Mid-air Pan-and-Zoom on Wall-sized Displays
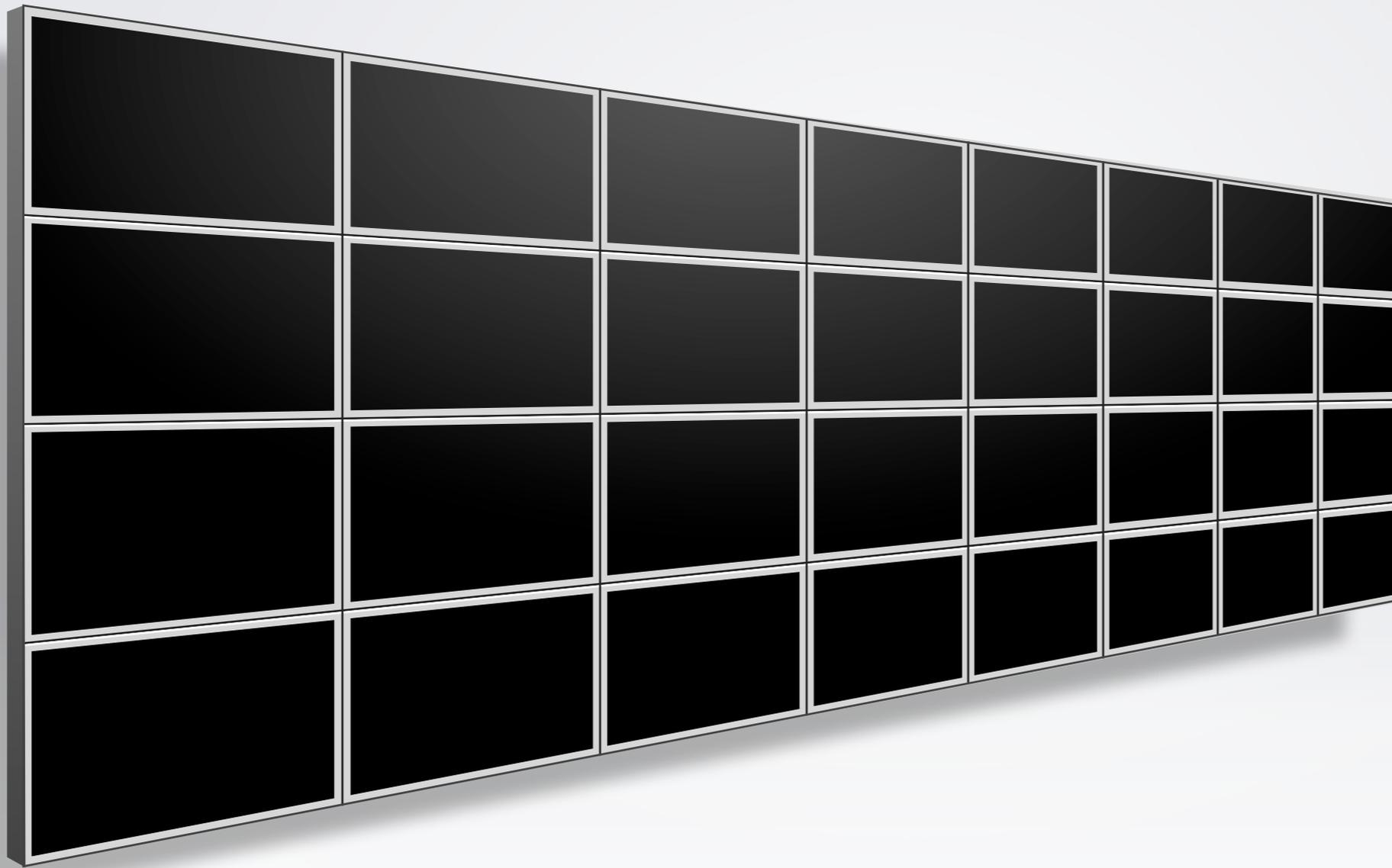
Mathieu Nancel

