Surfpad:
Riding Towards Targets on a Squeeze Film Effect

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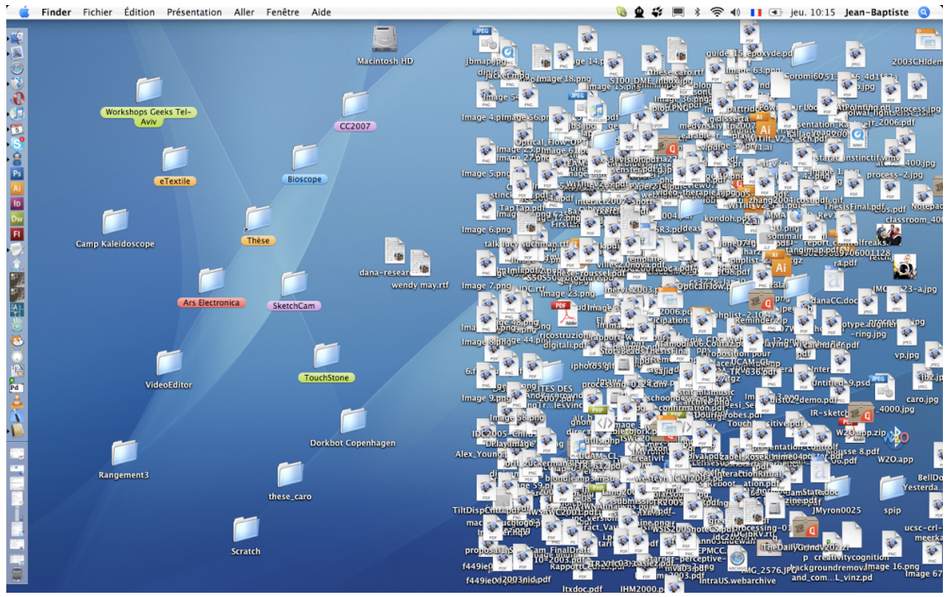
Pointing facilitation

Most pointing facilitation techniques are target aware (e.g. Semantic Pointing, Sticky Targets)



http://www.flickr.com/photos/jeanbaptisteparis/724619122/

What is a target?

Only a few studies on the effect of distractors

They conclude on their negative impact on movement time, error rate or user satisfaction

Pointing with haptic feedback

Haptic = tactile + kinesthetic

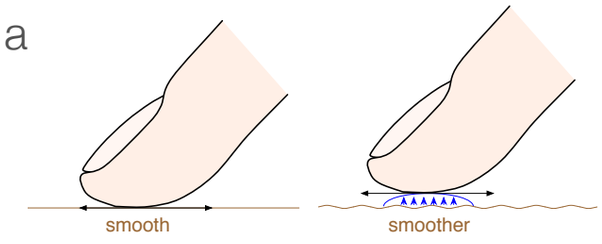
- tactile : information received through nerve receptors in the skin
- kinesthetic : information sensed through movement and/or force to muscles and joints

Many studies on the use of haptic for pointing, but

- based on active stimulation using simple electromagnetic technologies
- only a few take distractors into account

Example of haptic technology using passive feedback : *the squeeze film effect*

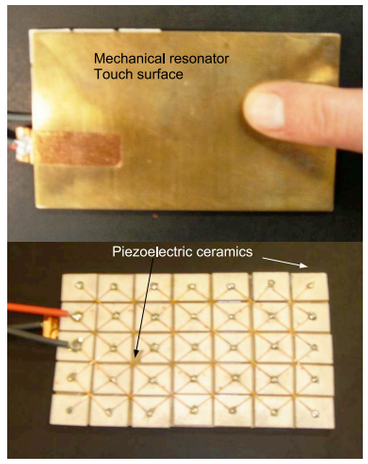
- a simple principle : soften the contact with a surface by vibrating it using a very low amplitude but a high frequency
- more difficult to implement ...

