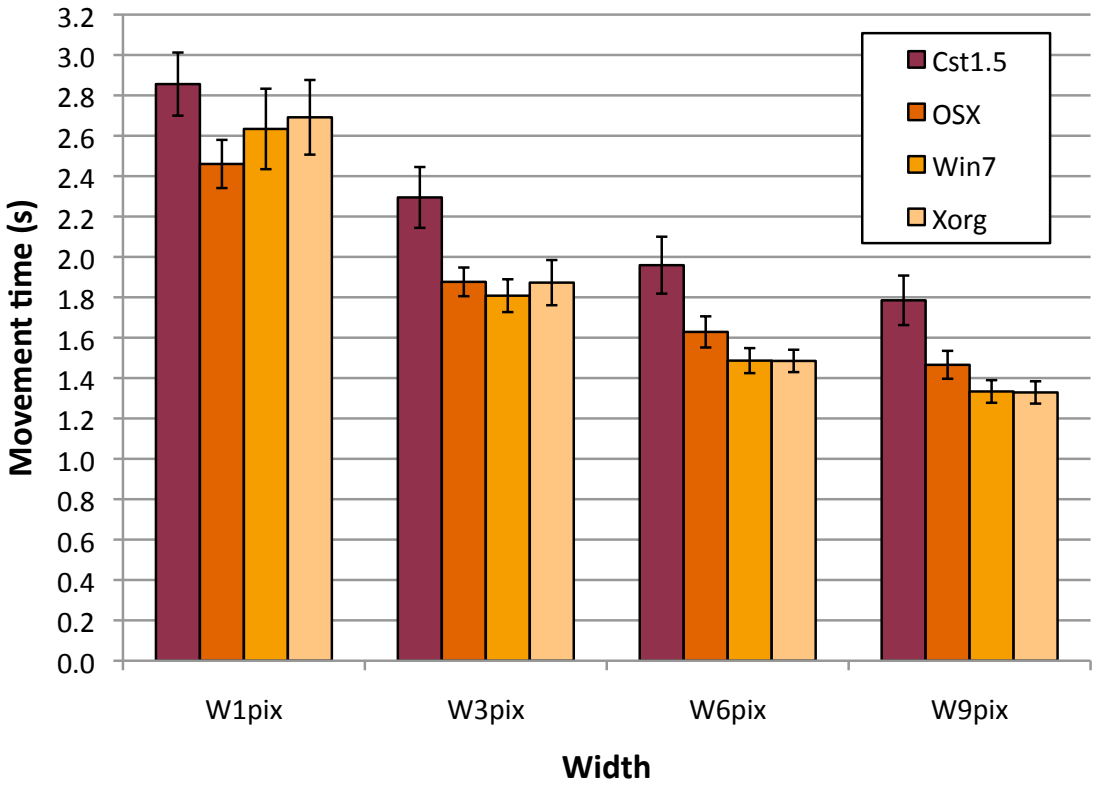
http://libpointing.org





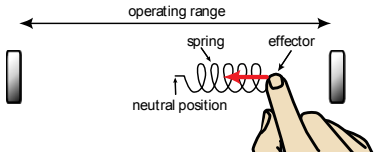




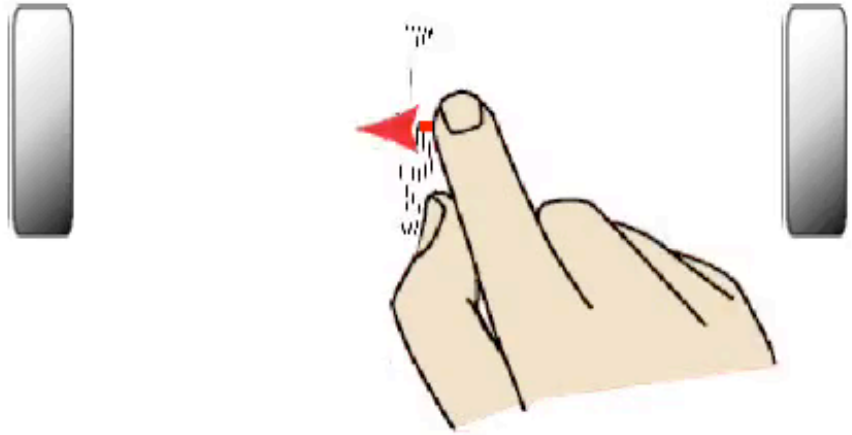


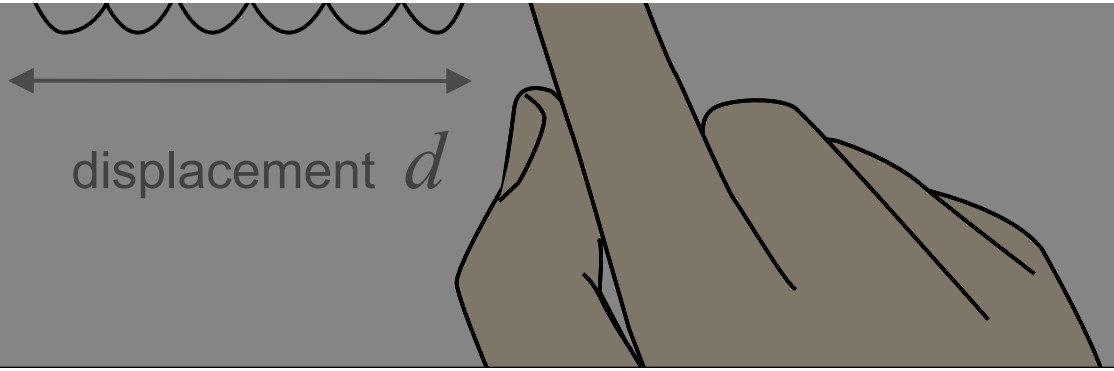
Géry Casiez and Nicolas Roussel. 2011. No more bricolage! Methods and tools to characterize, replicate and compare pointing transfer functions. In UIST '11, 603-614. ACM.

Elastic transfer functions

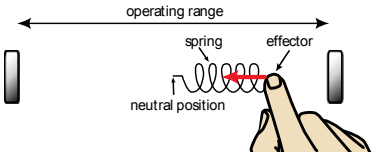


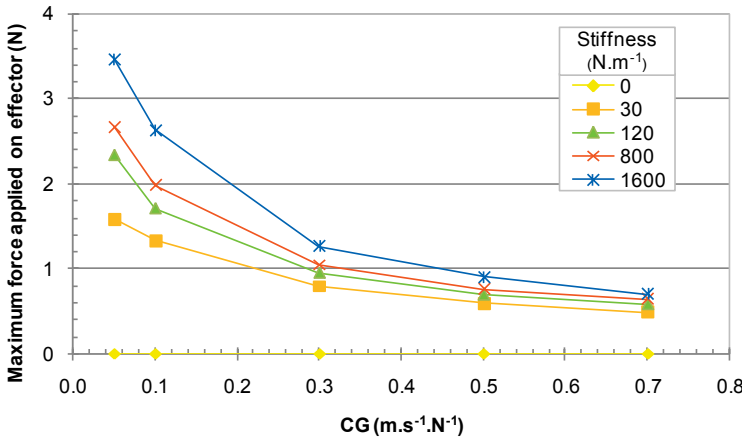
$$V = \mathrm{X} \cdot F$$

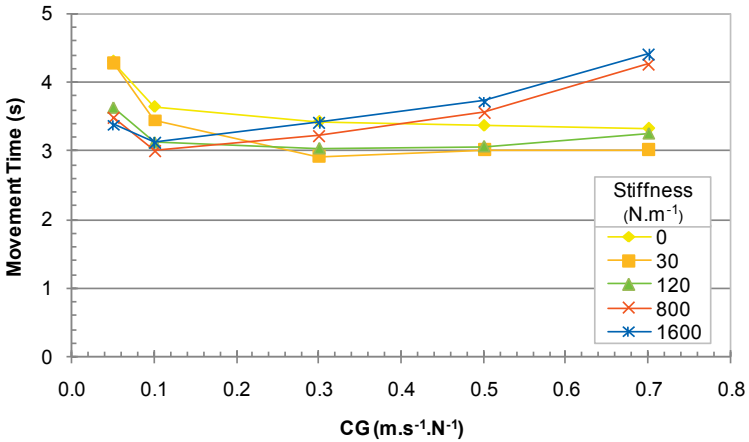


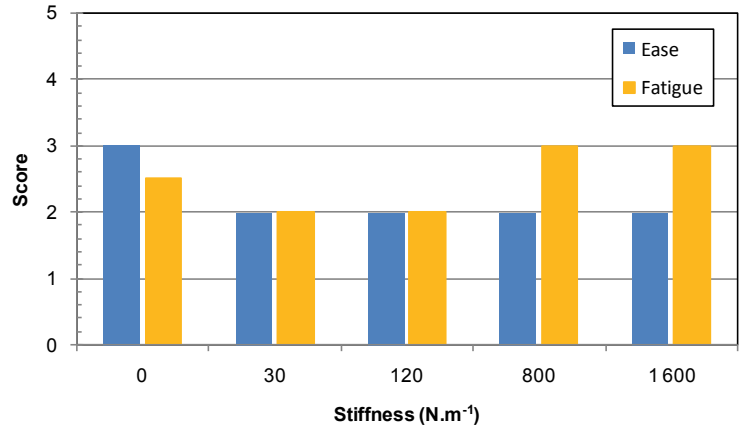


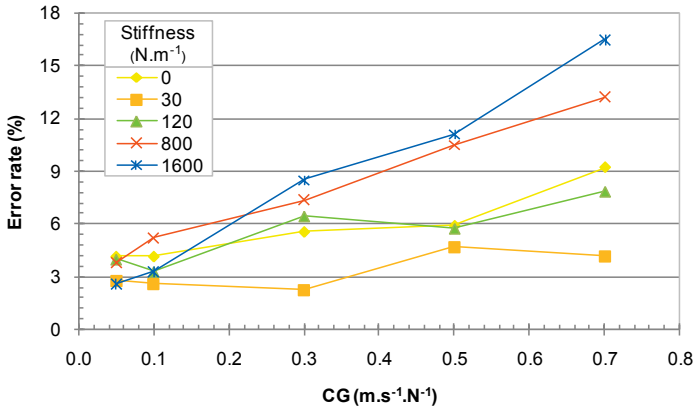
Elastic transfer functions





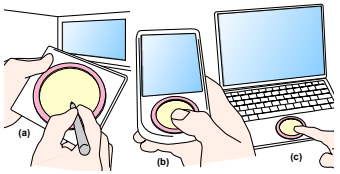


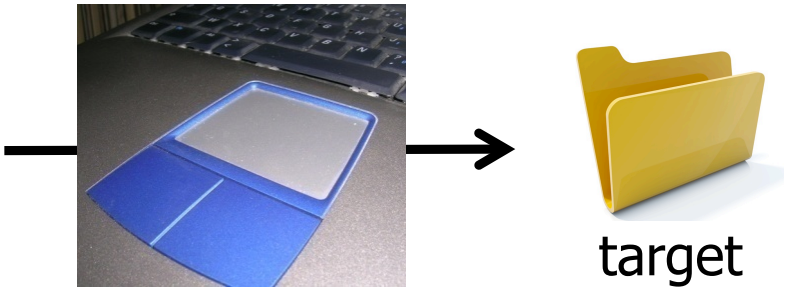




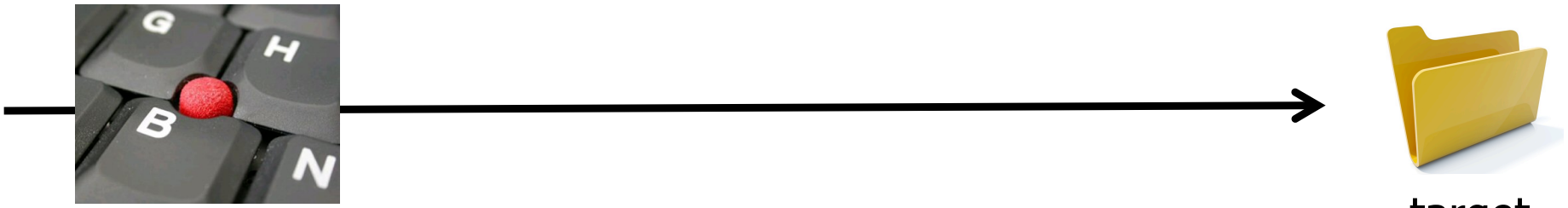
Casiez, G., & Vogel, D. (2008). The Effect of Spring Stiffness and Control Gain with an Elastic Rate Control Pointing Device. In CHI'08, 1709-1718. ACM Press.