Julie Wagner

Emmanuel Pietriga

Olivier Chapuis

Wendy Mackay

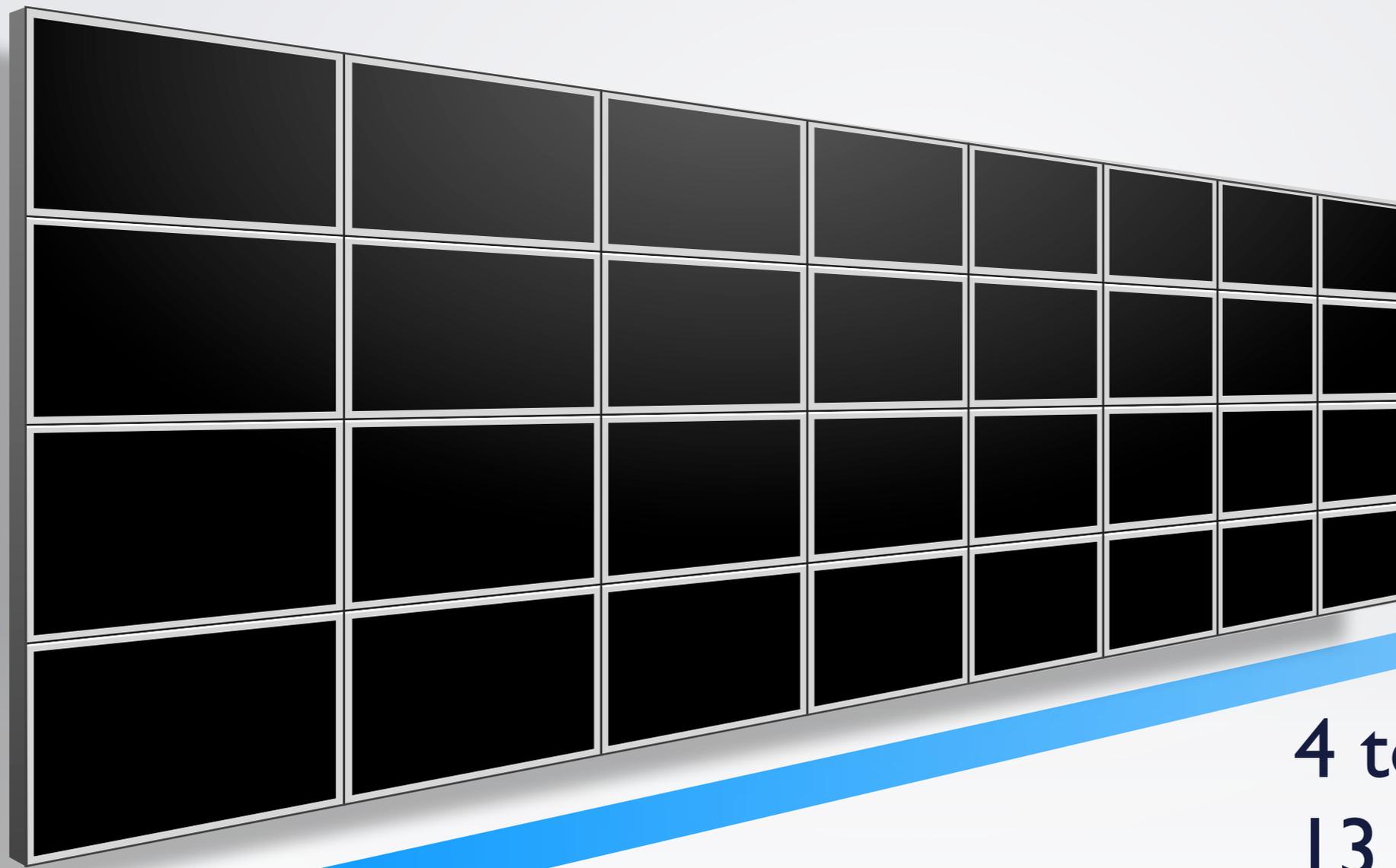in | situ |

Introduction
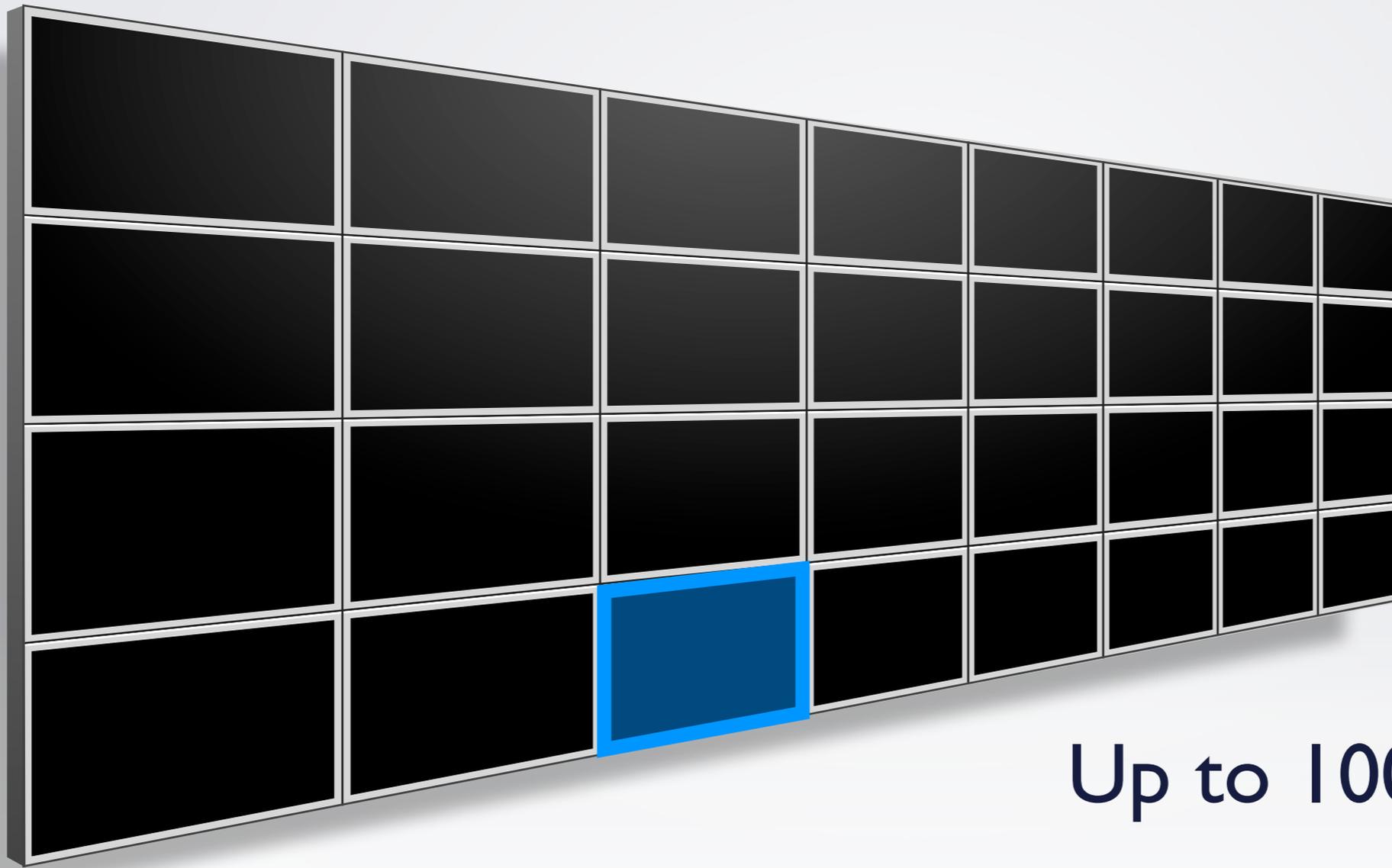
- Wall-Sized displays

Introduction

- Wall-Sized displays

4 to 7 meters
13 to 23 feet

Sunday, May 15, 2011

Introduction

- Wall-Sized displays

Up to 100 dots per inch

Introduction
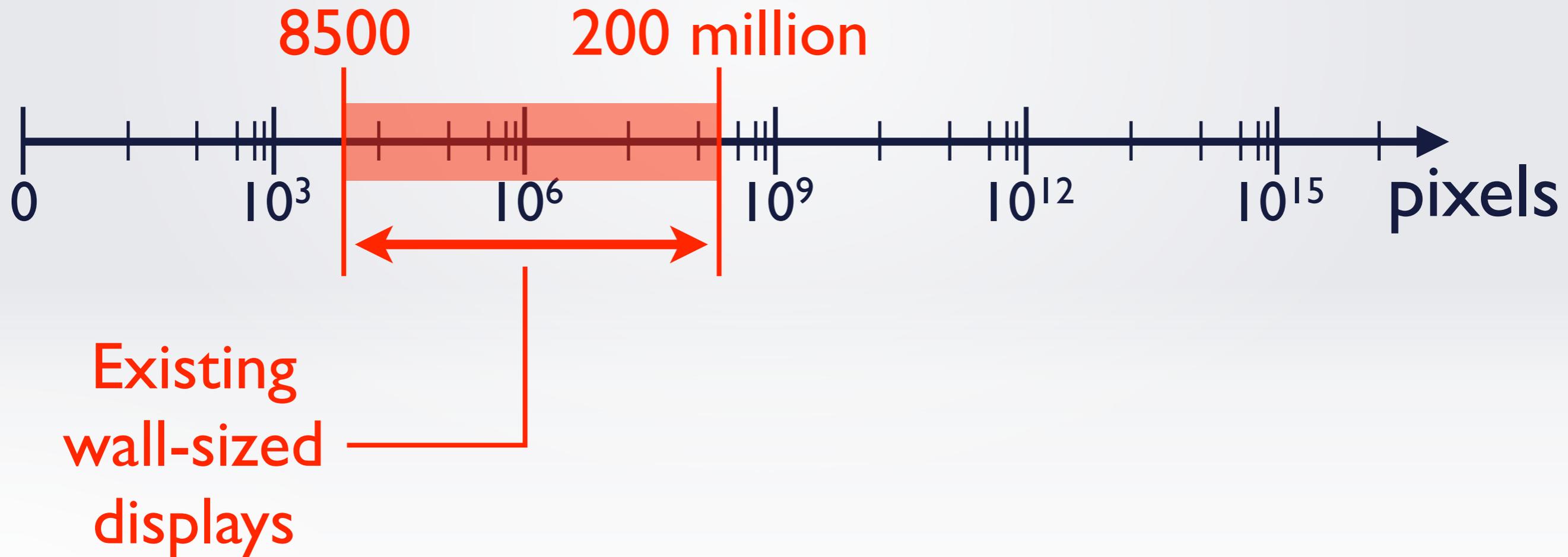
- Wall-Sized displays

Several hundred megapixels
Very large datasets

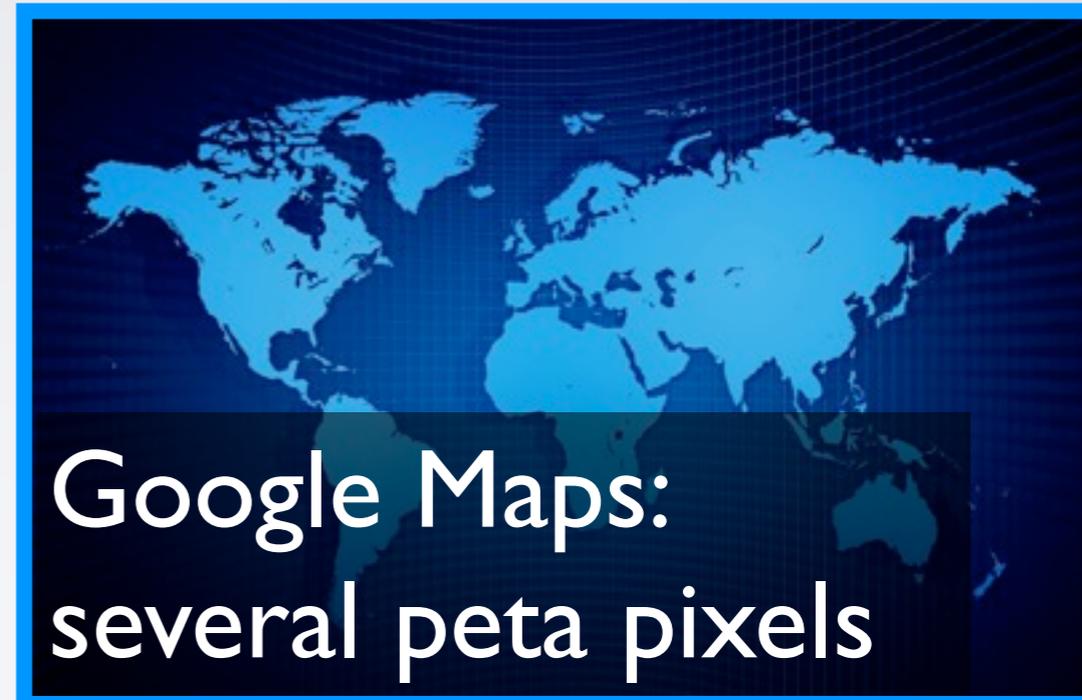# Introduction

- Wall-Sized displays

Introduction

Spitzer: 5 giga pixels

Existing wall-sized displays

0   10^3 10^6 10^9 10^{12} 10^{15} pixels

Paris 26 giga pixels

Introduction

Spitzer: 5 giga pixels

Google Maps:
several peta pixels

0   10^3 10^6 10^9 10^{12} 10^{15} pixels
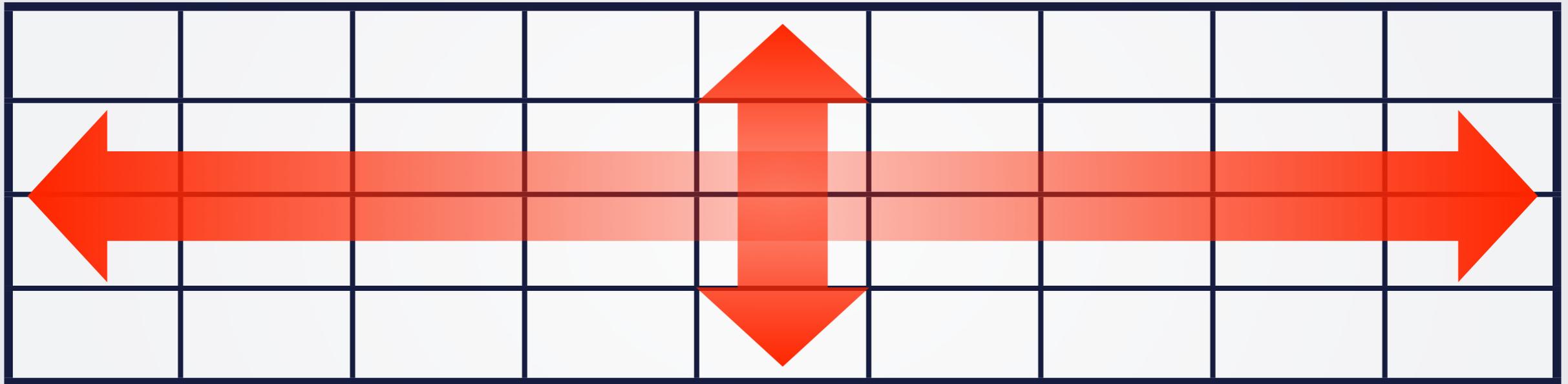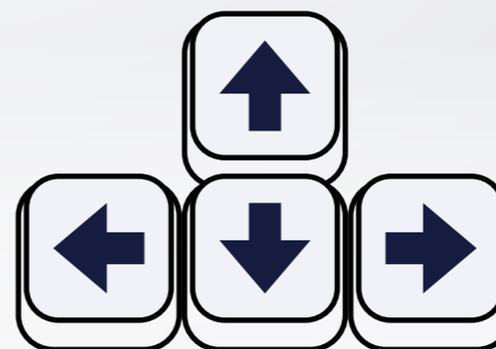
Existing
wall-sized
displays
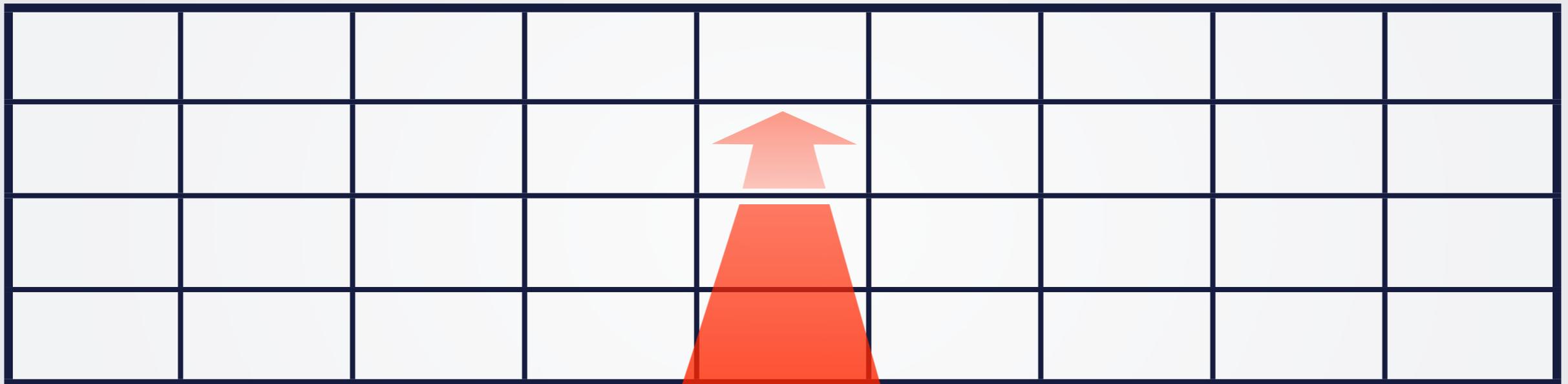
Paris 26 giga pixels