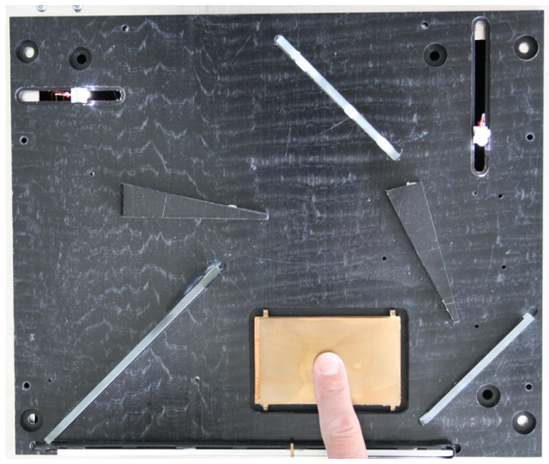


STIMTAC (ALCOVE/MINT : Biet, Giraud & Semail)

A surface with tactile feedback based on a squeeze film effect

- a matrix of piezoelectric ceramic cells coated on a copper-beryllium plate
- a vibration generated by the shrinking/stretching of the ceramics
- the variable amplitude of vibration allows to control the amount of friction





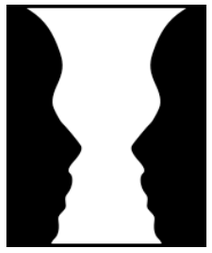
Three years of work to build a 1D prototype and design a 2D plate

Almost three more years to build this plate and optimize it

Surfpad

Surfpad

A pointing technique using the STIMTAC



A figure-ground reversal: as it is not possible to increase friction on targets, it is reduced everywhere else

http://www.flickr.com/photos/remydugoua/4098087579/

A simple implementation using a step function Π

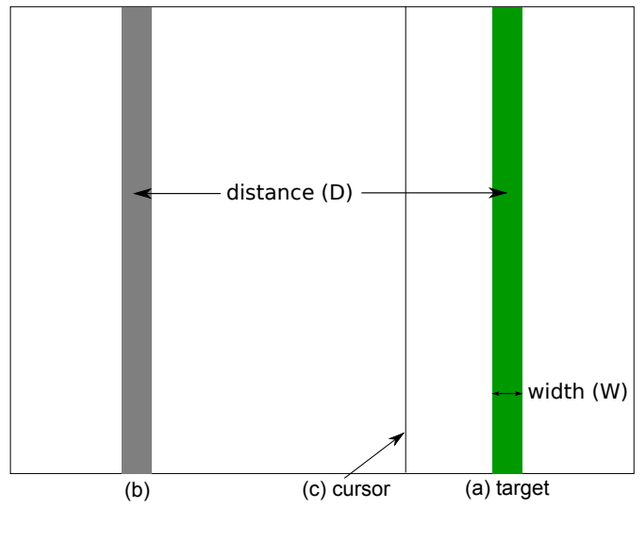
- 0 = maximum friction if over a target
- 127 = minimum friction otherwise