RubberEdge



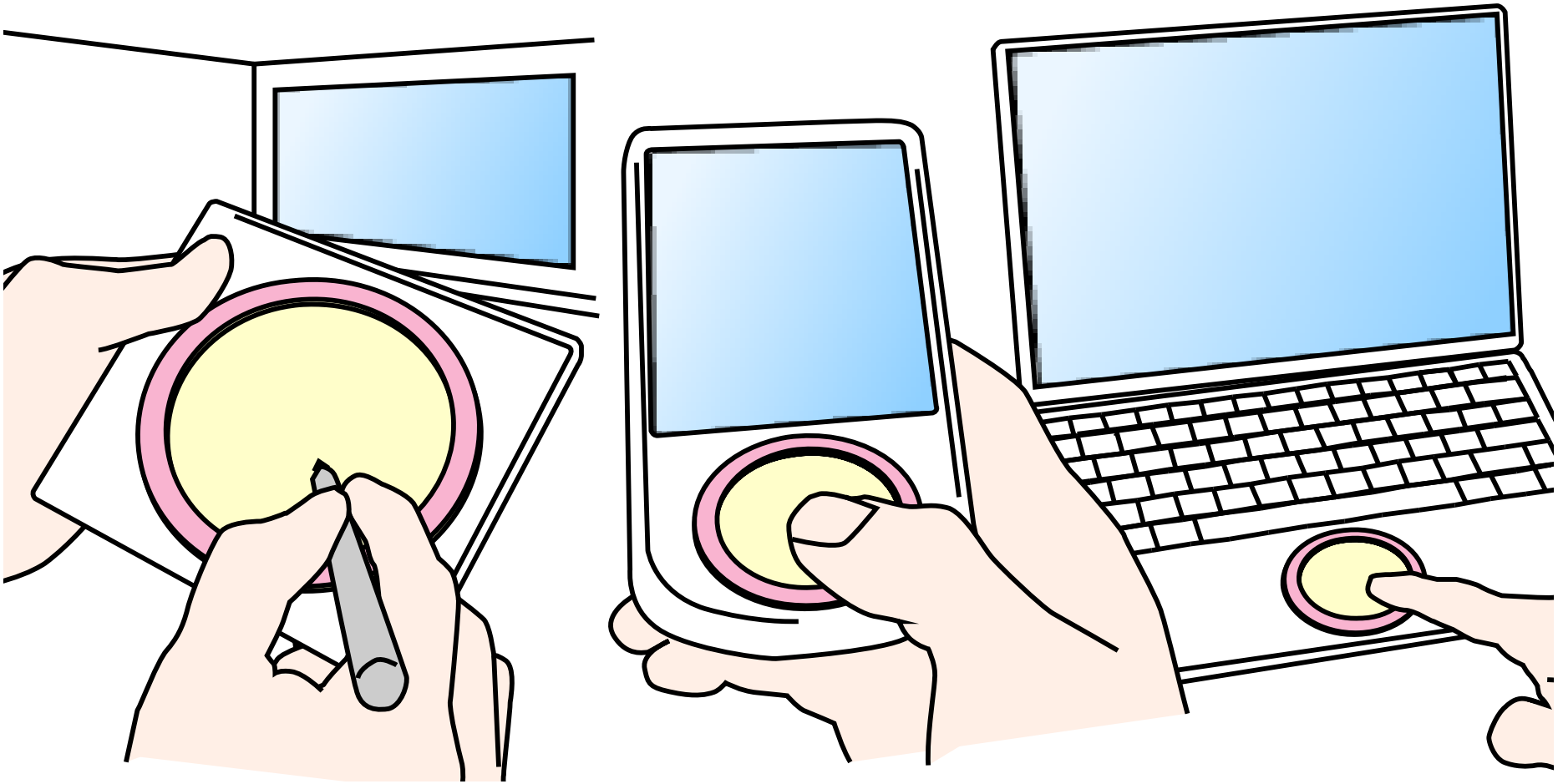


target



target

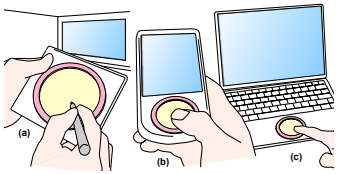
RubberEdge

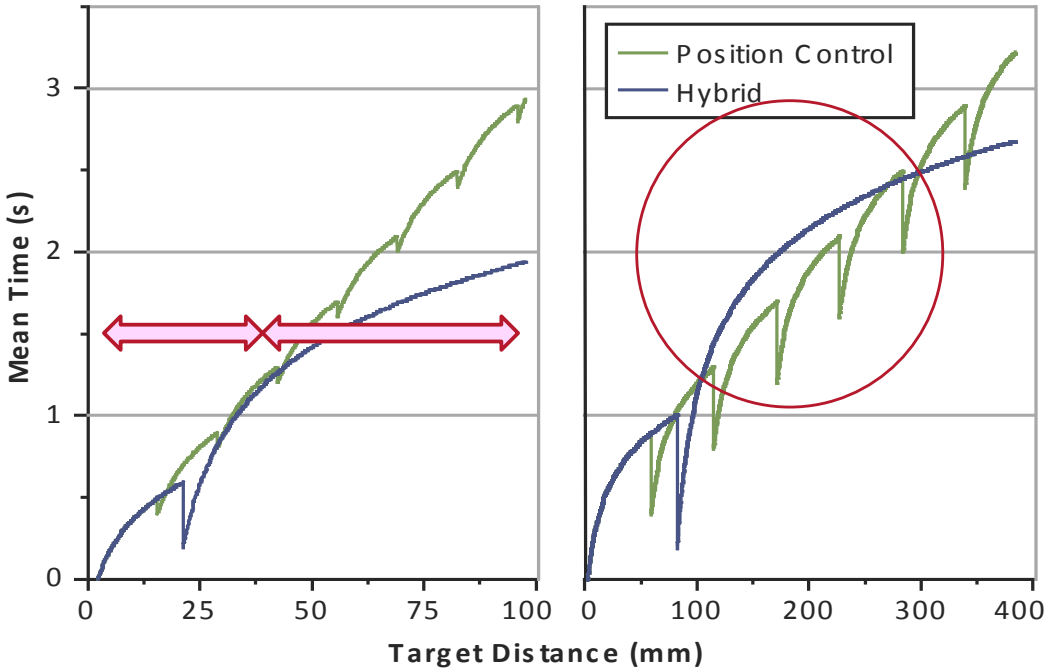


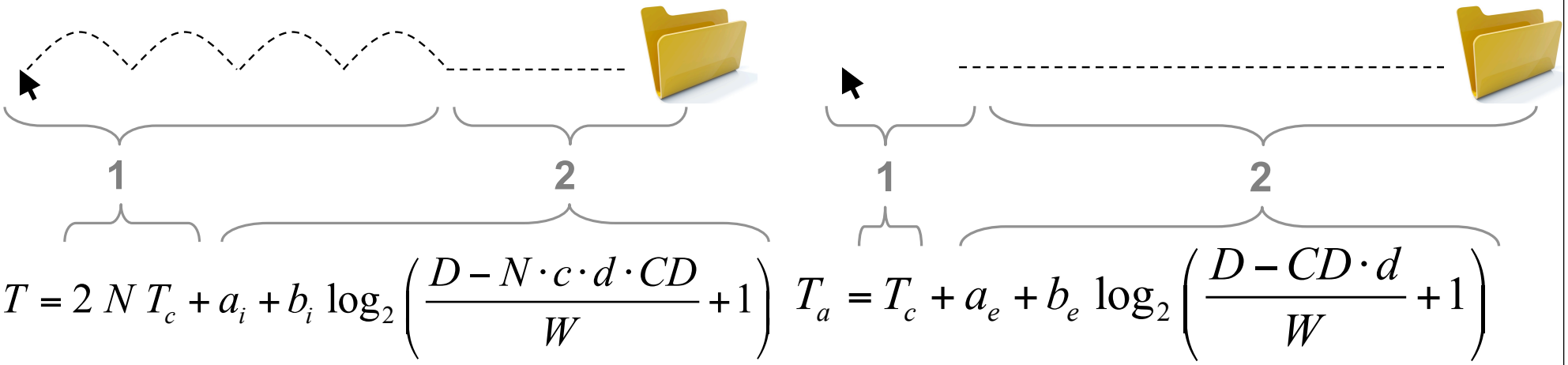
Casiez, G., Vogel, D., Pan, Q., & Chaillou, C. (2007). RubberEdge: Reducing Clutching by Combining Position and Rate Control with Elastic Feedback. In UIST'07, 129-138. ACM Press.

(a)

(b)







$$T = 2\,N\,T_c + a_i + b_i \log_2\left(\frac{D - N \cdot c \cdot d \cdot CD}{W} + 1\right)$$

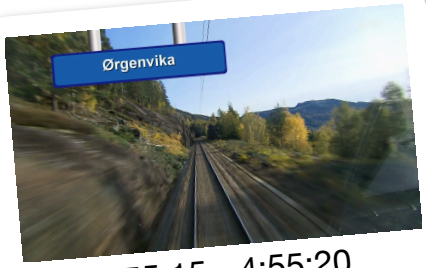
$$T_a = T_c + a_e + b_e \log_2\left(\frac{D - CD \cdot d}{W} + 1\right)$$

“Bergensbanen” - NRK

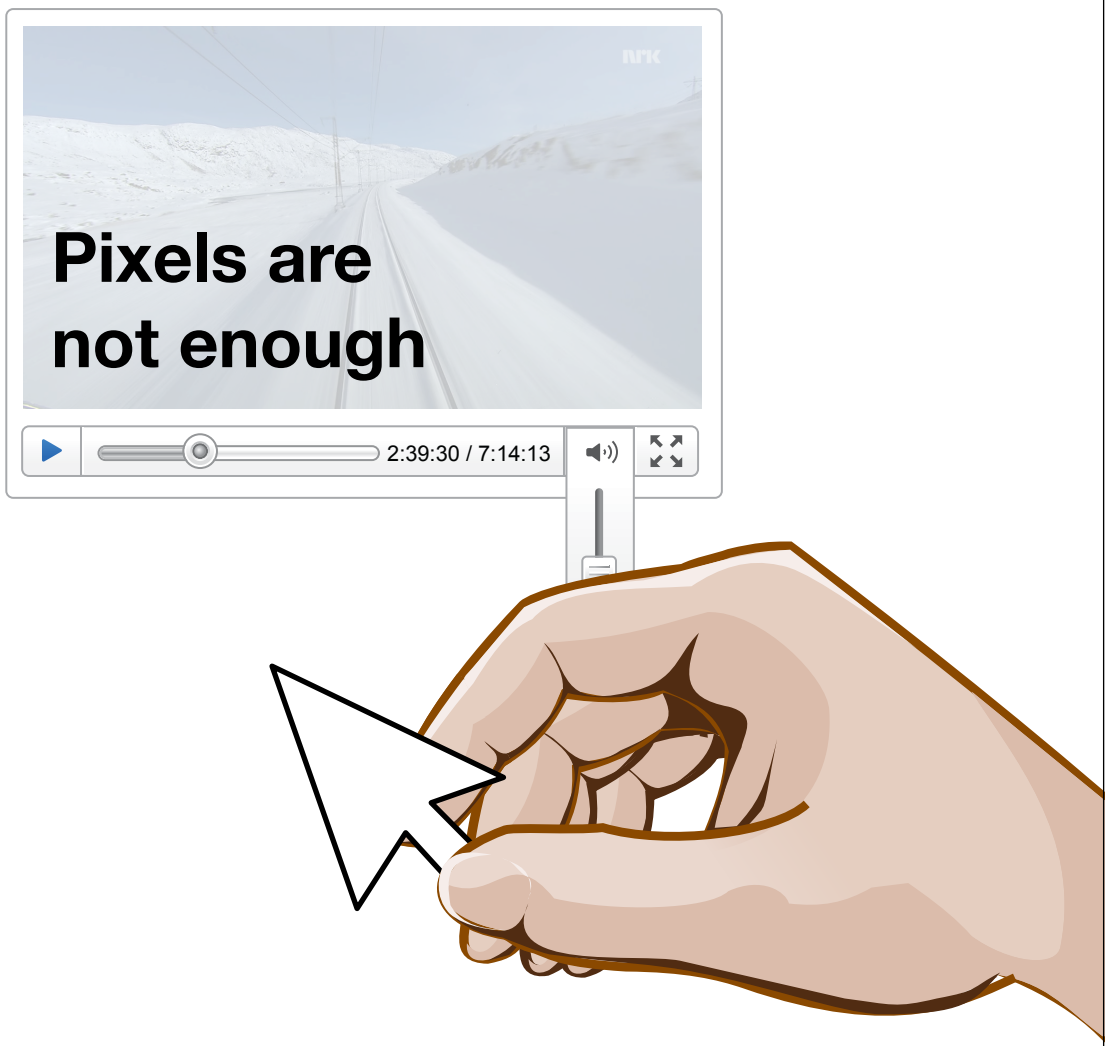
7:14:13 ➟ 26 053 seconds ➟ 1 302 650 frames

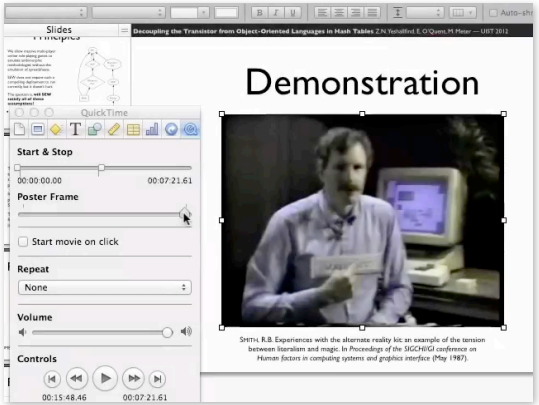
1:41:39 - 1:41:44

2:37:35 - 2:37:40

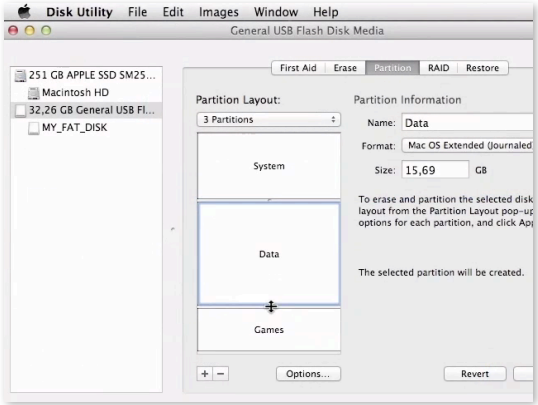


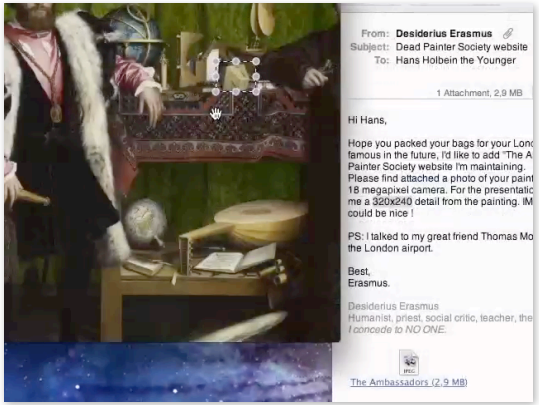
4:55:15 - 4:55:20



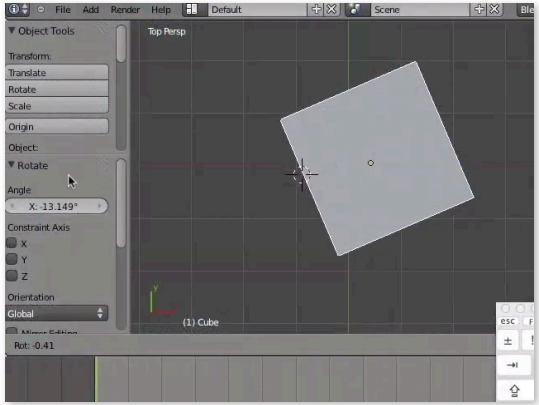

Slides
Demonstration
QuickTime
Start & Stop
Poster Frame
Start movie on click
Repeat
None
Volume
Controls