Introduction
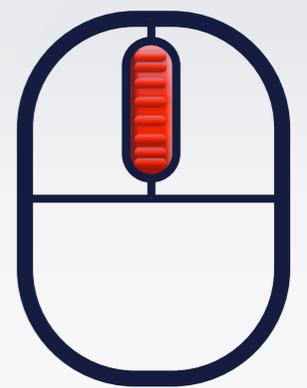
- Panning

- 2 dimensional
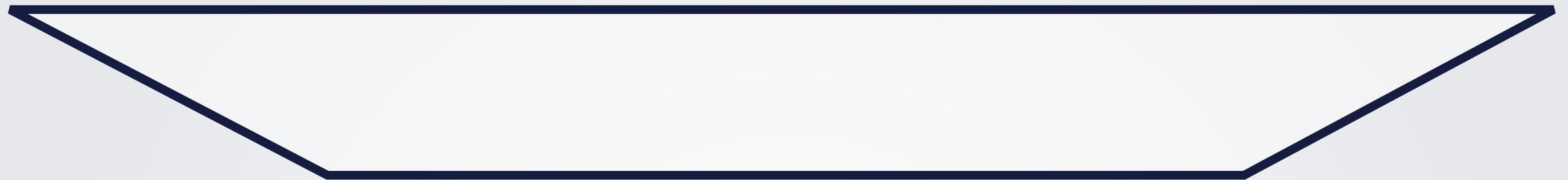
Introduction

- Zooming

- 1 dimensional
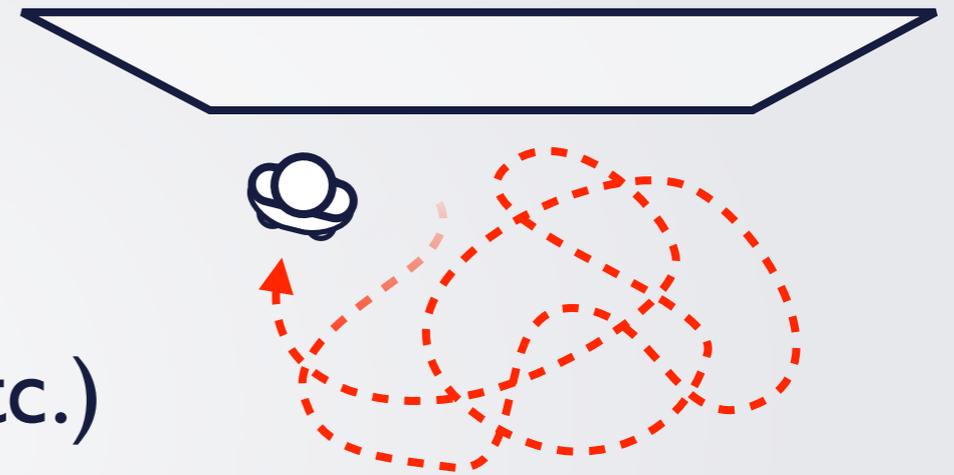
Introduction

Physical zooming

Physical panning

Introduction

- Users can move

  - Location independent
  - No table (mice, keyboards, etc.)

- Mid-air

  - Compatible with other interaction techniques

Goals

- Panning and Zooming:

  - 2+1 Degrees Of Freedom
  - How to control both seamlessly and mid-air?

- What inputs should be used to navigate?

  - In which situation?
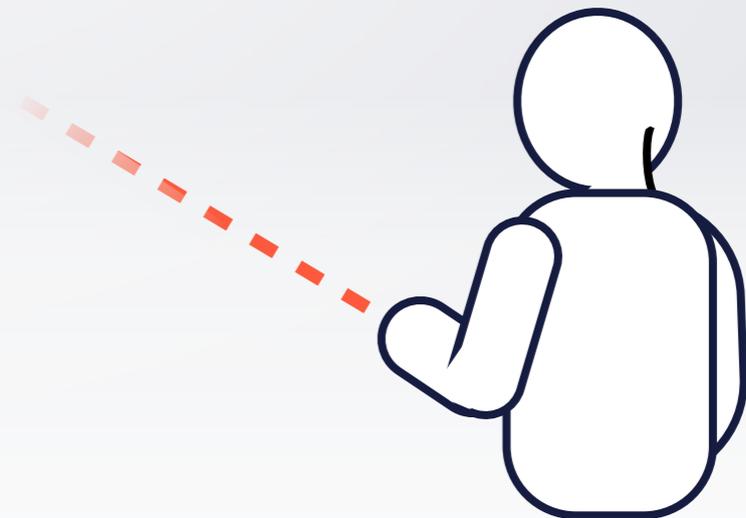
Summary of contributions

- Design space of inputs for navigation gestures

- Exploration of this design space

  - Designing the corresponding techniques
  - Evaluating these techniques

- Design guidelines about the design space

- Set of useful techniques

14

Design and testing phase

- Many possibilities

- Weeks of prototyping and pilot testing

- Examples of discarded techniques:

  - Two-handed pinch
  - Rate-based panning and zooming

15

Design Choice: Panning

- Dragging the visualization
  - Similar to Google Maps

- Ray-casting
  - Any visible area of the display can be reached
  - Absolute: no clutching
  - Enough precision

16

Design Space

- ## Hands use

  Uni-manual vs Bimanual

- ## Gesture type

  Linear vs Circular

- ## Physical guidance

  Path vs Surface vs Free hands

17

Design Space

- **Hands use**

  Uni-manual vs Bimanual
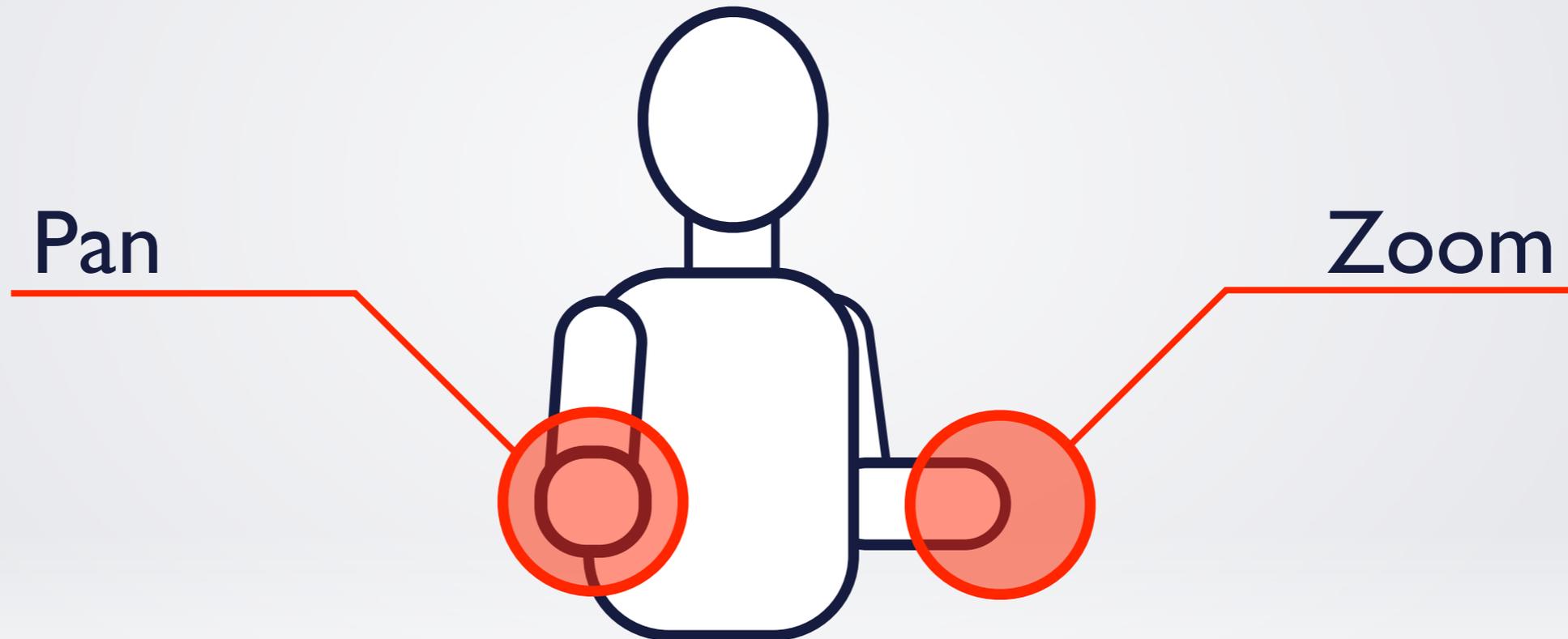
- **Gesture type**

  Linear vs Circular

- **Physical guidance**

  Path vs Surface vs Free hands

18

Design Space: Hands

- Panning with the dominant hand

- Zooming with the non-dominant hand

Pan   Zoom
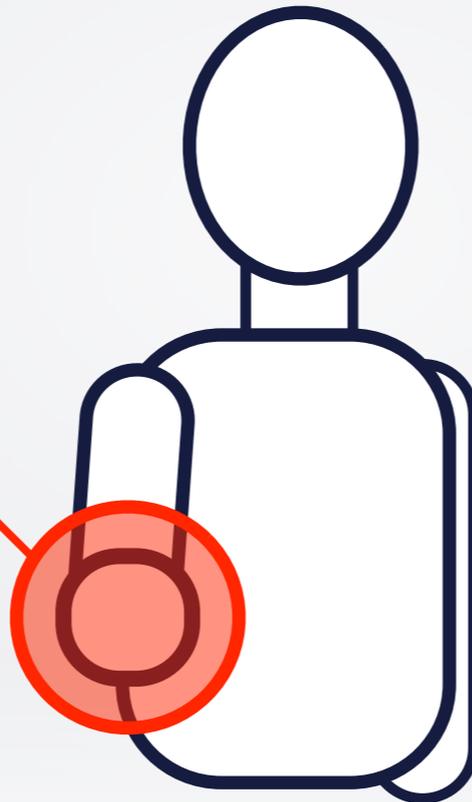
Kinematic Chain theory (Guiard 87)