Using a Bell-shape function Ω

- Smooth transition between minimum and maximum friction

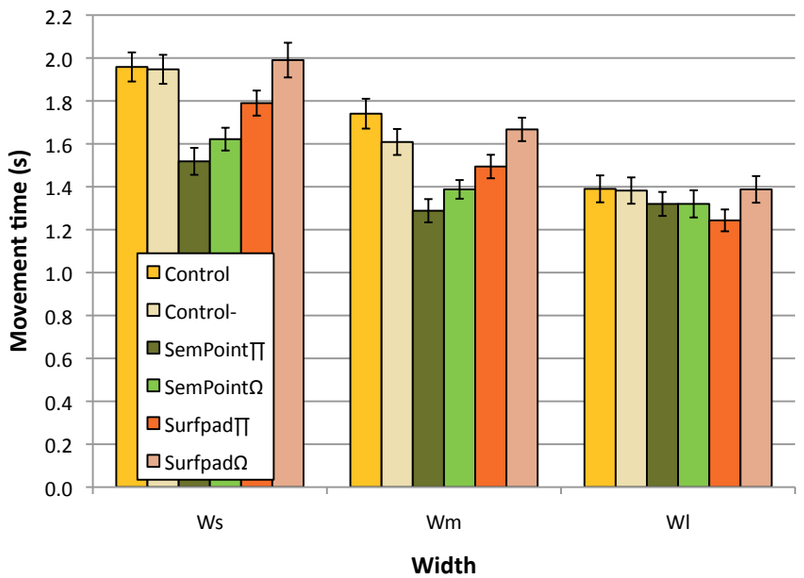
First experiment

12 participants
x 6 Techniques (Control, Control-, Semantic Pointing Π, Semantic Pointing Ω, Surfpad Π, Surfpad Ω)
x 4 Blocks
x 3 Distances (100, 50 & 25mm)
x 3 Widths (16, 8 & 4 pixels)
x 3 = 7,776 trials



Main results

- No difference between the two control conditions
- Surfpad Π improves movement time by 8.8% compared to the Control conditions
- No difference between Surfpad Ω and the two control conditions
- Semantic pointing improves movement time by 17.7% compared to the Control conditions
- interaction technique/width : no difference for large targets



Discussion

Mechanical effect (H1) or information feedback (H2) ?

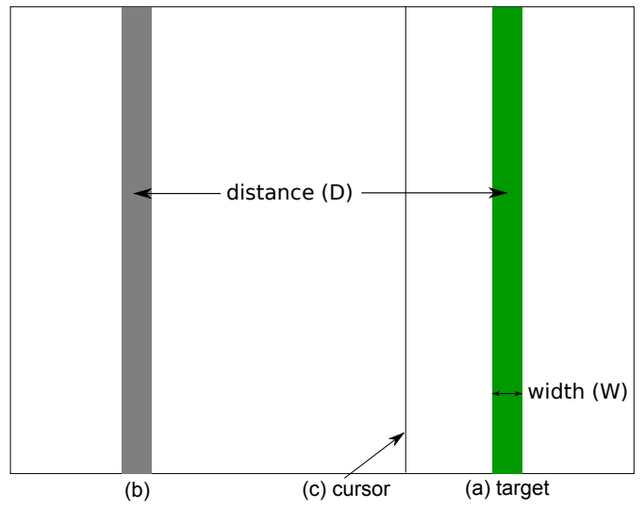
A detailed analysis of the movement time reveals that:

- There was no difference between the two control conditions
- Semantic Pointing Π, Semantic Pointing Ω, Surfpad Π significantly decreased the approaching time compared to the two control conditions (anticipation phenomenon)
- The integrals of Ω and Π are the same but there was no significant decrease in the stopping time for Ω

This suggest a stronger effect of information feedback

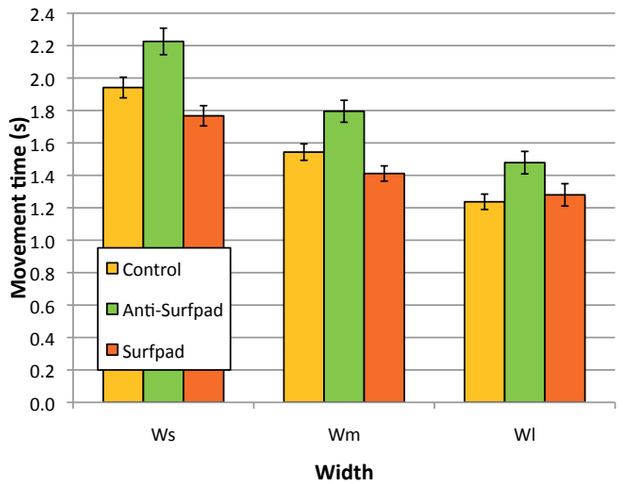
Second experiment

9 participants
x 3 Techniques (Control, Surfpad Π, Anti-Surfpad Π)
x 4 Blocks
x 3 Distances (100, 50 & 25mm)
x 3 Widths (16, 8 & 4 pixels)
x 3 = 2,916 trials