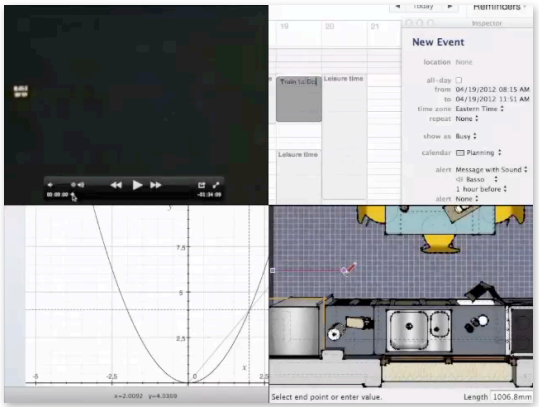

Overview
Visits
vs.
Select a metric
Visits
200
100
Friday, September 12, 2008
Visits: 8
Jul 2008
Jan 2009
Jul 2009
Jan 2010
8,274 people visited this site
10,120 Visits
8,274 Unique Visitors
12,611 Pageviews
1.25 Pages/Visit


Disk Utility
File
Edit
Images
Window
Help
General USB Flash Disk Media
First Aid
Erase
Partition
RAID
Restore
251 GB APPLE SSD SM25...
Macintosh HD
32,26 GB General USB Fl...
MY_FAT_DISK
Partition Layout:
3 Partitions
Partition Information
Name:
Data
Format:
Mac OS Extended (Journaled
Size:
15,69
GB
System
Data
Games
The selected partition will be created.
Options...
Revert

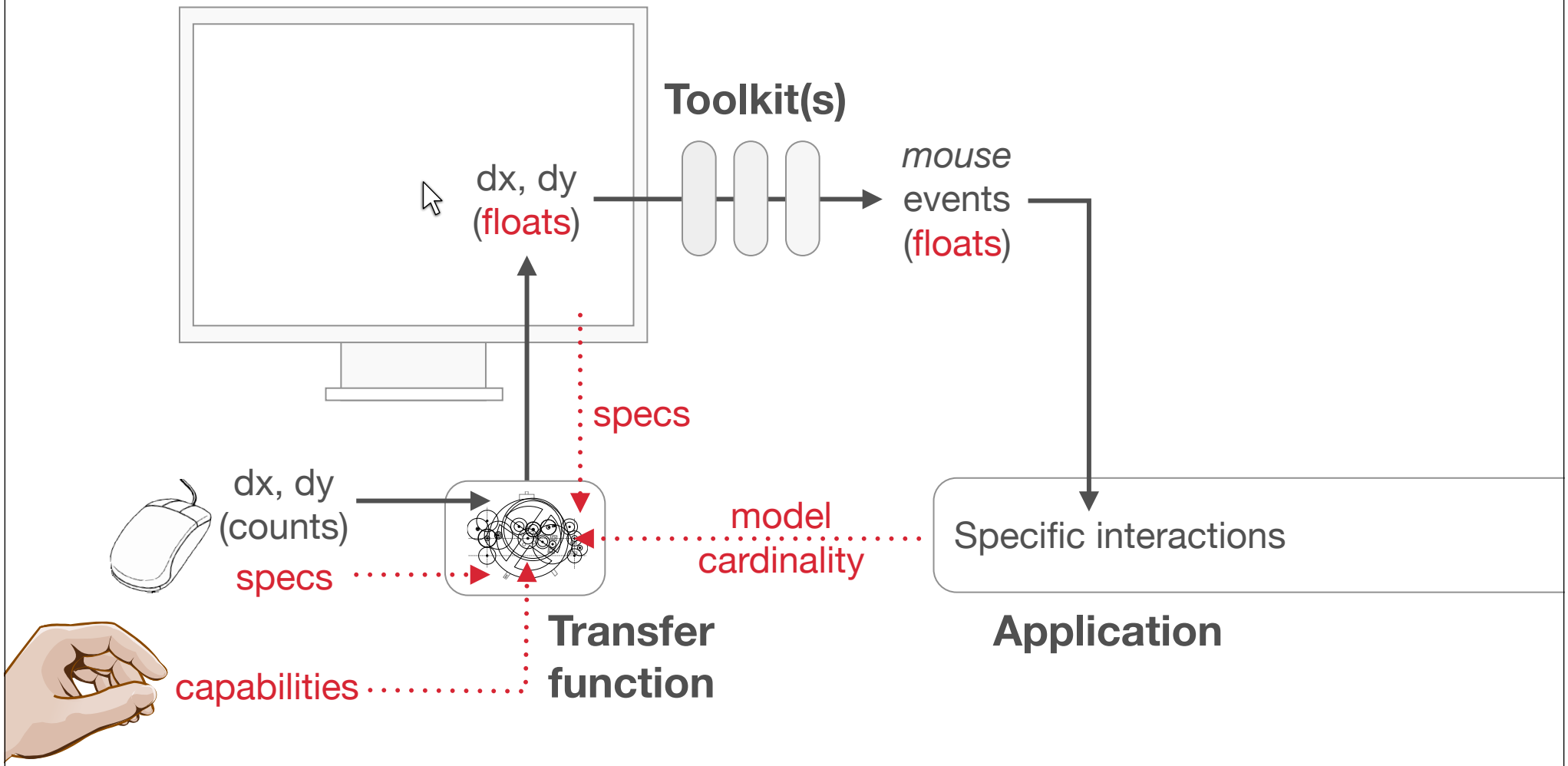

From: Desiderius Erasmus
Subject: Dead Painter Society website
To: Hans Holbein the Younger
1 Attachment, 2,9 MB
Hi Hans,
Hope you packed your bags for your Lon
famous in the future, I'd like to add "The A
Painter Society website I'm maintaining.
Please find attached a photo of your paint
18 megapixel camera. For the presentatic
me a 320x240 detail from the painting. IM
could be nice !
PS: I talked to my great friend Thomas Mo
the London airport.
Best,
Erasmus.
Desiderius Erasmus
Humanist, priest, social critic, teacher, the
I concede to NO ONE.
The Ambassadors (2,9 MB)


1 Bass
2 Drums
A Return
B Return
Master
Impulse
Volume
Start
Transp
Stretch
Drive
Freq
Res
Decay
Pan
Volume
Time


File
Add
Render
Help
Default
Scene
Object Tools
Transform:
Translate
Rotate
Scale
Origin
Object:
Rotate
Angle
Constraint Axis
Orientation
Global
Top Persp
(1) Cube

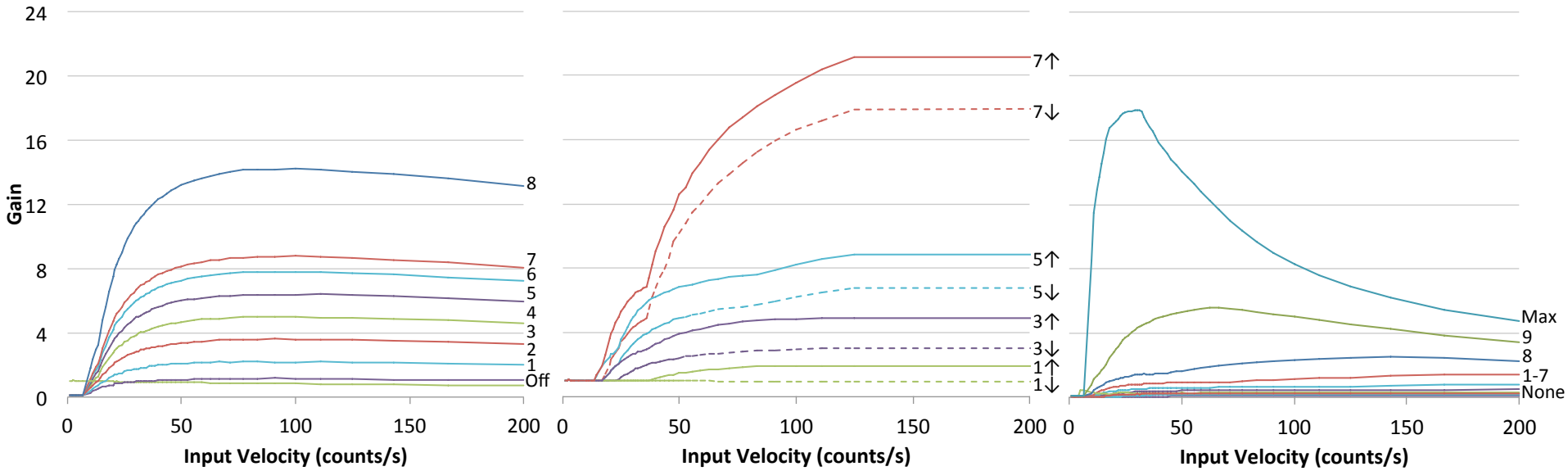

New Event
Select end point or enter value.
Length 1006.8mm

Giving a hand to the eyes



Roussel, N., Casiez, G., Aceituno, J. & Vogel, D. (2012). Giving a hand to the eyes: leveraging input accuracy for subpixel interaction. In UIST'12, 351-358. ACM Press.

Scrolling transfer functions



(a) Mac OS X (Generic Device).

(b) Microsoft IntelliPoint: up (solid) and down (dashed).

(c) Logitech Control Center.

	Velocity	Direction	Duration	Clutching
Apple Mac OS X	●	◐	○	◐
Microsoft Windows 7	○	○	○	○
Microsoft IntelliPoint	●	●	○	●
Logitech SetPoint	○	○	○	○
Logitech Control Center	●	◐	●	○

Quinn, P., Cockburn, A., Casiez, G., Roussel, N. & Gutwin, C. (2012). Exposing and understanding scrolling transfer functions. In UIST'12, 341-350. ACM Press.

Summary

Importance of transfer functions in interactive systems

Constant vs. dynamic functions

Hardware independent functions

Isotonic / elastic devices - hybrid devices

Pointing / manipulation / scrolling tasks

Recommendations, tools and libraries

Perspectives

"Transfer function law"

Domain of definition of Fitts' law $T = a + b \log_2 \left(\frac{D}{W} + 1 \right)$

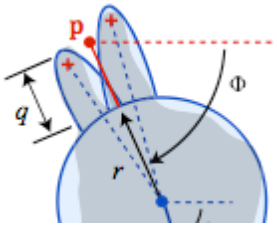
Better understand human motor capabilities