Integrality and Separability of Input Devices (Jacob 94)

Design Space: Hands

- Both actions with the same hand

Pan and zoom

Design Space

- Hands use
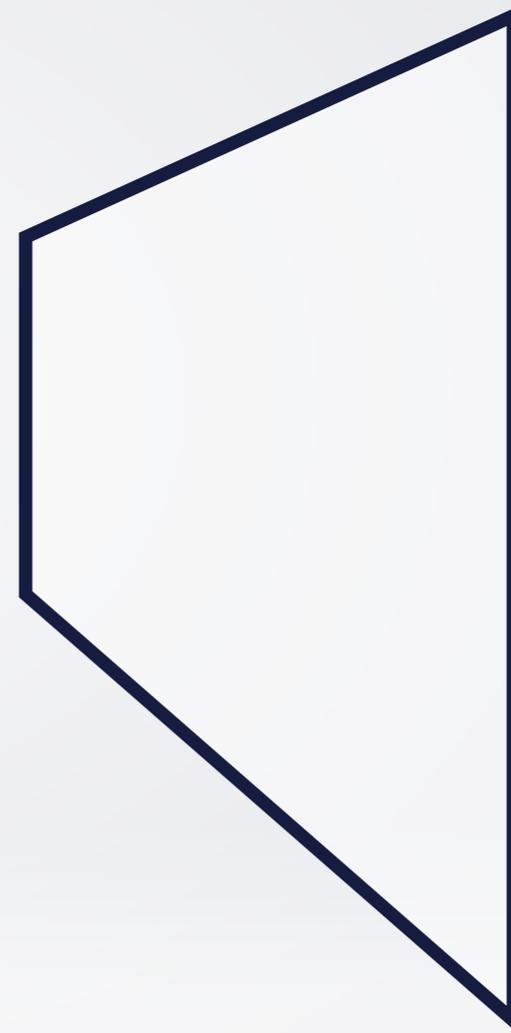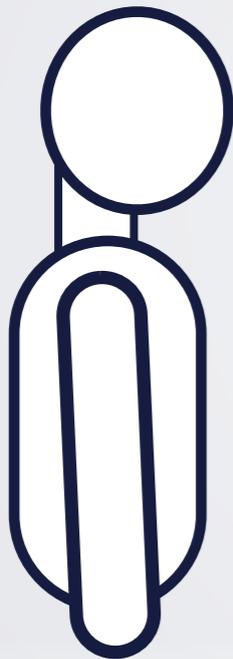
    Uni-manual vs Bimanual

- **Gesture type**

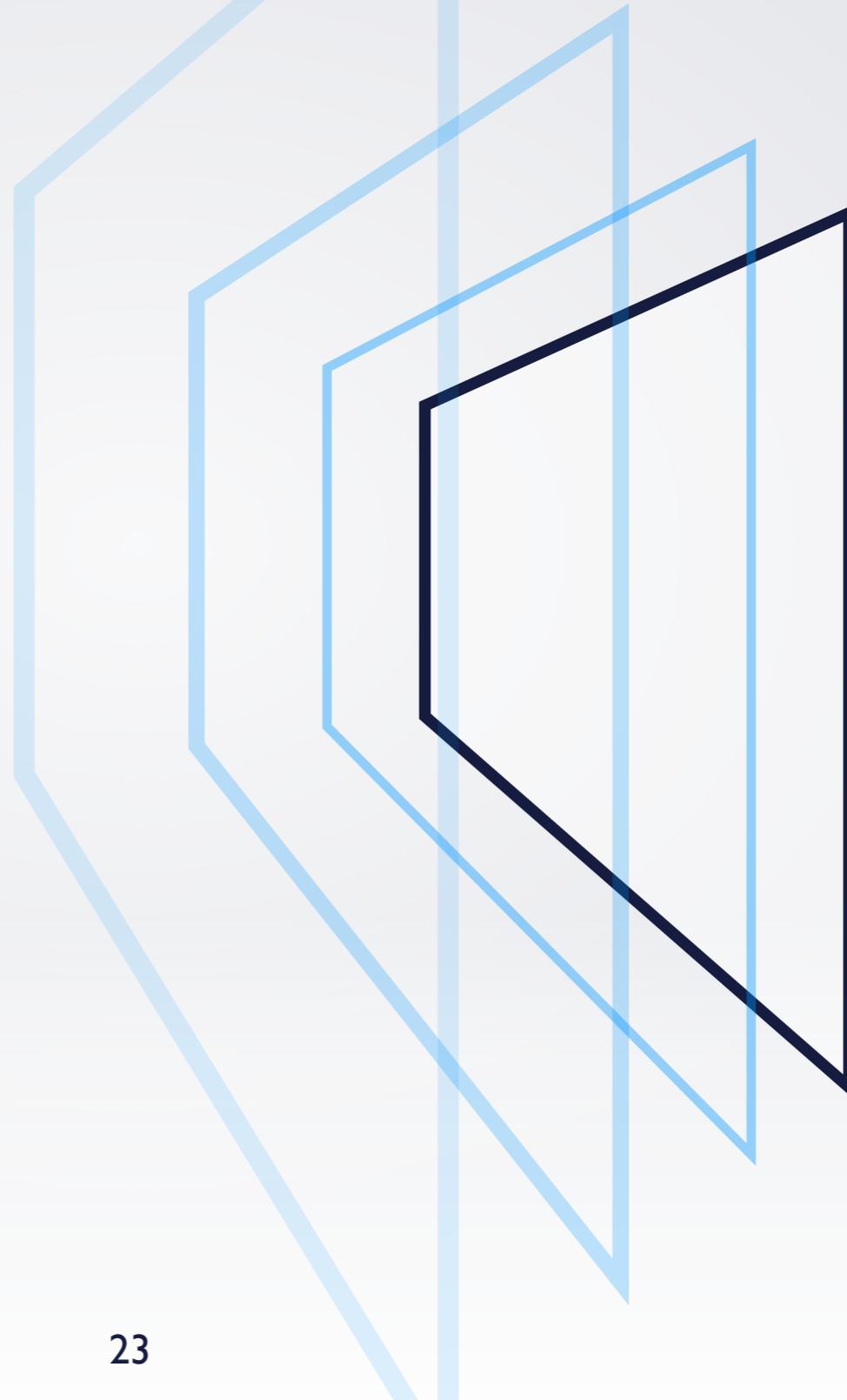   **Linear vs Circular**

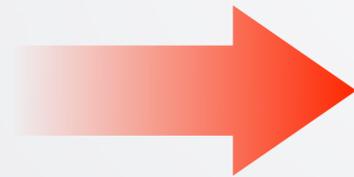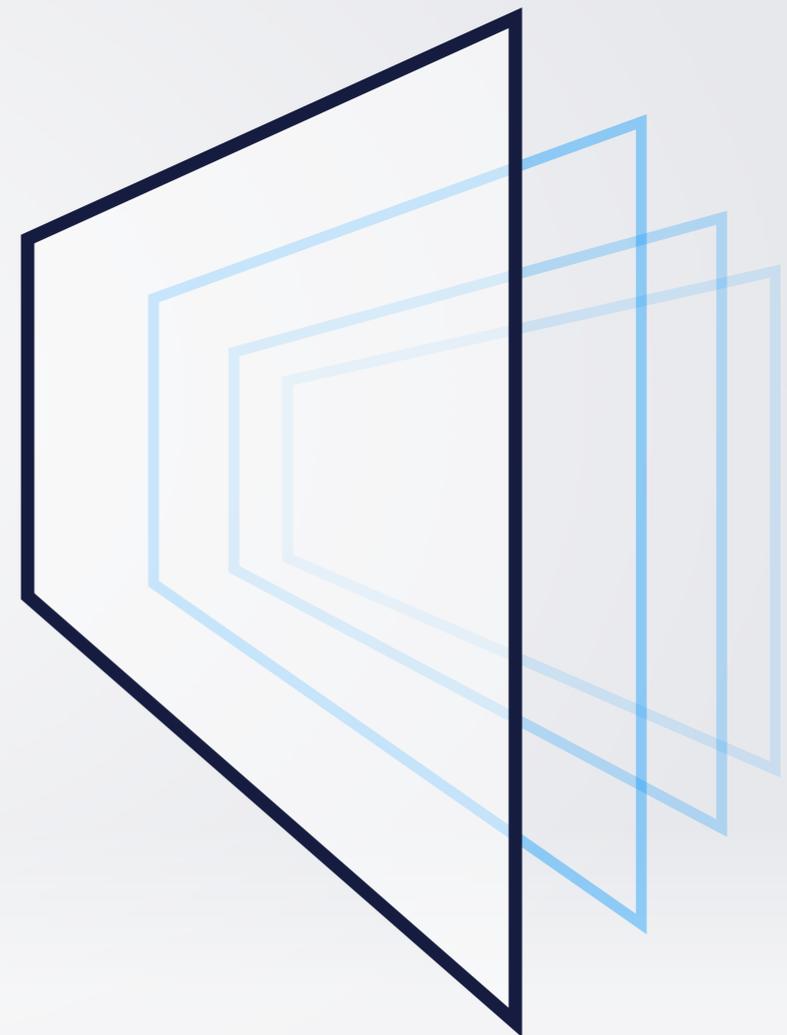- Physical guidance
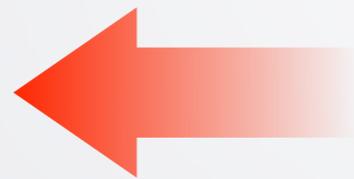
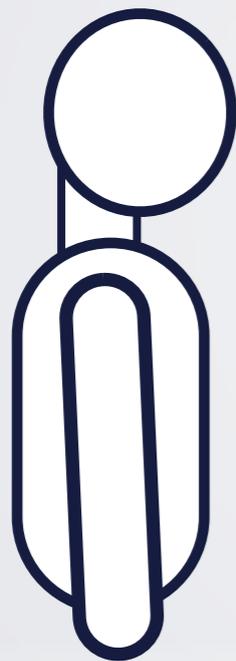   Path vs Surface vs Free hands