Main results

- Anti-Surfpad Π increased movement time for all target widths
- interaction technique/width : no difference for large targets but Surfpad Π improves movement time compared to Control and Anti-Surfpad Π for smaller target widths



Discussion

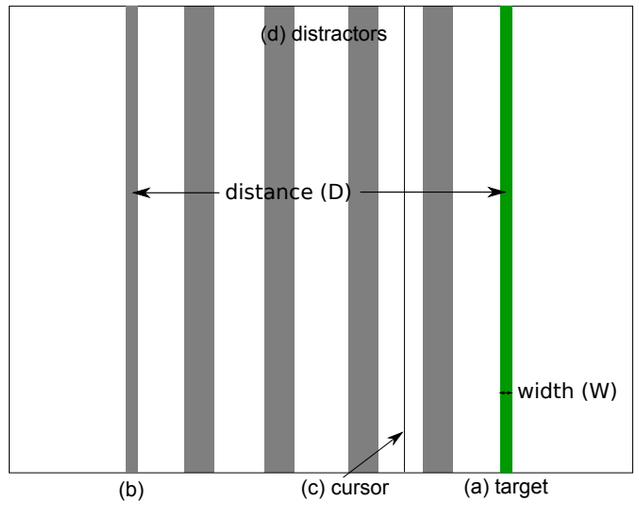
Negative mechanical effect stronger than the information feedback (H3) or counter-effective information feedback (H4) ?

Require further experiments to conclude

Third experiment

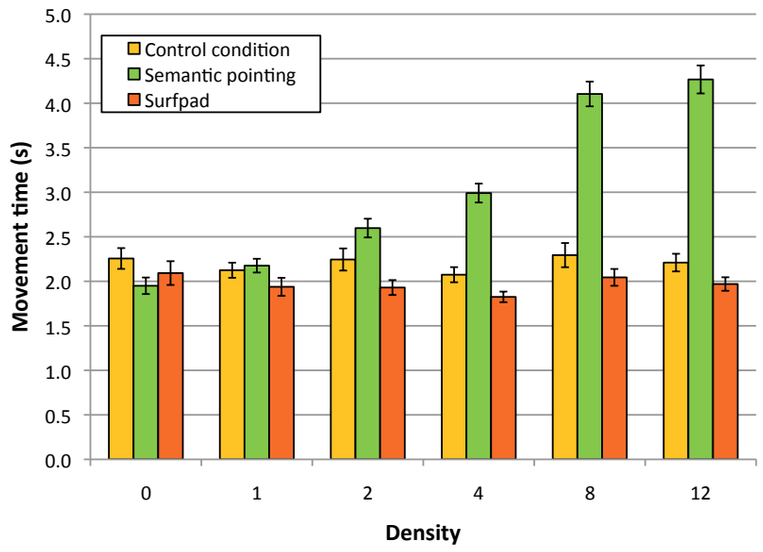
Targets separated by 100 mm

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



Discussion

Why Surfpad is still efficient, even in the presence of distractors ?