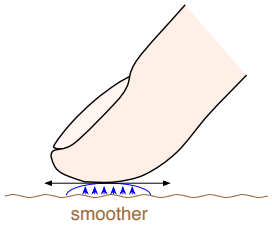
Hardware independent functions

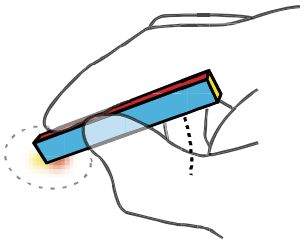
Situated transfer functions

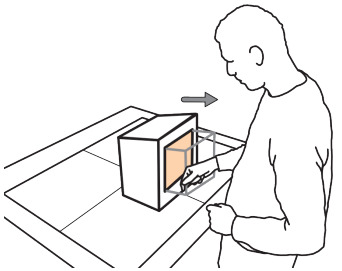
Consider other parameters

Touch and gesture based interaction

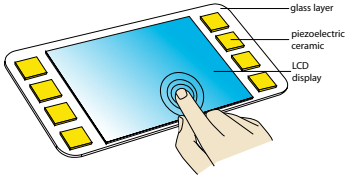


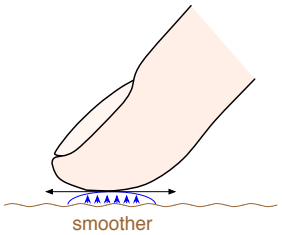




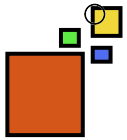


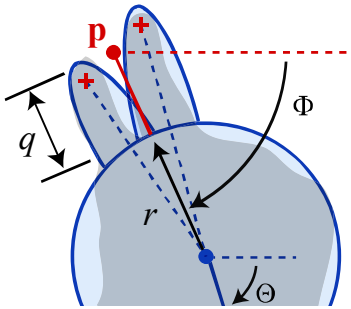
Tactile feedback

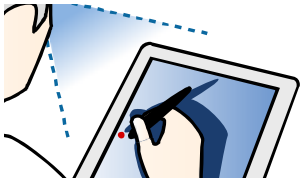




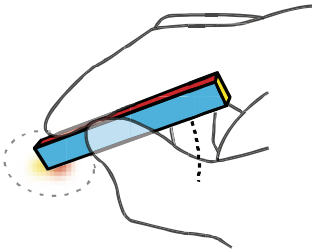
Occlusion aware interfaces

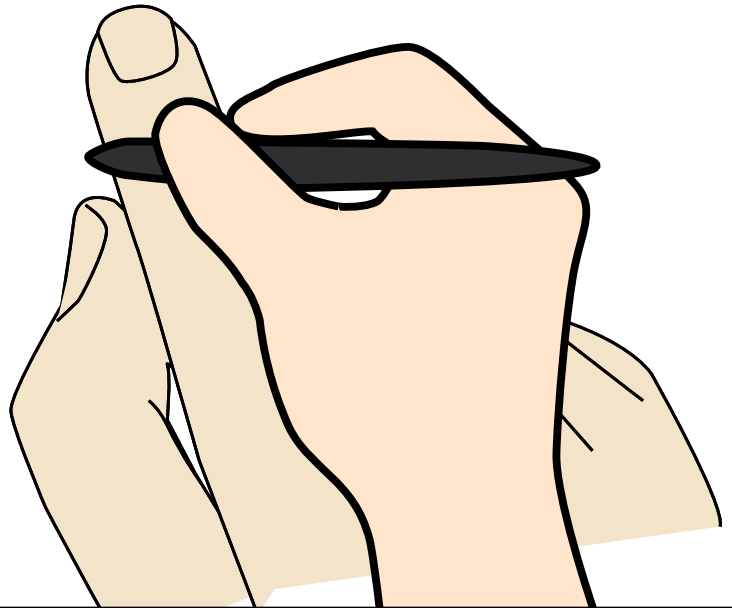




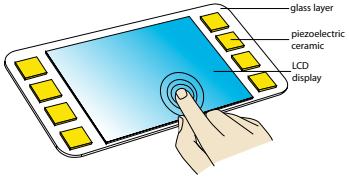


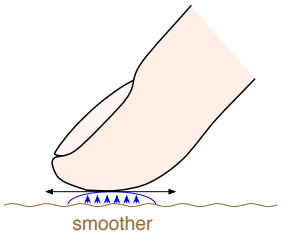
Multimodal input



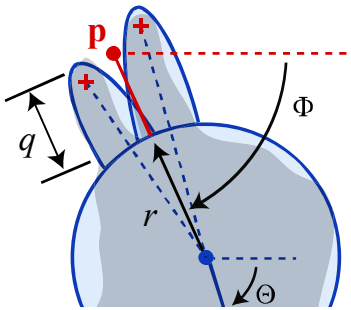


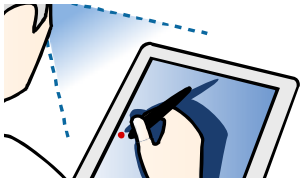
Tactile feedback





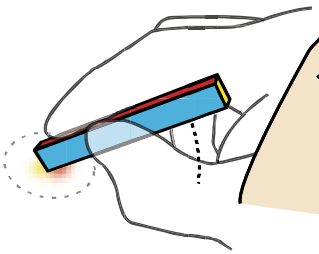
Occlusion aware interfaces



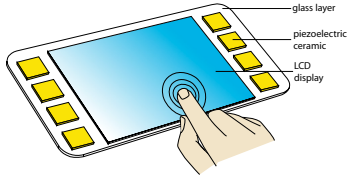


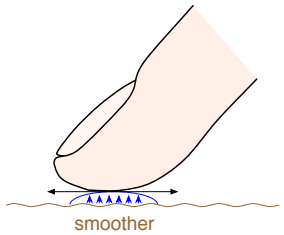
3D manipulation

Multimodal input

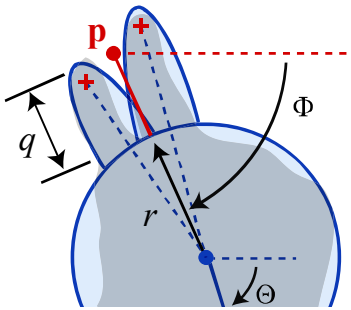


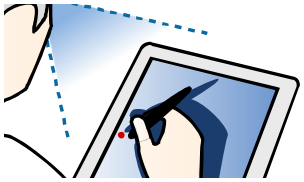
Tactile feedback



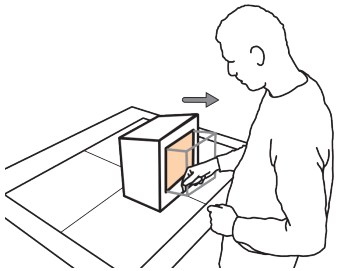


Occlusion aware interfaces



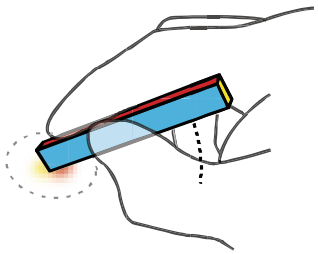


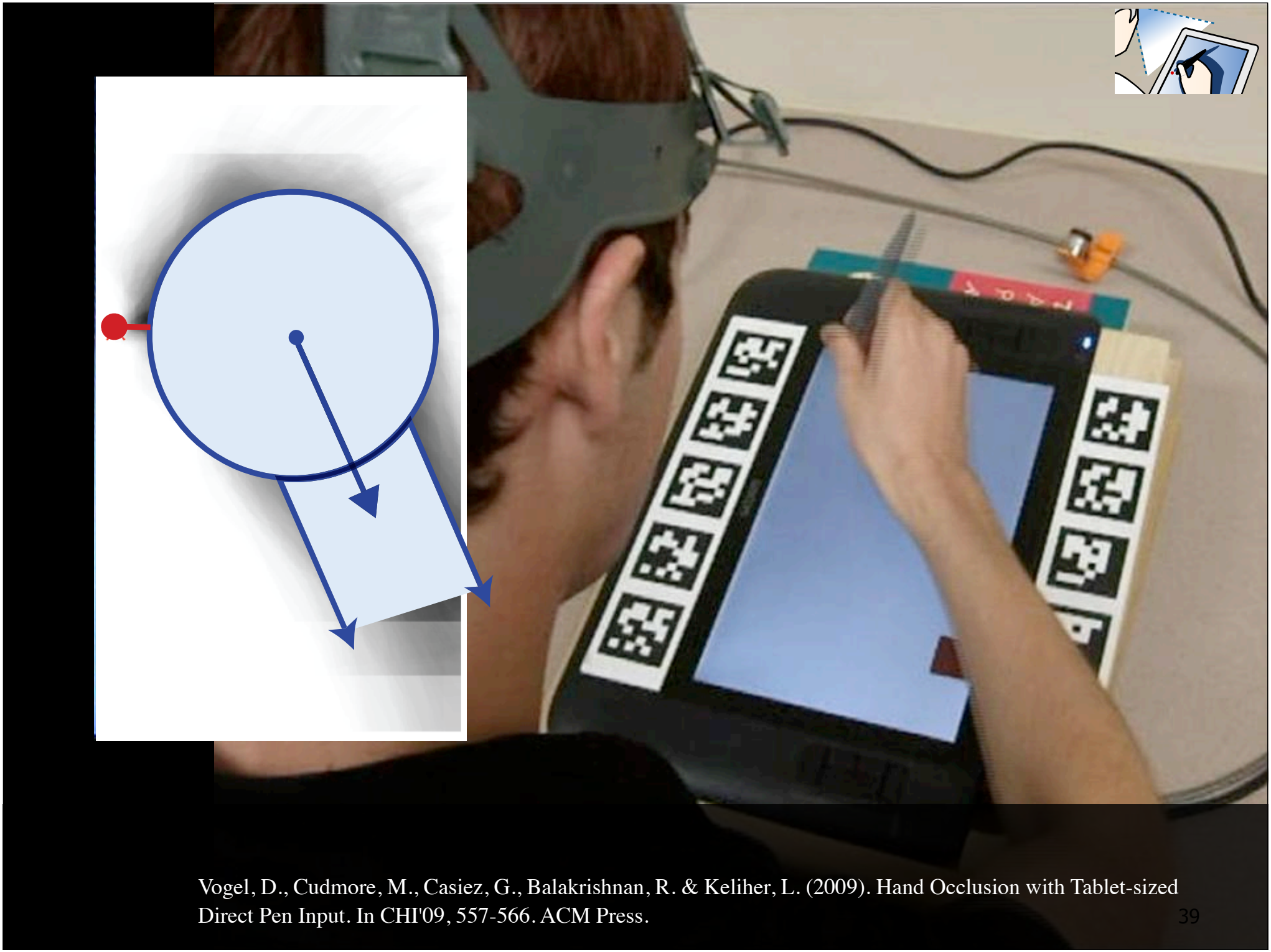
Gestures



3D manipulation

Multimodal input

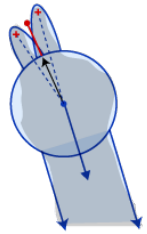




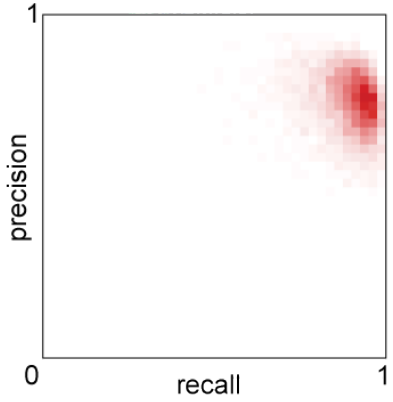
Vogel, D., Cudmore, M., Casiez, G., Balakrishnan, R. & Keliher, L. (2009). Hand Occlusion with Tablet-sized Direct Pen Input. In CHI'09, 557-566. ACM Press.

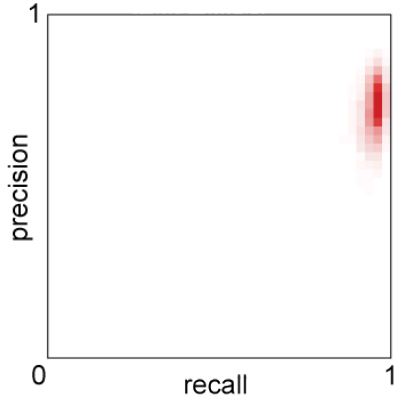

Georgia
28
Book Antiqua
Bookman Old Style
Bookshelf Symbol 7
Brush Script Std
Calibri
Cambria
Cambria Math
Candara
Century
Century Gothic
Chaparral Pro
CHARLEMAGNE STD
Comic Sans MS
Consolas
Constantia
Cooper Std Black
Corbel
Courier New
ECCENTRIC STD
Estrangelo Edessa
Honolulu
Type anything
SPEAK

DI Model



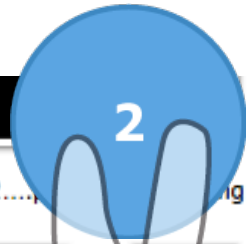
MT Model

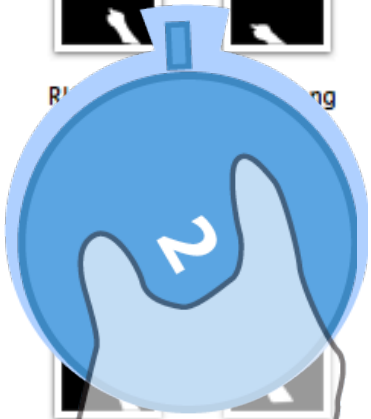




F_1=0.80

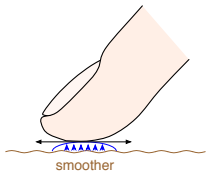
F_1=0.81

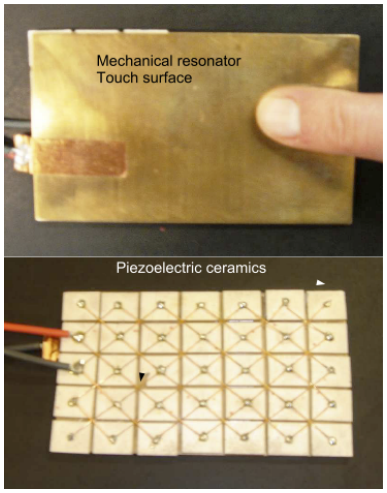


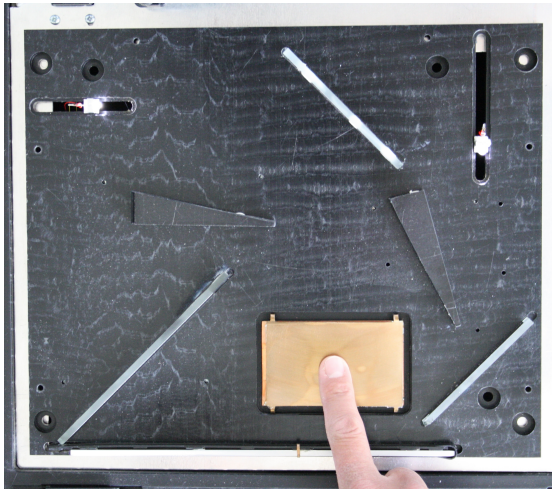


Vogel, D. & Casiez, G. (2012). Hand Occlusion on a Multi-Touch Tabletop. In CHI'12, 2307-2316. ACM Press.

STIMTAC



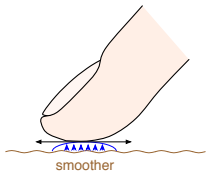




Amberg, M., Giraud, F., Semail, B., Olivo, P., Casiez, G. & Roussel, N. (2011). STIMTAC, a tactile input device with programmable friction. In UIST'11 EA, 7-8. ACM Press.

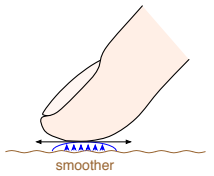
Giraud, F., Amberg, M., Lemaire-Semail, B. & Casiez, G. (2012). Design of a Transparent Tactile Stimulator. In proceedings of Haptics Symposium 2012. 485-489. IEEE Computer Society.