Design Space: Gesture Type

- Linear mapping

Design Space: Gesture Type
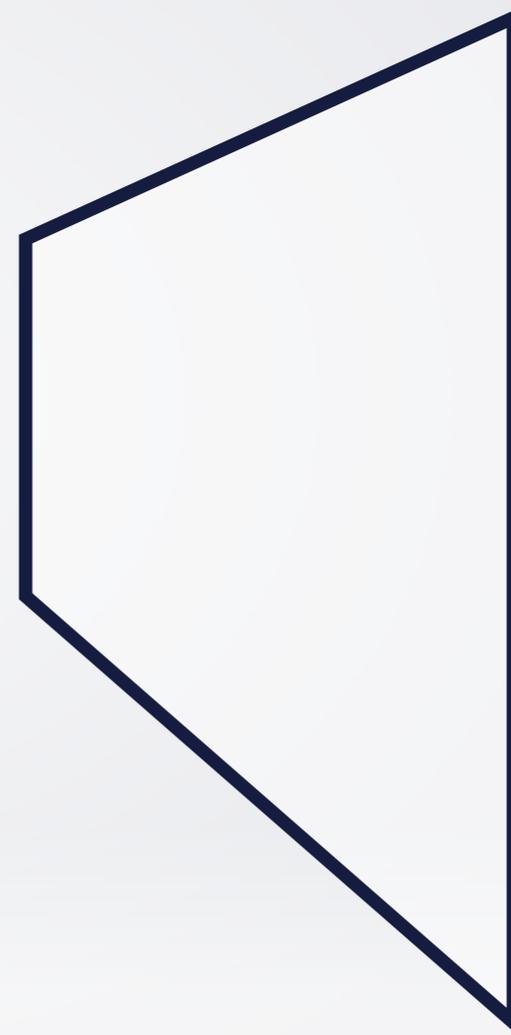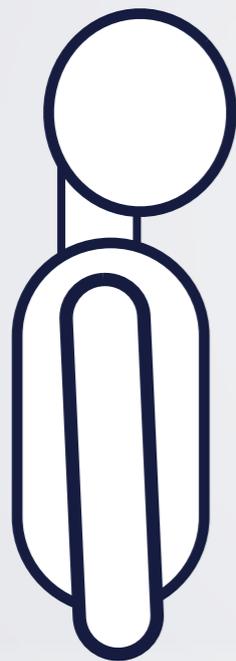
- Linear mapping

Design Space: Gesture Type

- Linear mapping

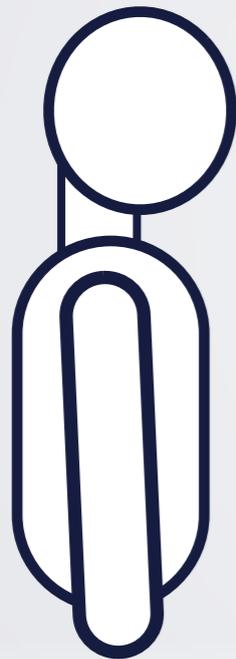# Design Space: Gesture Type

- Circular mapping
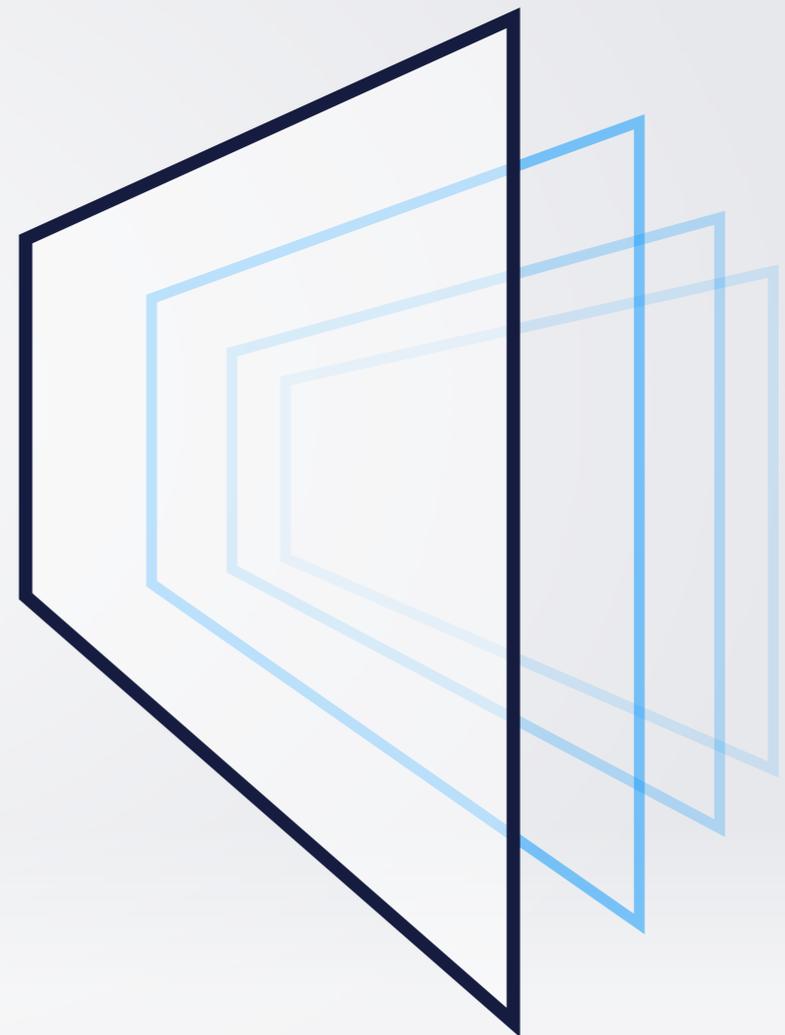

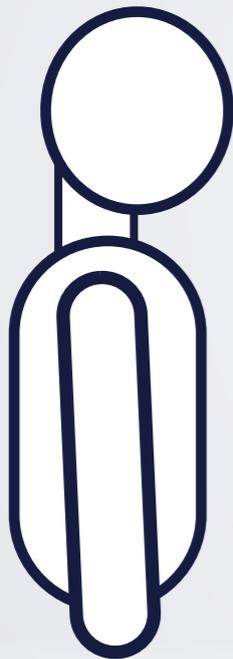CycloStar (Malacria et al., CHI 10)

Design Space: Gesture Type

- Circular mapping

Design Space: Gesture Type

- Circular mapping

Design Space

- Hands use

    Uni-manual vs Bimanual

- Gesture type

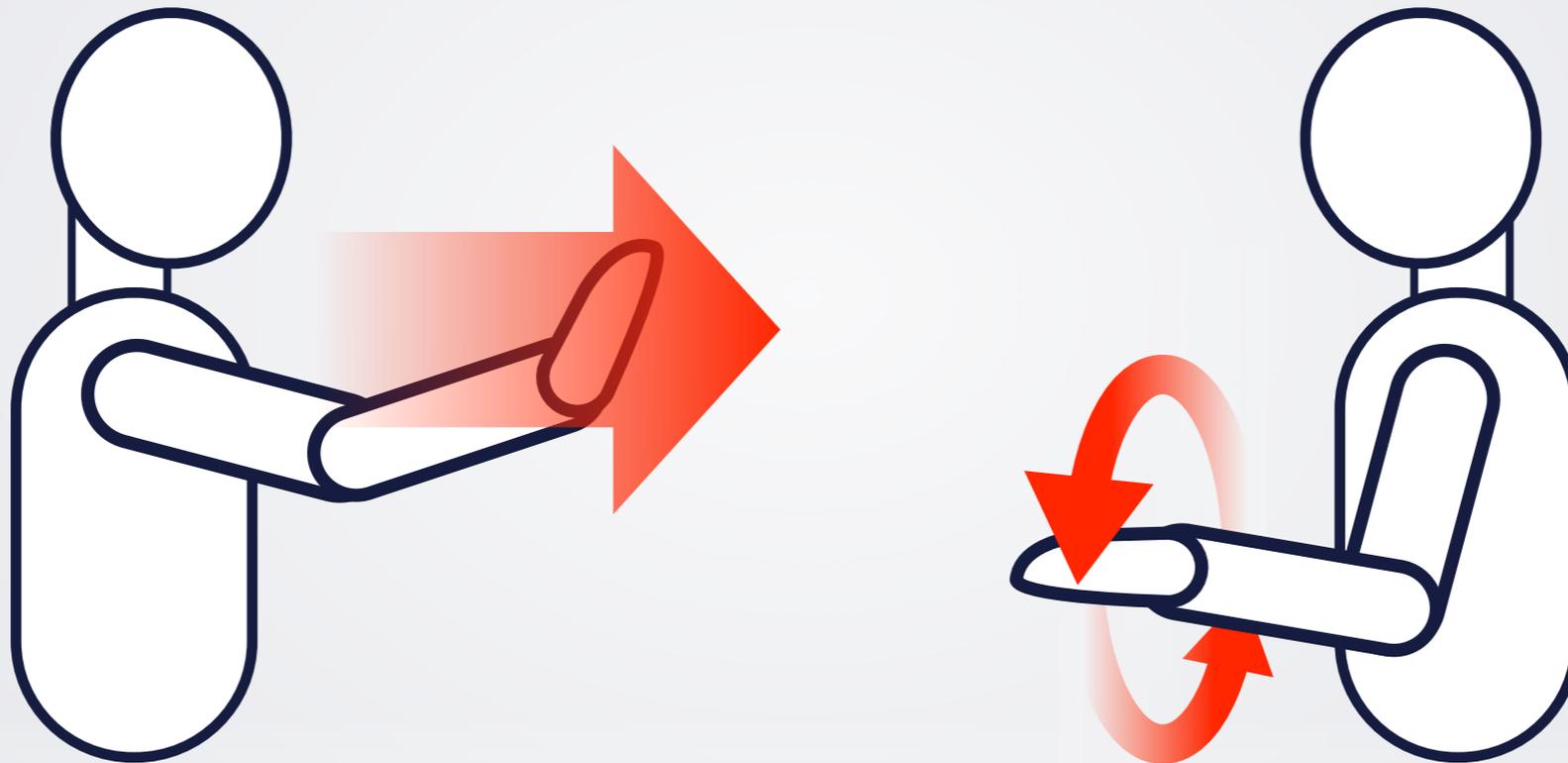   Linear vs Circular

- **Physical guidance**

    Path vs Surface vs Free hands

28

Design Space: Physical Guidance
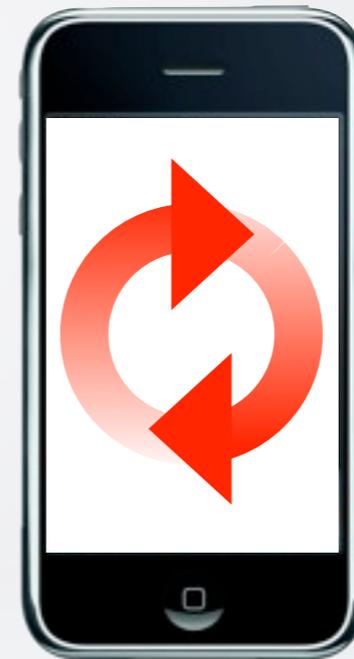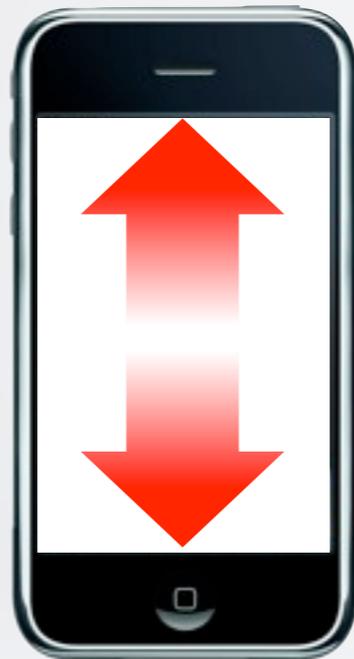
- Free hands (no guidance):