Reinforces our belief that Surfpad Π implementation mainly provides information feedback and little or no mechanical effect

Conclusion

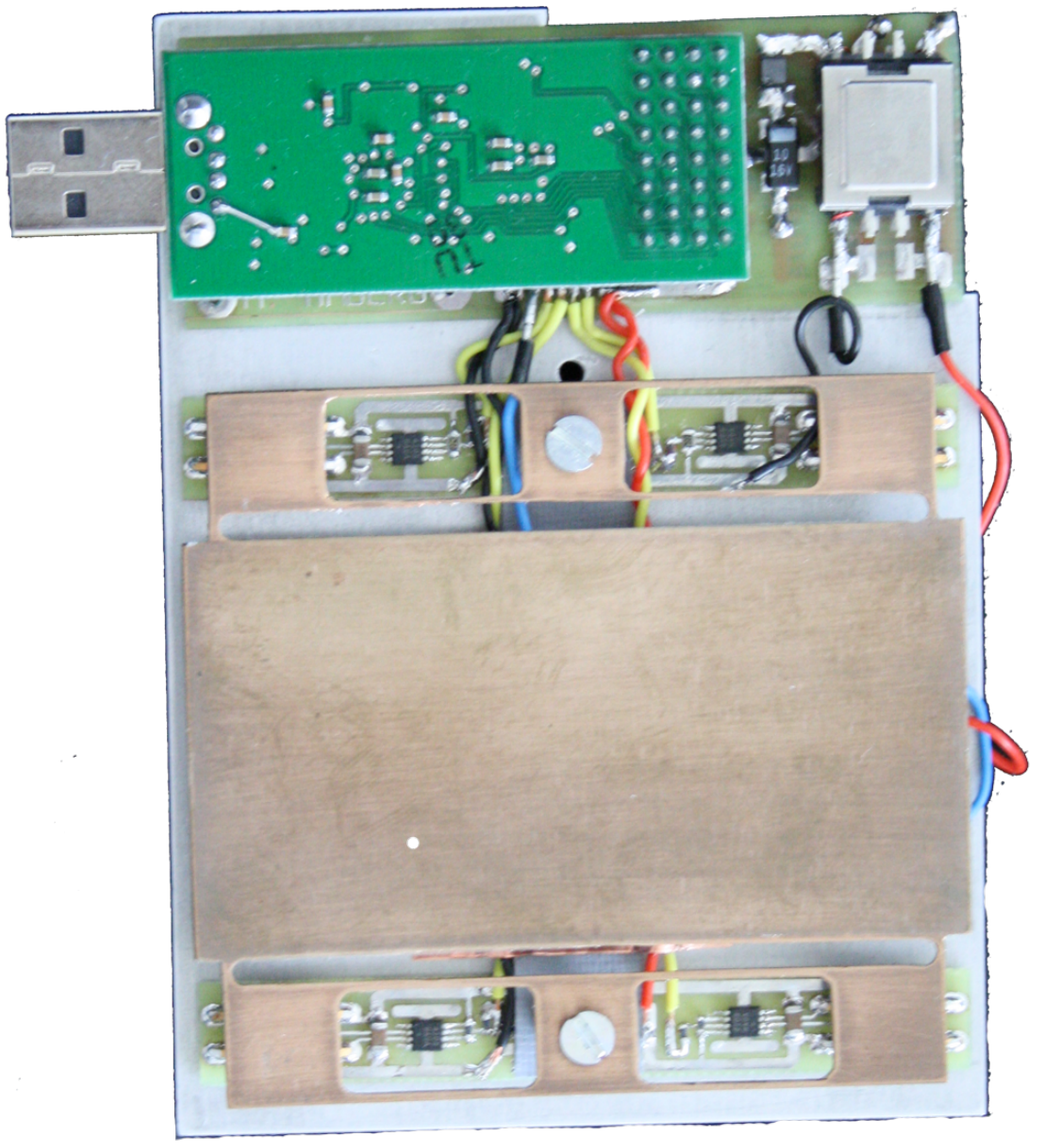
Surfpad is a target aware pointing facilitation technique

- as Semantic Pointing, it improves performance in the absence of distractor
- robust to distractors independently of their number

Explanation : maybe a mechanical effect, but most likely information feedback

Advantage : the question “What is a target ?” becomes less critical

Feelings very similar to Tesla Touch



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