Surfpad



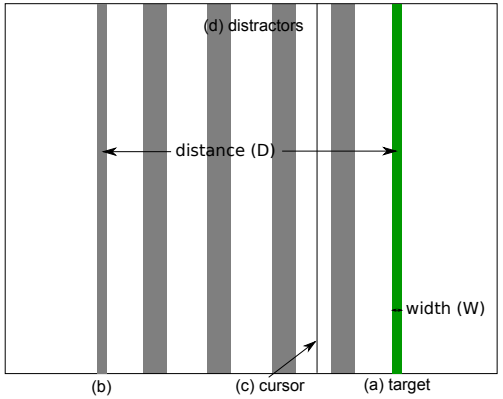
Friction

Surfpad



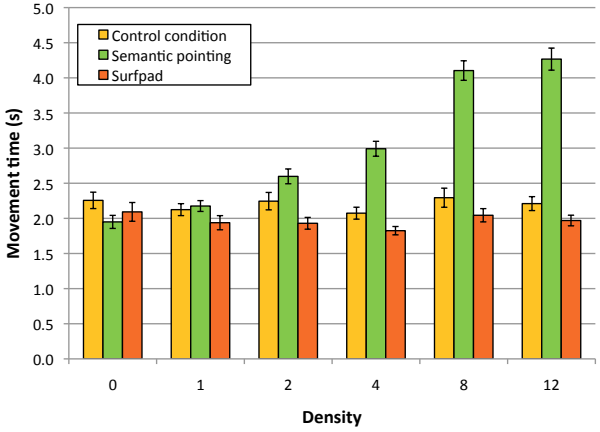
Targets separated by 100 mm

12 participants
x 3 Techniques (Control, Semantic Pointing Ω & Surfpad Π)
x 4 Blocks
x 2 Widths (16 et 4 pixels)
x 6 Density (0, 1, 2, 4, 8 & 12 distractors)
x 3 = 5,184 trials



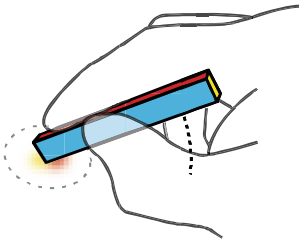
Main results

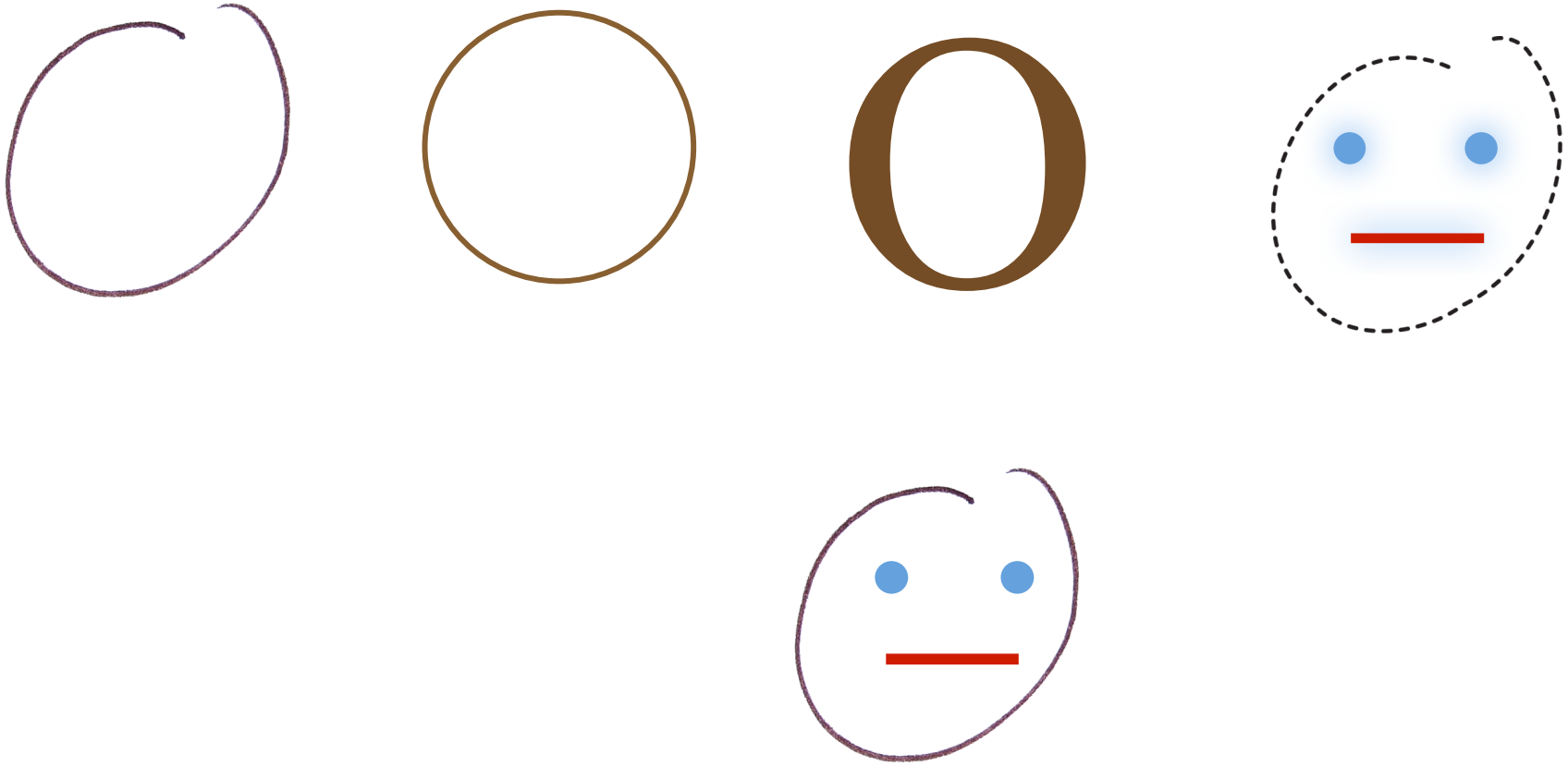
- Surfpad continues to improve movement time by 9,5% compared to Control, whatever the number of distractors
- Semantic Pointing degrades performance up to 100%, due to clutching



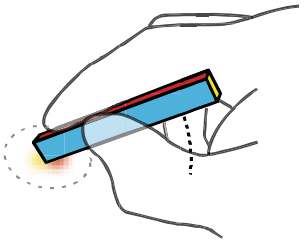
Géry Casiez, Nicolas Roussel, Romuald Vanbelleghem, and Frédéric Giraud. 2011. Surfpad: riding towards targets on a squeeze film effect. In CHI '11, 2491-2500.

Conté



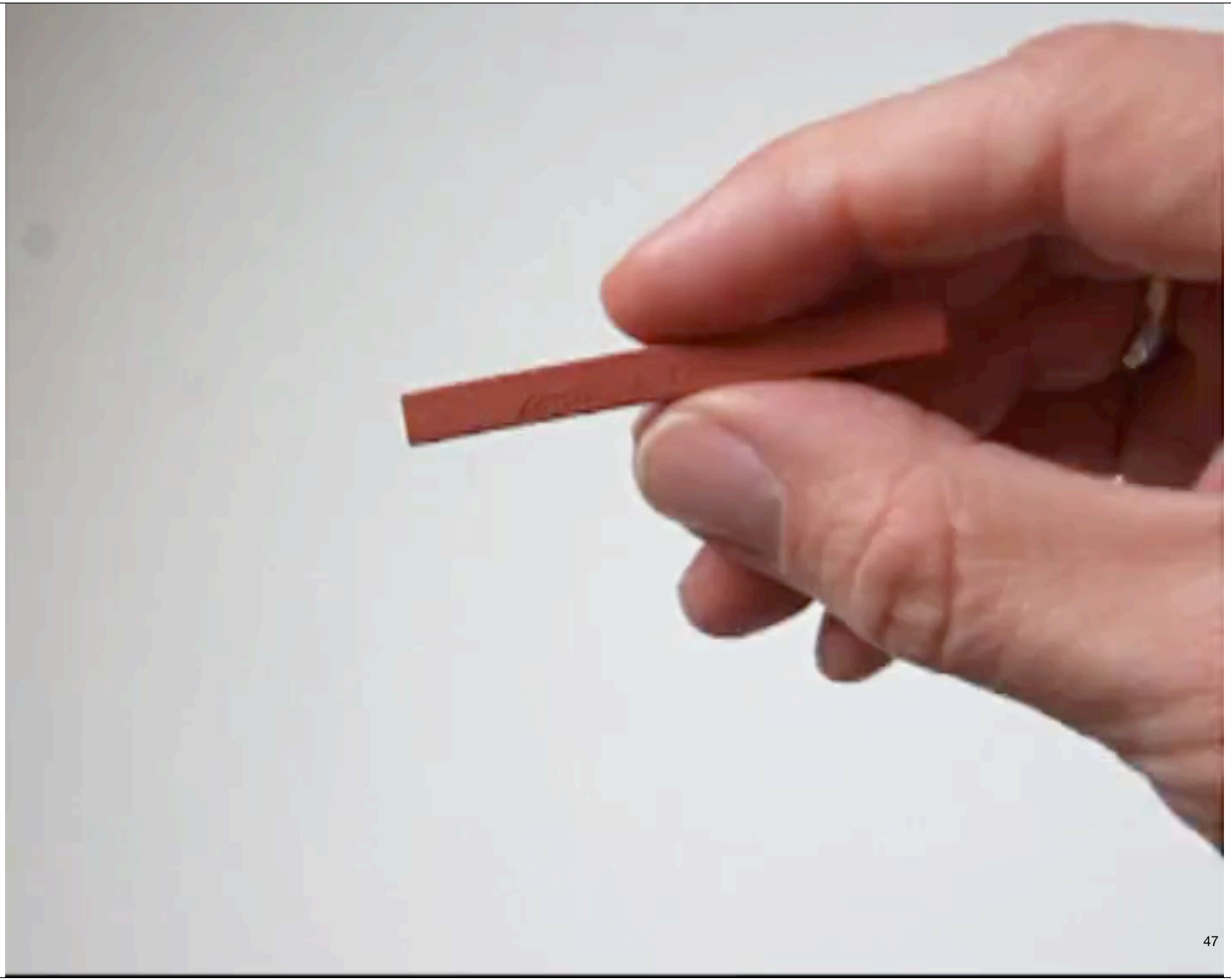


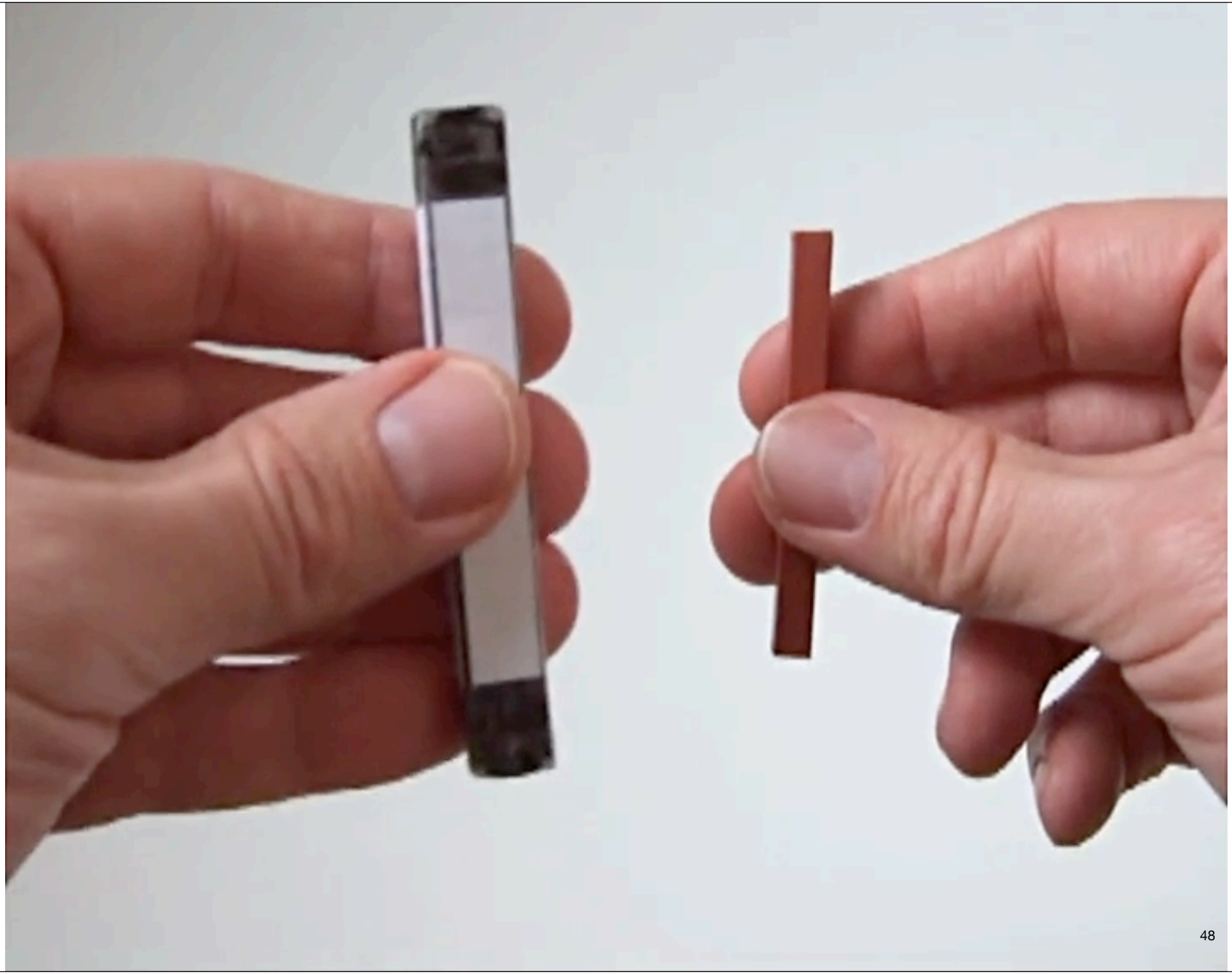
Daniel Vogel and Géry Casiez. 2011. Conté: multimodal input inspired by an artist's crayon. In UIST '11, 357-366.