Design Space: Physical Guidance

- Surface (2D):

Design Space: Physical Guidance

- Path (1D):
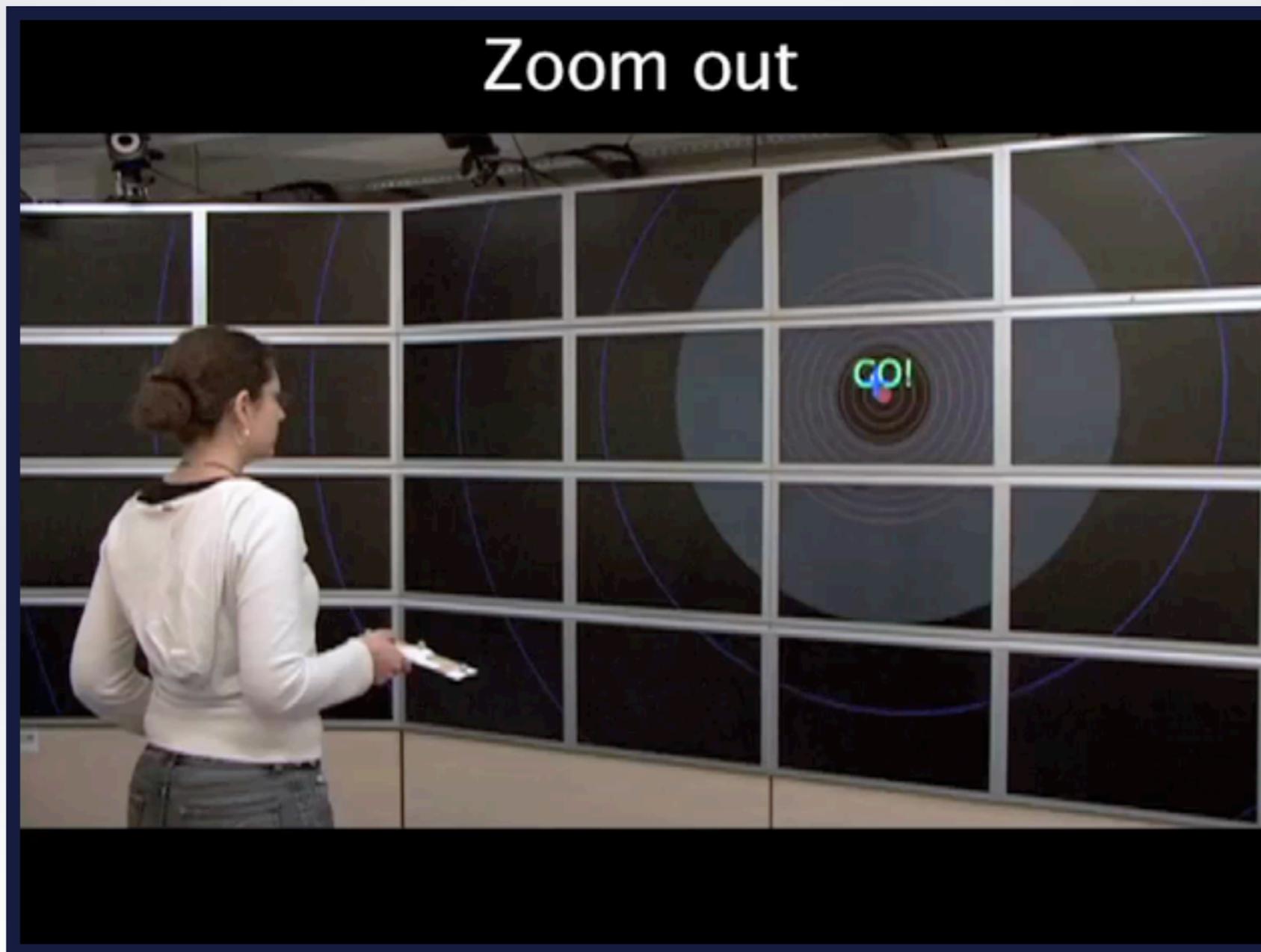
Design Space

Linear or circular zoom control (2)

x Path-restricted, surface or no guidance (3)

x One or two hands (2)

= 12 possible combinations

Experiment: Task

- Reaching a certain position and zoom level

Results

Sunday, May 15, 2011
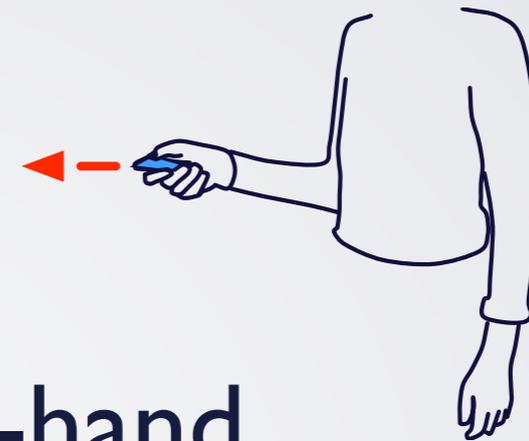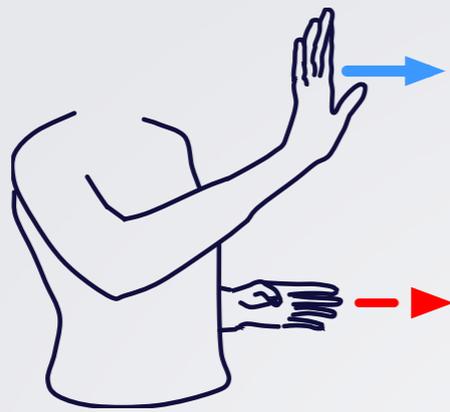
Results: Hands

- Two-hands faster than One-hand

    - Pointing jitter decreases zooming accuracy
    - User preference
    - Less tiring

Results: Gesture Type
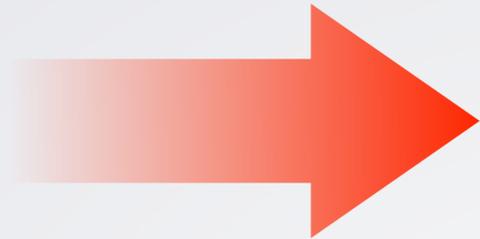
- Linear performs better than Circular