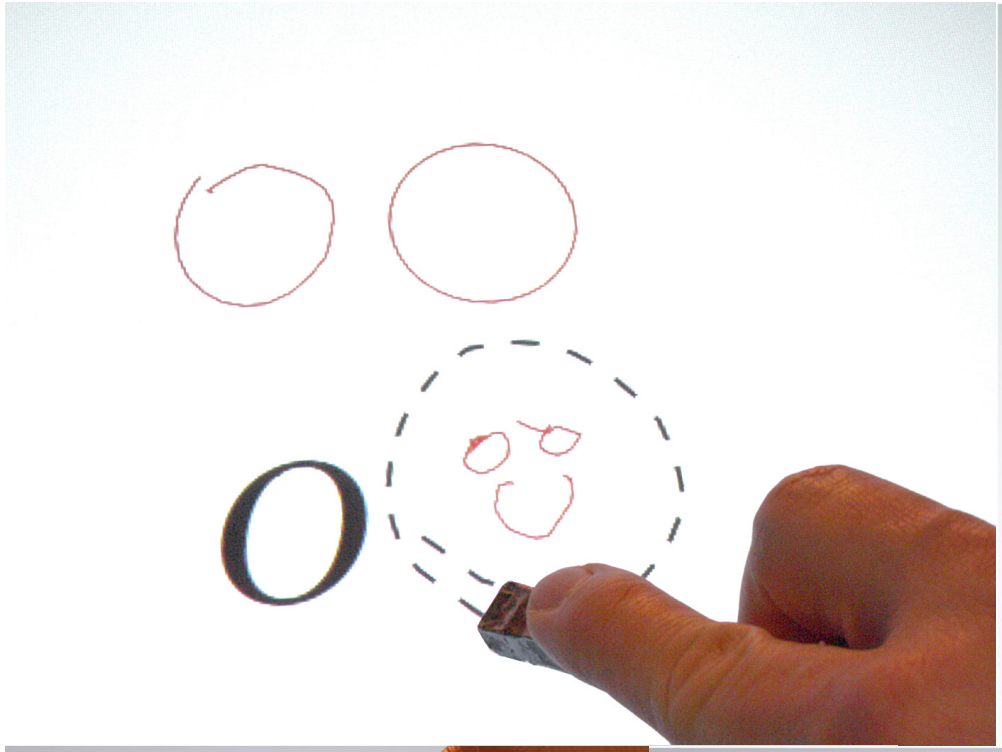


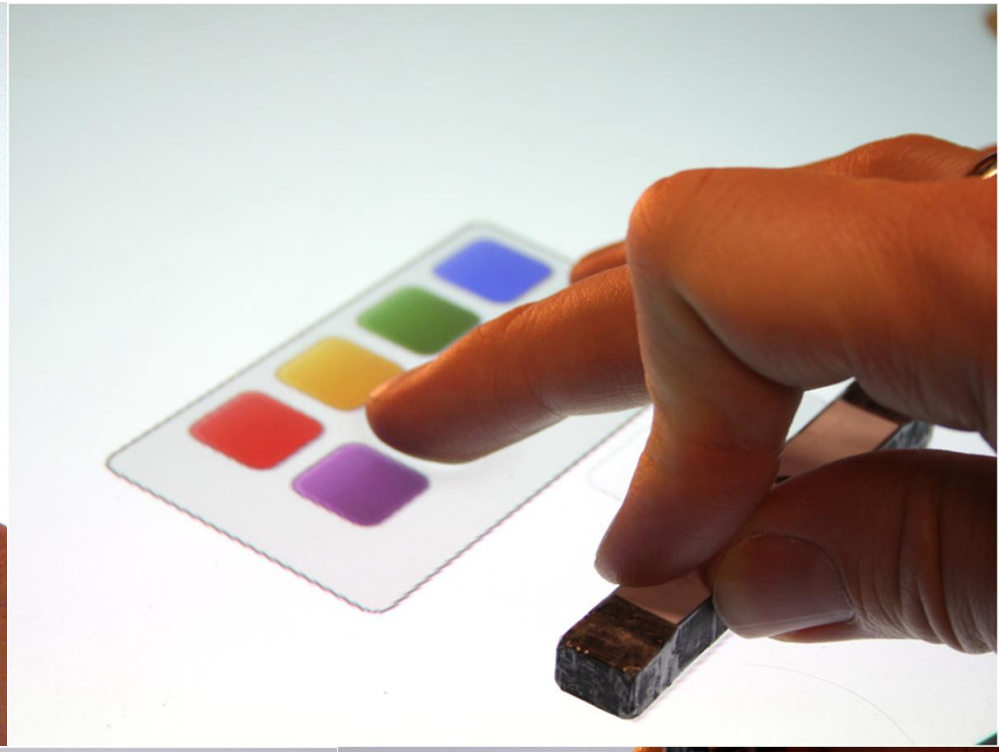

U.S.A. TICONDEROGA Ladalie 3304 NO. 2 - HB

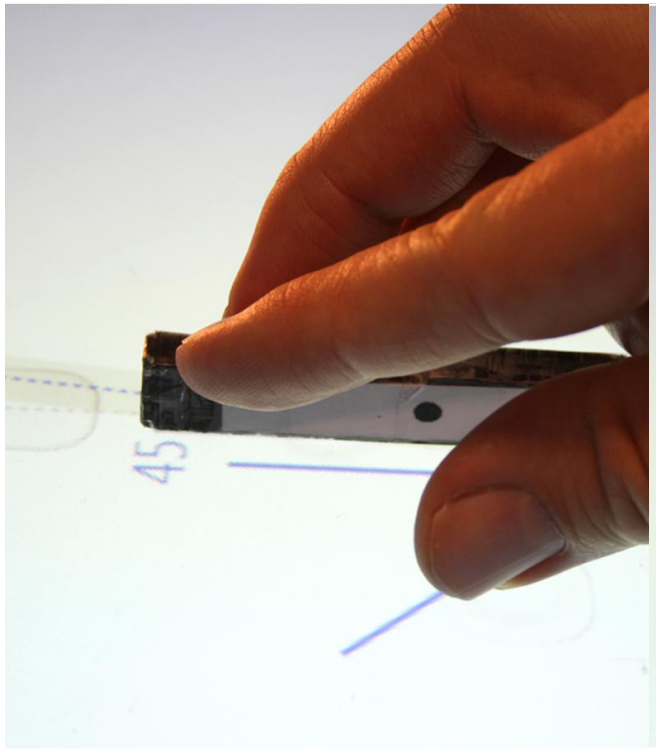

wacom

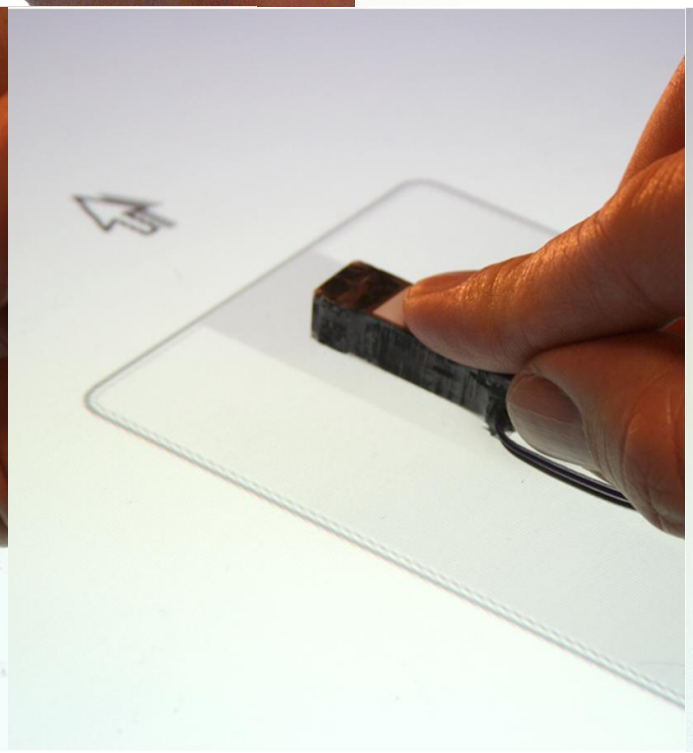


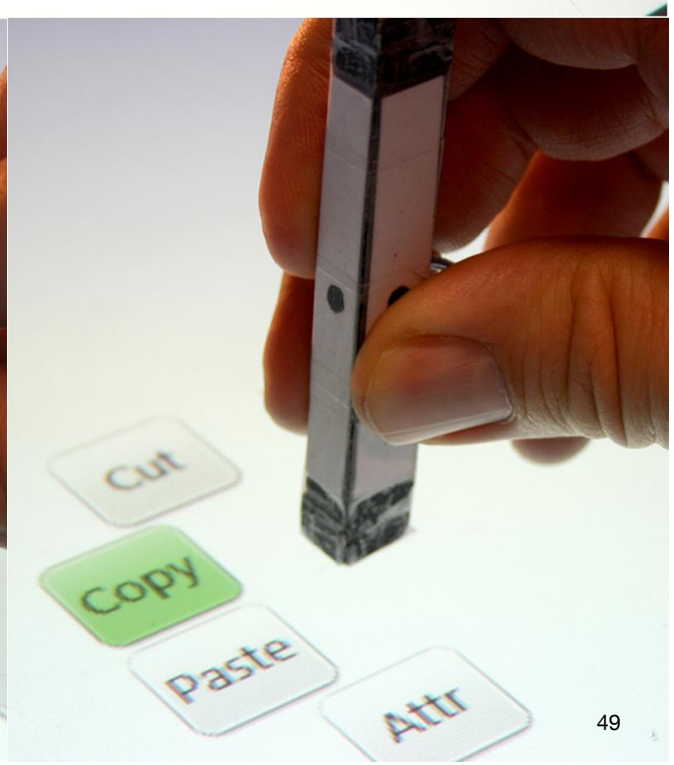




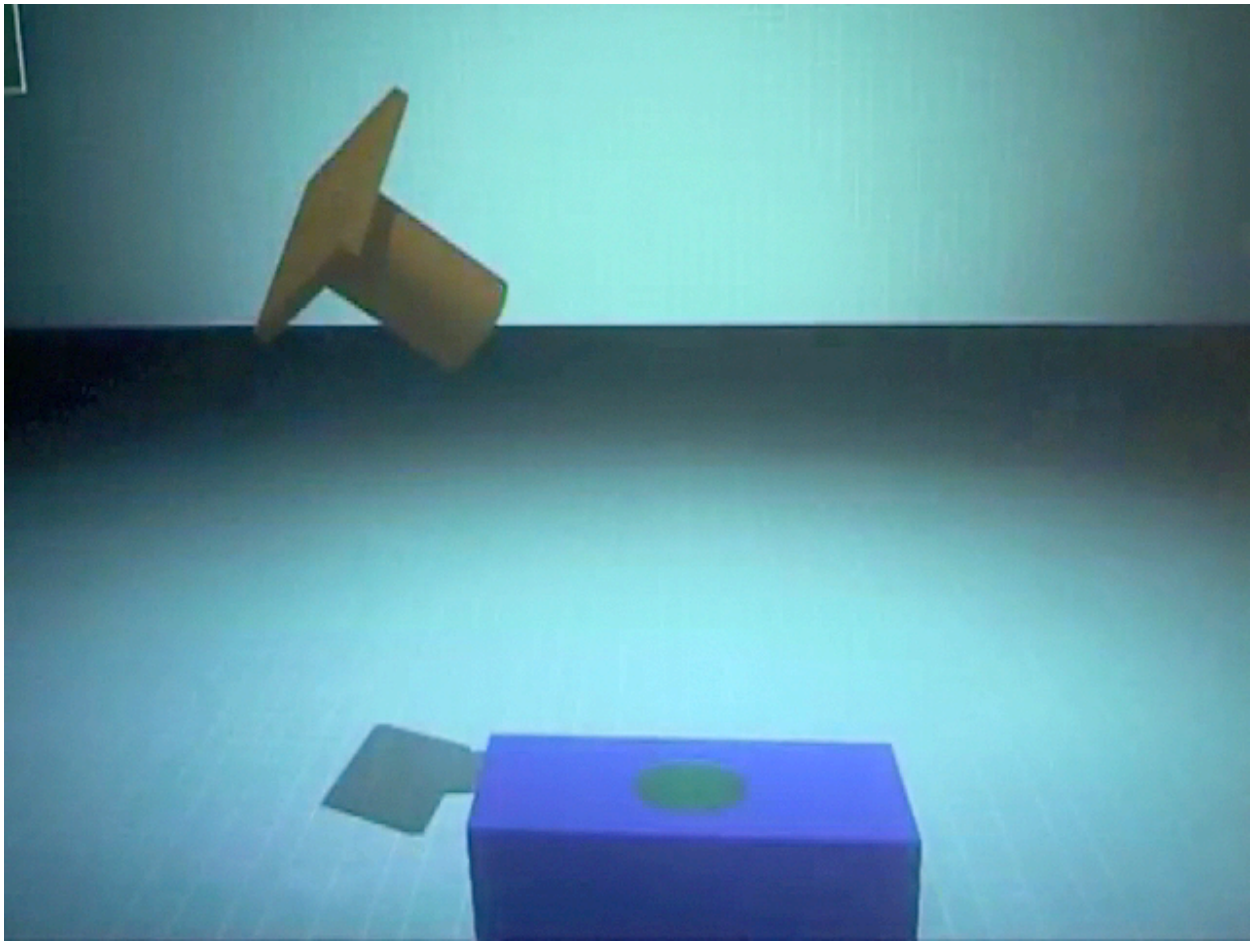


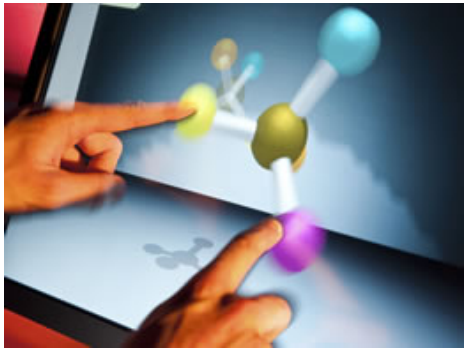

45




Cut
Copy
Paste
Attr

3D Manipulation



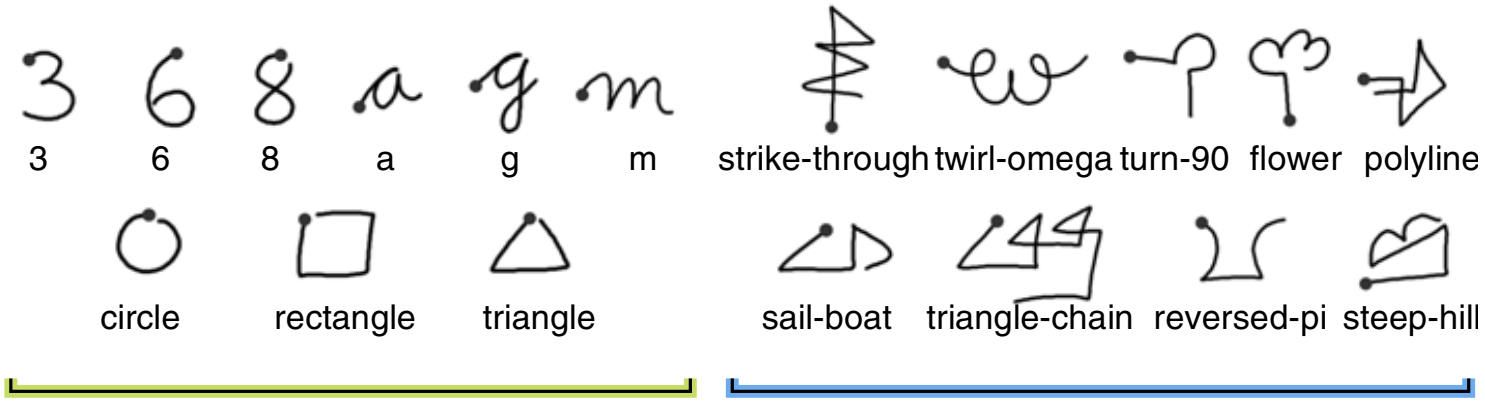


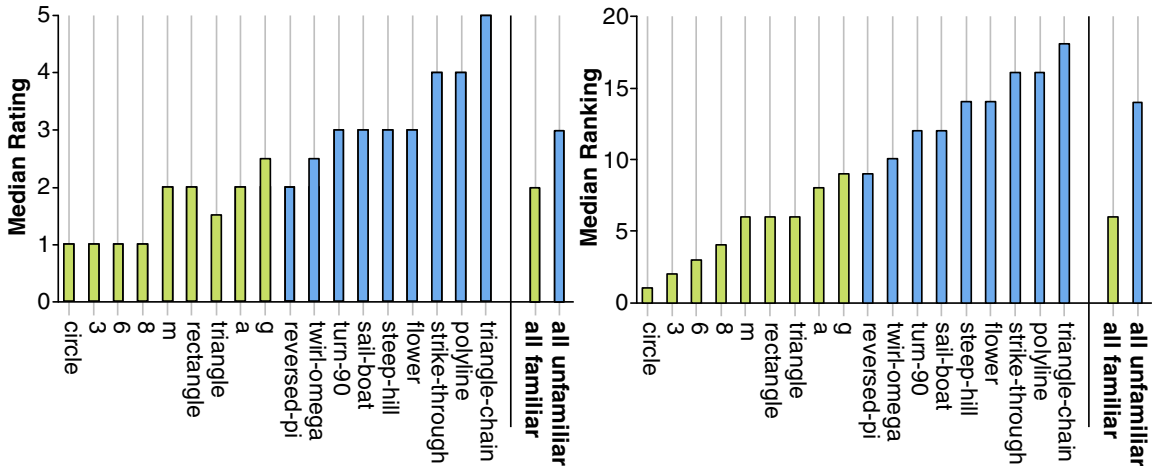
		Translation			Rotation		
	Mode	Tx	Ty	Tz	Rx	Ry	Rz
Screen-Space	1*d*	●	●				
	2*d*	●	●	Added after pilot study ●	●	●	●
	≥ 3*d*	●	●	●	●	●	●

		Translation			Rotation		
	Mode	Tx	Ty	Tz	Rx	Ry	Rz
DS3	1*d*	●	●				
	1*d* + 1*i*	●	●	*i*	Z-Technique		
	≥ 2*d*				●	●	●
	≥ 2*d* + 1*i*			*i*	●	●	●

Martinet, A., Casiez, G. & Grisoni, L. (2012). Integrality and Separability of Multi-touch Interaction Techniques in 3D Manipulation Tasks. IEEE Transactions on Visualization and Computer Graphics. IEEE Computer Society, volume 18, issue 3, 369-380.

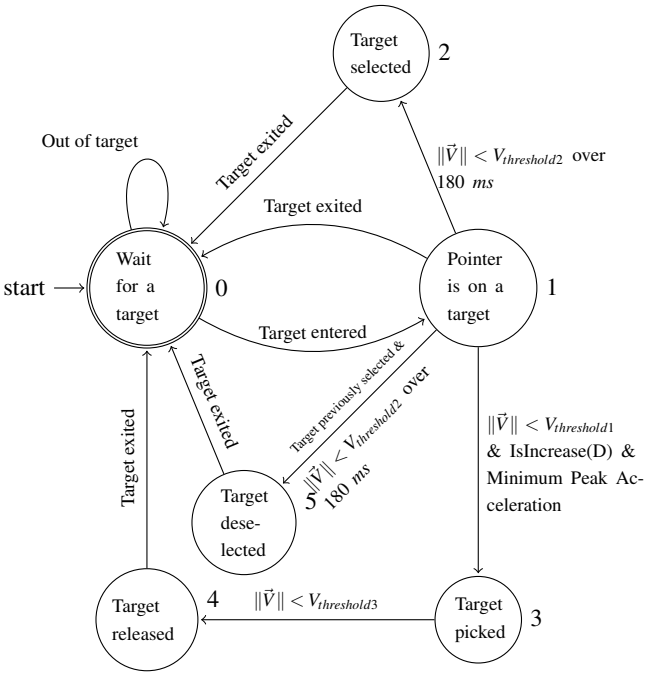
Gestures

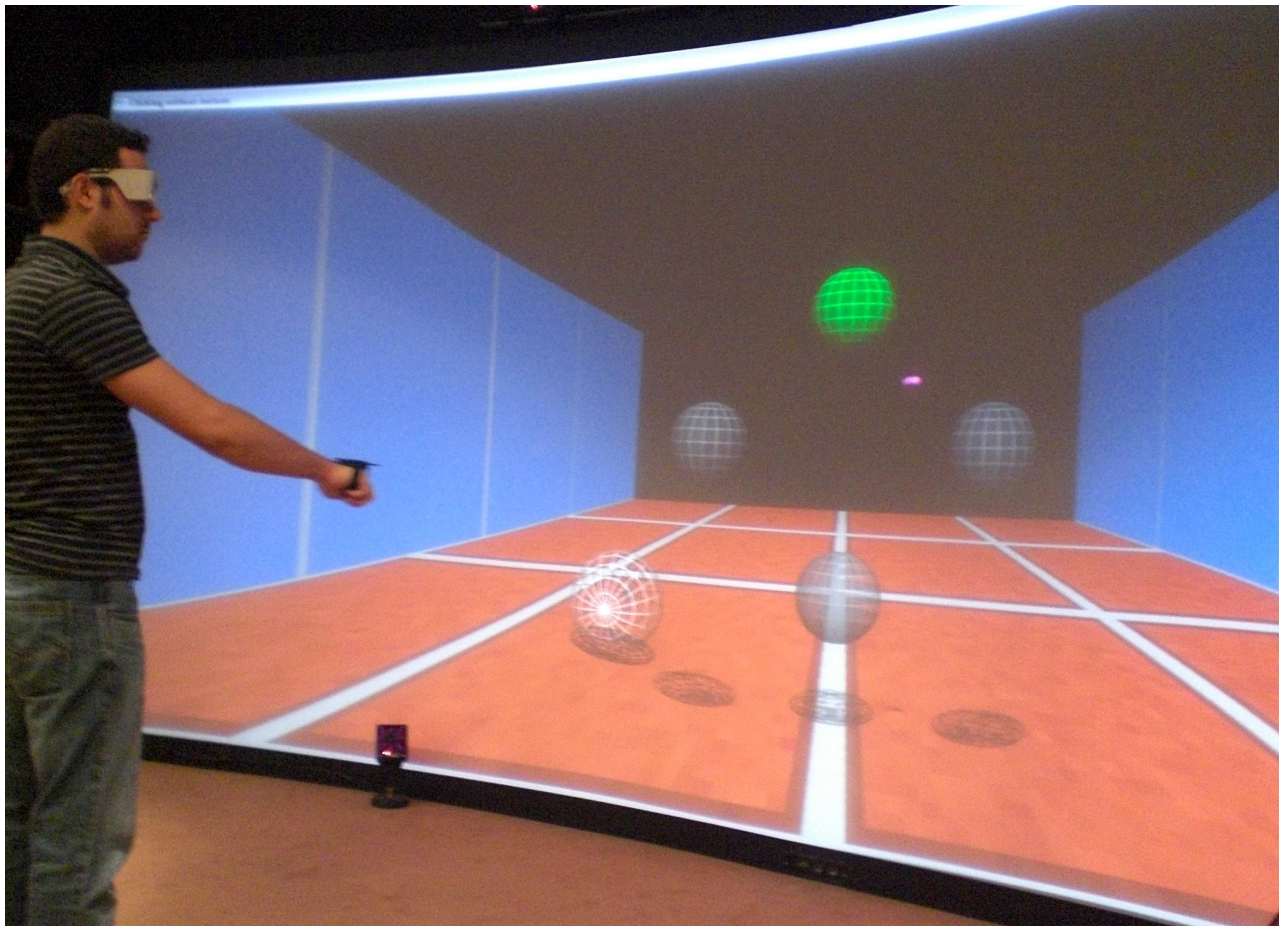




Vatavu, R.D., Vogel, D., Casiez, G. & Grisoni, L. (2011). Estimating the Perceived Difficulty of Pen Gestures. In INTERACT'11, 89-106. Springer.