  - Even with clutching

  - Speed, precision and user preference

  - Circular too difficult without guidance

Sunday, May 15, 2011
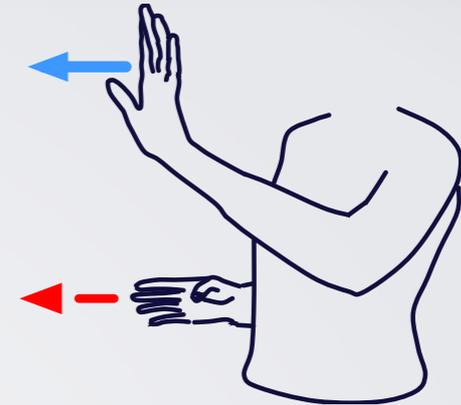
Results: Guidance

- Guidance makes users faster

  - Path >> Surface >> Free hands

- Surface is less precise

- Free hands is more tiring

  - But users found it cooler

37

Results: Techniques

- Three groups of techniques based on average speed

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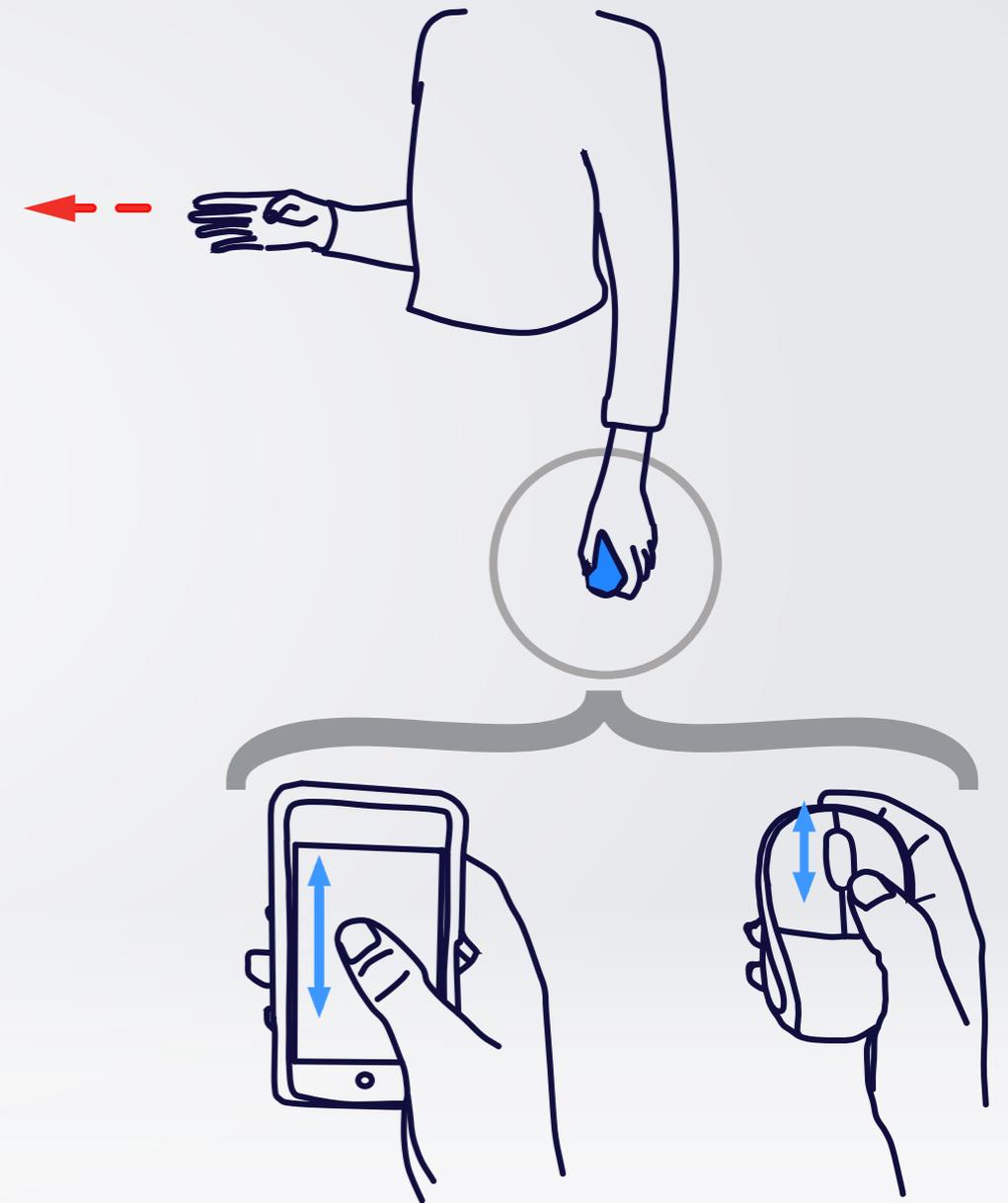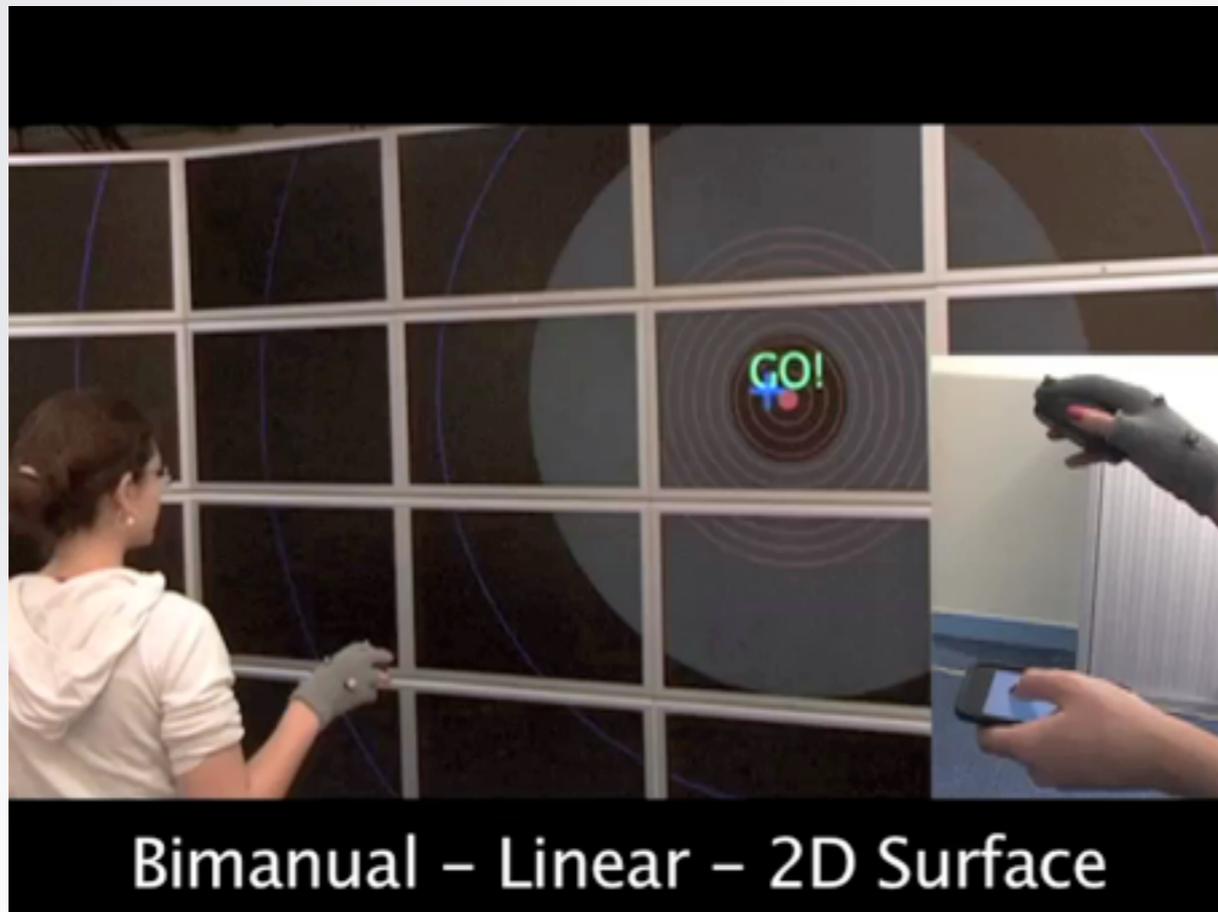
Results: Techniques

- 2 winners (average 8.2s):

    - Two-handed, Linear, Surface
    - Two-Handed, Linear, Path

Bimanual – Linear – 2D Surface

Results: Techniques

- 2 winners (average 8.2s):

  - Two-handed, Linear, Surface
  - Two-Handed, Linear, Path

Bimanual – Linear – 1D Path

Results: Techniques

- 2 winners (average 8.2s):

  - Two-handed, Linear, Surface
  - Two-Handed, Linear, Path

- 4 alternatives (average 9.3s):

  - One-handed, Linear, Path
  - Two-handed, Circular, Path
  - Two-handed, Linear, Free hands
  - One-handed, Linear, Surface

41

Results: Techniques

- 2 winners (average 8.2s):
  - Two-handed, Linear, Surface
  - Two-Handed, Linear, Path