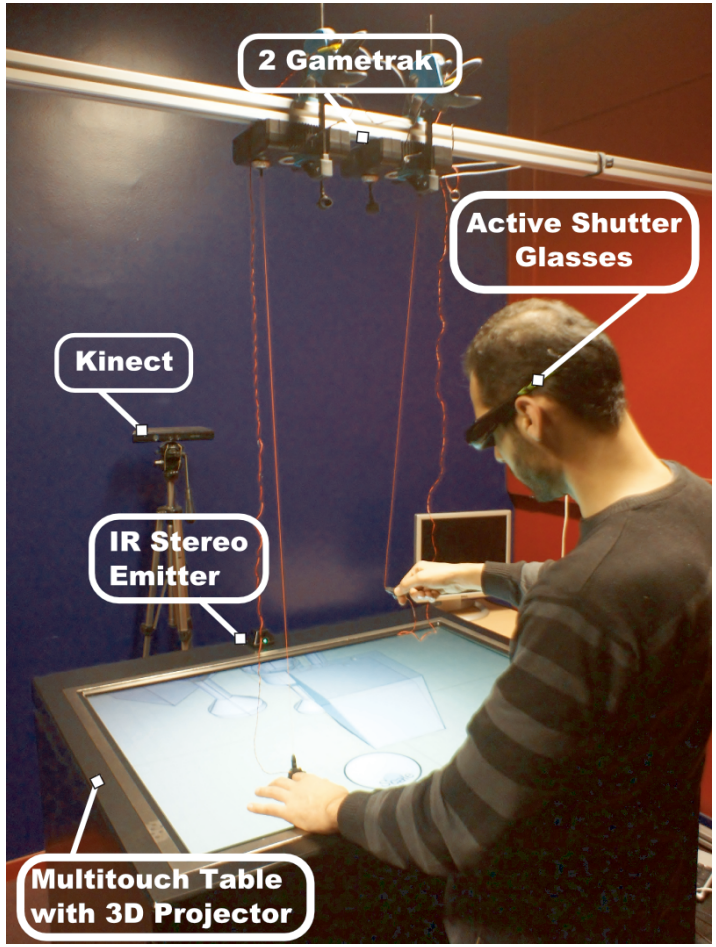
Buttonless clicking

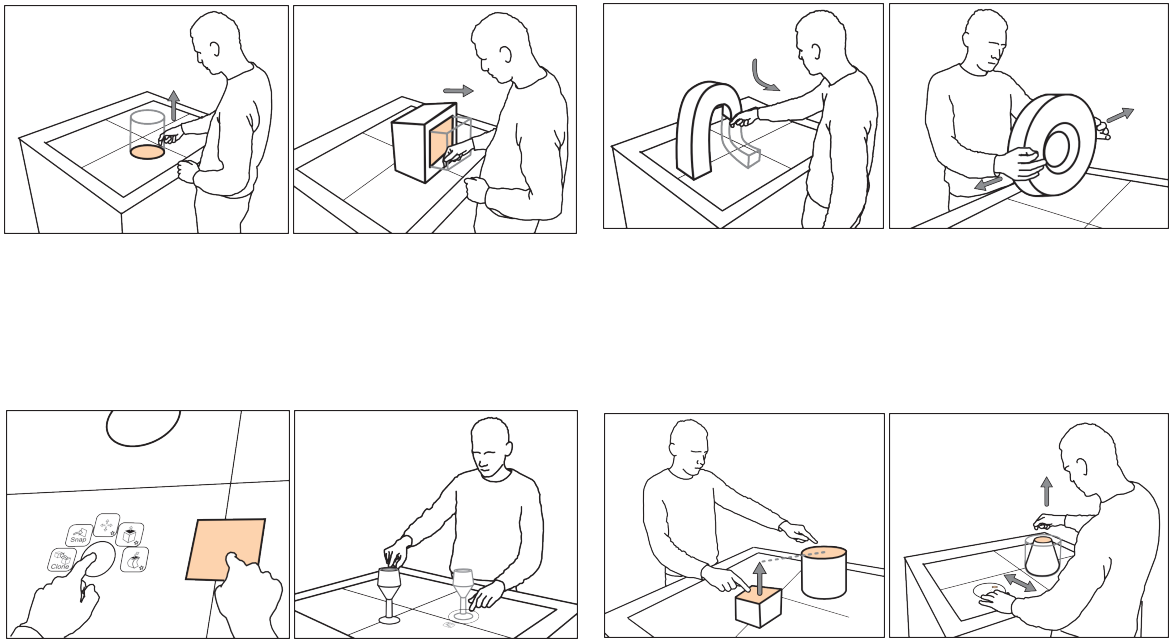




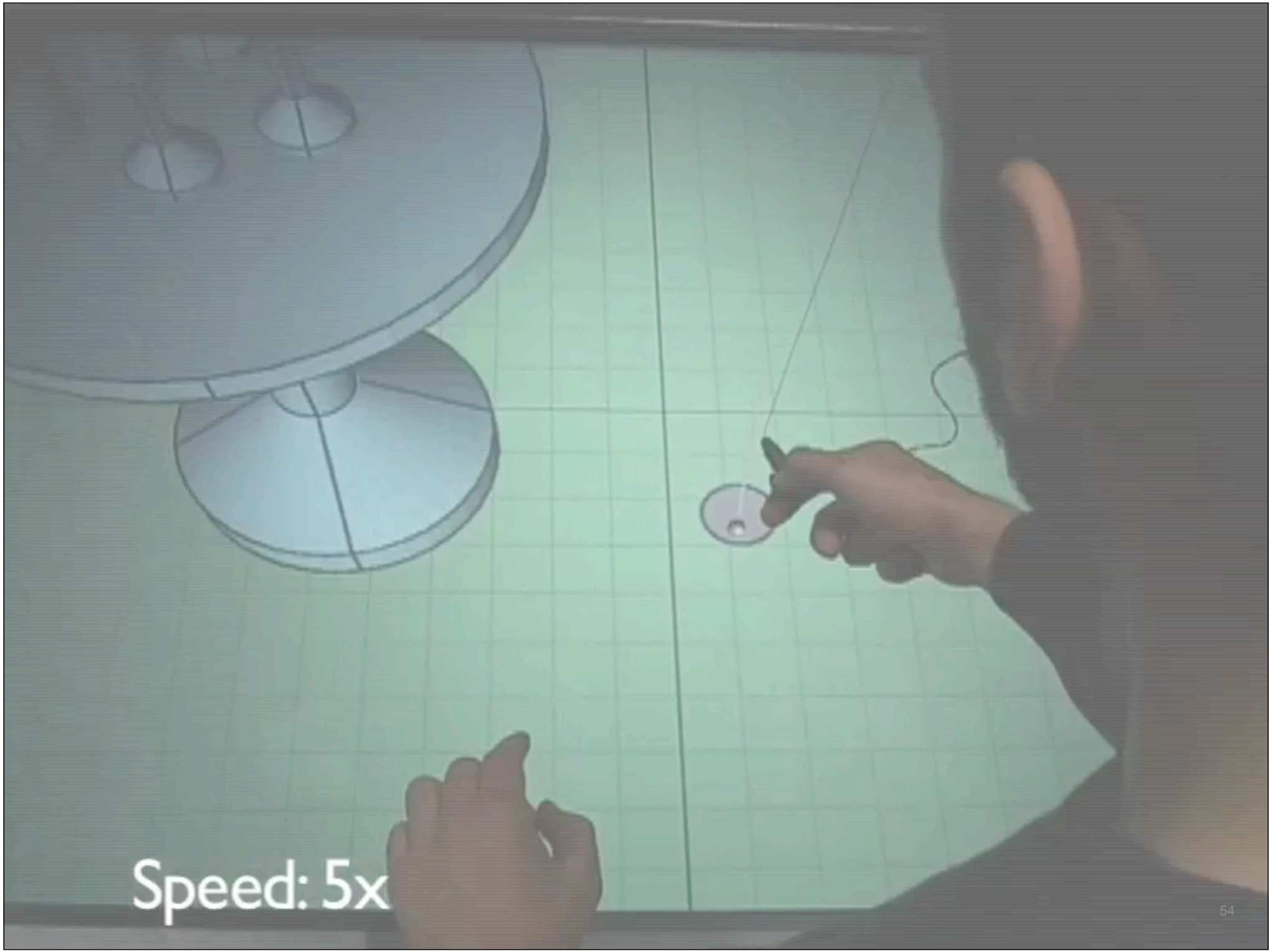
Choumane, A., Casiez, G. & Grisoni, L. (2010). Buttonless Clicking: Intuitive Select and Pick-release Through Gesture Analysis. In IEEE VR, 67-70. IEEE Computer Society.

Mockup Builder





De Araùjo, B. R., Casiez, G. & Jorge, J. A. (2012). Mockup Builder: Direct 3D Modeling On and Above the Surface in a Continuous Interaction Space. In GI'12, 173-180.


Speed: 5x

Summary

Occlusion

Rendering tactile feedback on touch interfaces

New input device to support multimodal input

Degrees of freedom integration and separation

Gesture interaction

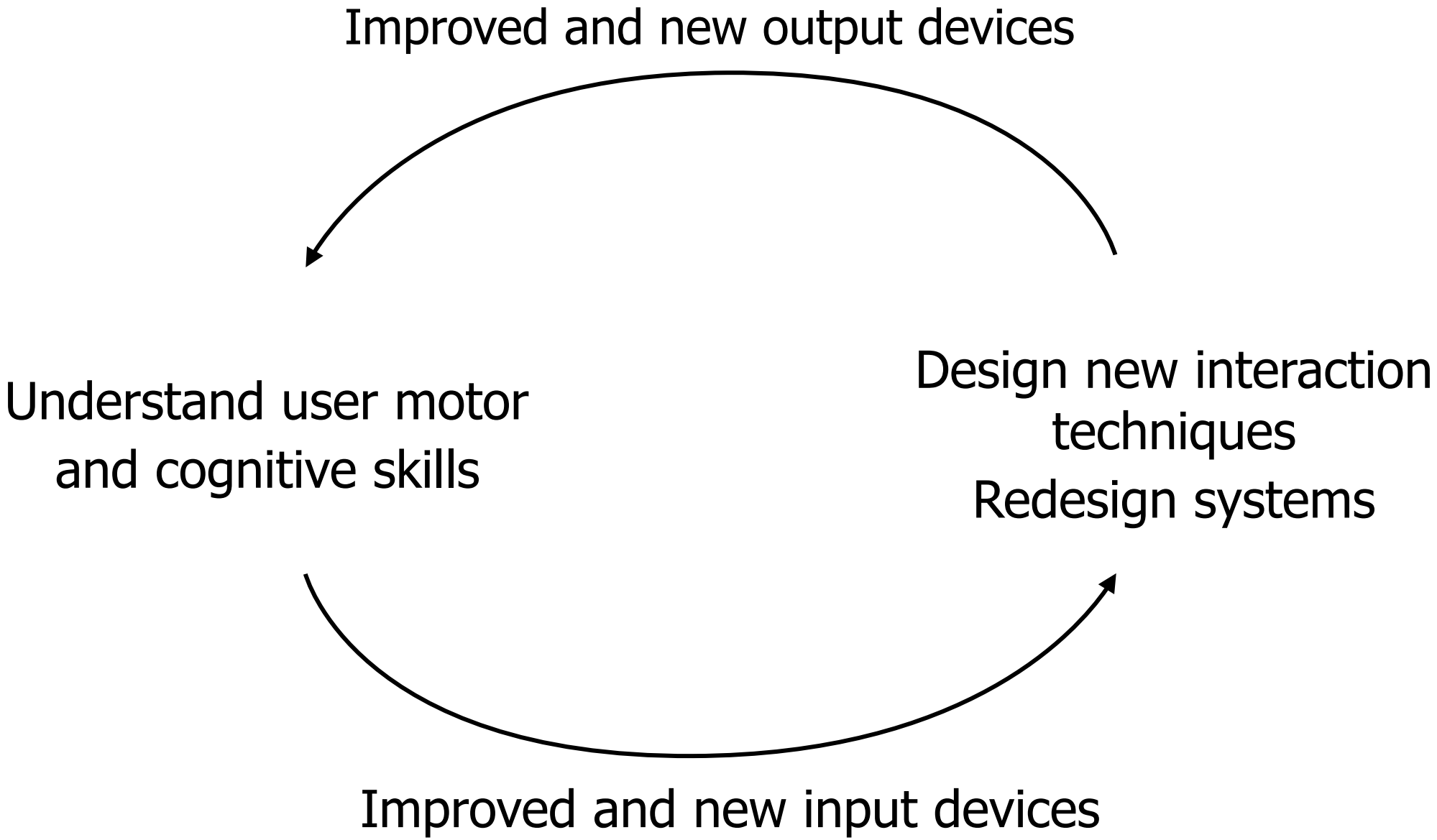
Perspectives

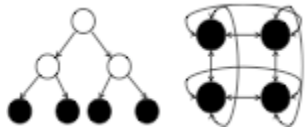
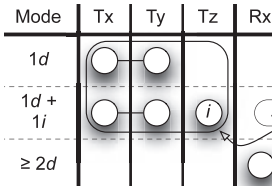
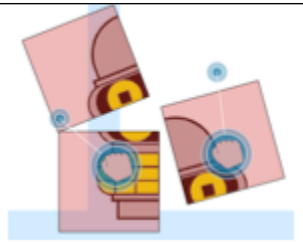
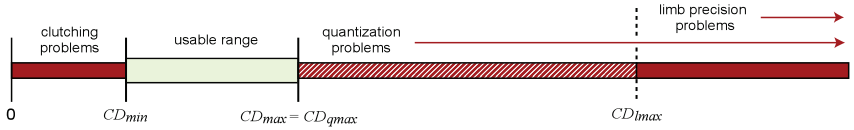
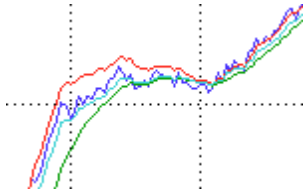
Friction based interfaces: increased knowledge and new prototypes

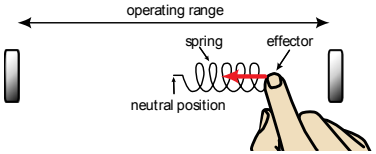
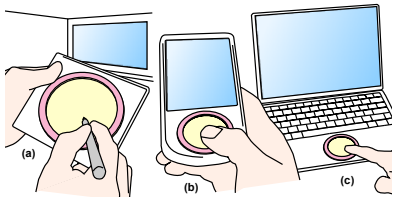
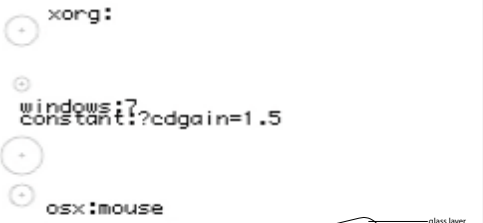
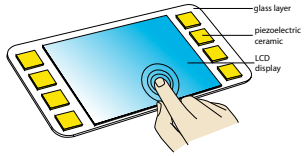
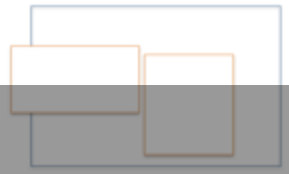
Indirect interaction on touch interfaces

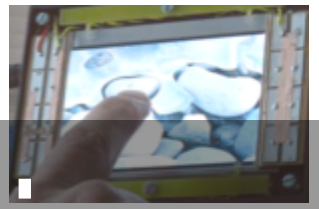
Additional degrees of freedom on touch interfaces

General perspectives

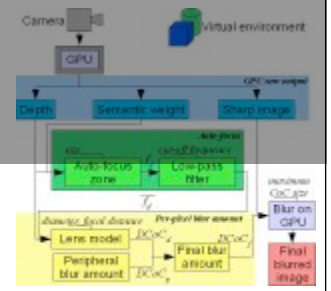
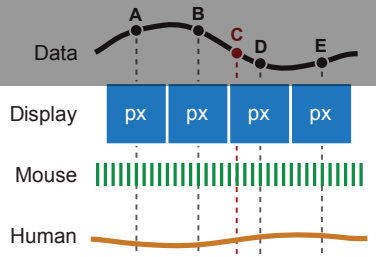

Improved and new output devices
Understand user motor and cognitive skills
Design new interaction techniques
Redesign systems
Improved and new input devices

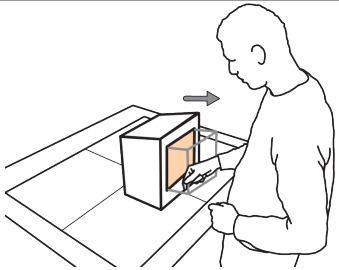


Mode
Tx
Ty
Tz
Rx
1d
1d + 1i
≥ 2d
i


clutching problems
usable range
quantization problems
limb precision problems
0
CD_{min}
$CD_{max} = CD_{qmax}$
CD_{lmax}


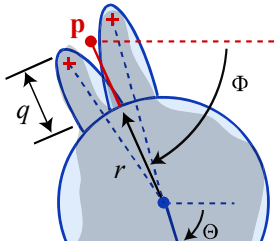
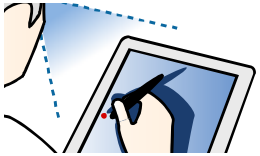
star
step-down
cat

operating range
spring
effector
neutral position

(a)
(b)
(c)

xorg:
windows:?
constant:?cdgain=1.5
osx:mouse

glass layer
piezoelectric ceramic
LCD display




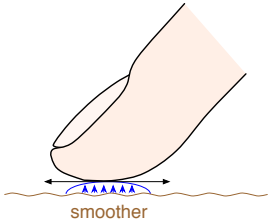
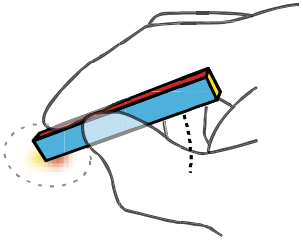
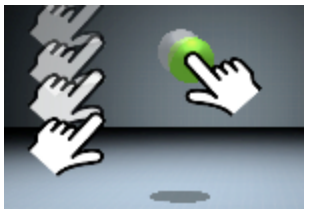



Camera
Virtual environment
GPU
Depth
Semantic weight
Sharp image
Lens model
Peripheral blur amount
Final blur amount
Blur on GPU
Final blurred image

A
B
C
D
E
Data
Display
px
px
px
px
Mouse
Human

Target selected



p
+
+
q
r
Φ
Θ






smoother



Questions?