- 4 alternatives (average 9.3s):
  - One-handed, Linear, Path
  - Two-handed, Circular, Path
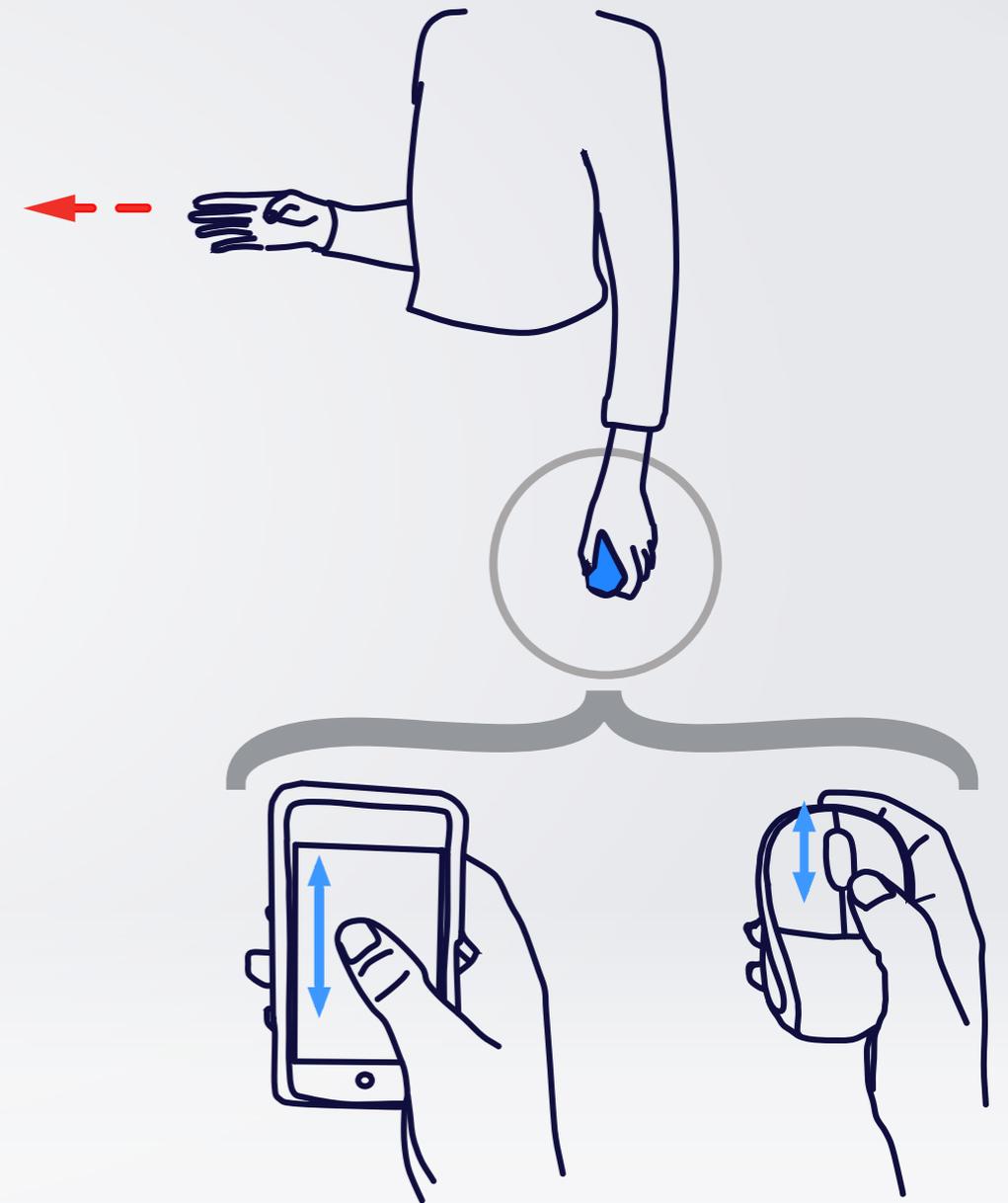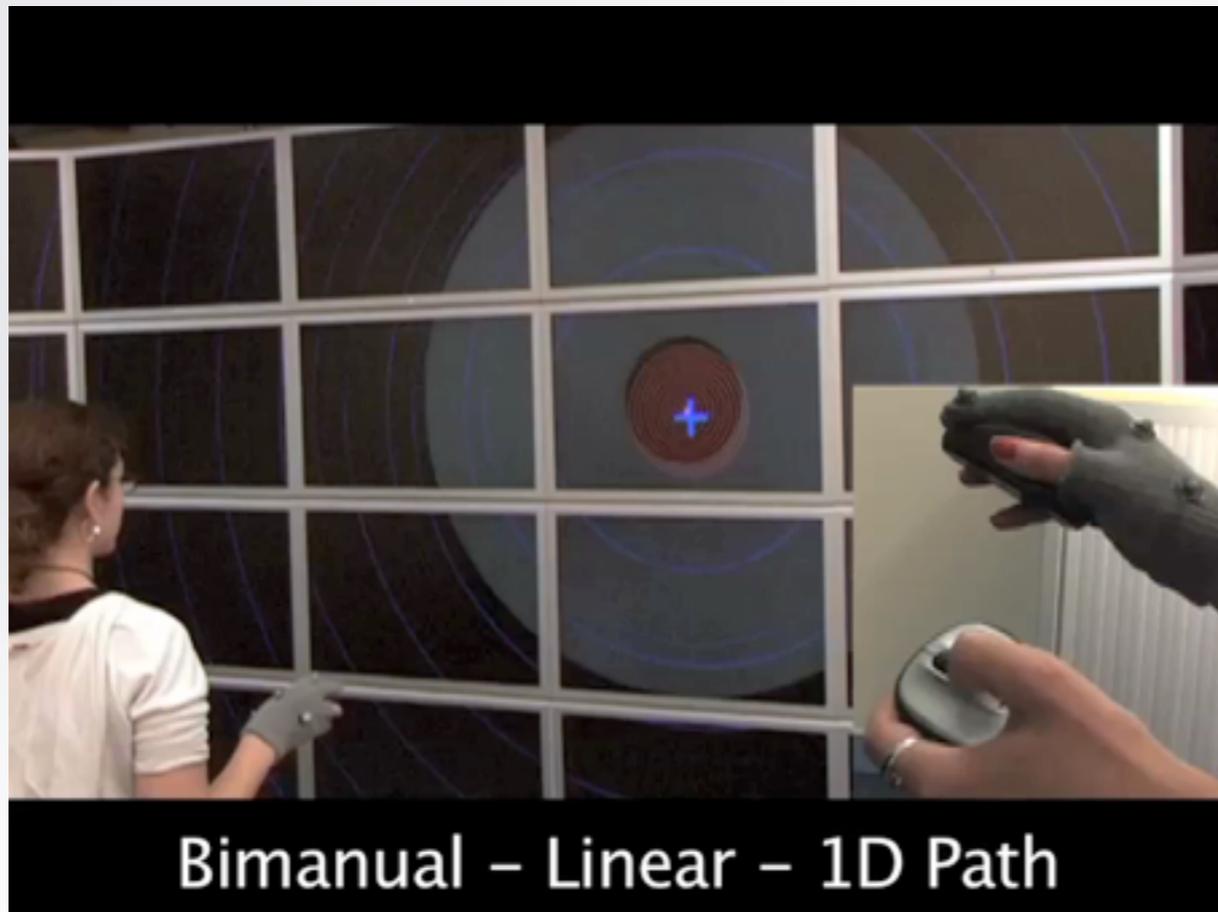 - Two-handed, Linear, Free hands
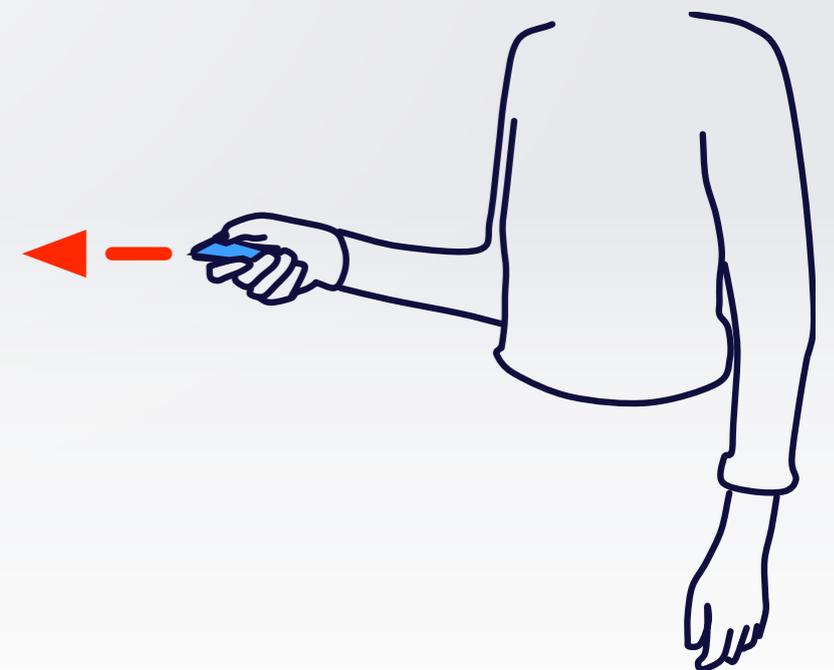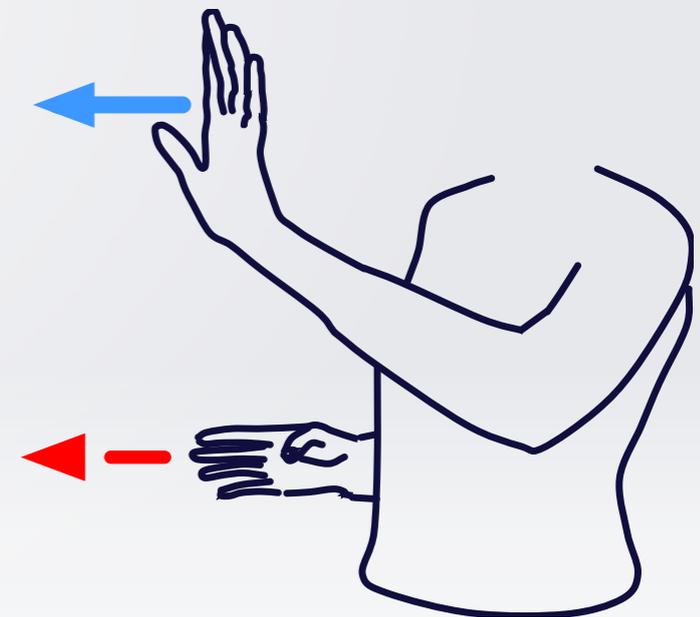 - One-handed, Linear, Surface

42

Results: Techniques

- 2 winners (average 8.2s):

  - Two-handed, Linear, Surface
  - Two-Handed, Linear, Path

- 4 alternatives (average 9.3s):

  - One-handed, Linear, Path
  - Two-handed, Circular, Path
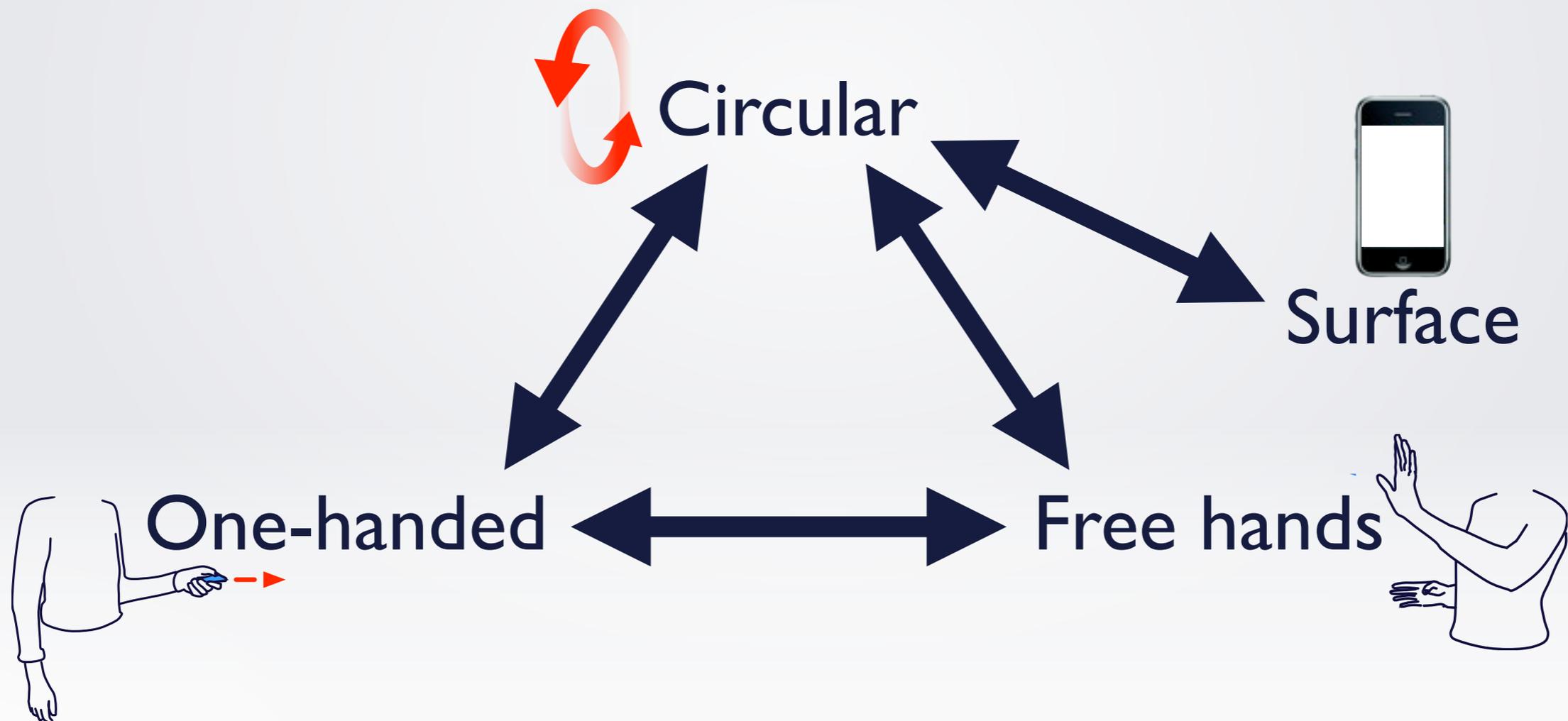 - Two-handed, Linear, Free hands
  - One-handed, Linear, Surface

43

- Bad combinations (average 11 to 15s):

- Bad combinations (average 11 to 15s):

- Bad combinations (average 11 to 15s):

Results: Techniques

- Bad combinations (average 11 to 15s):
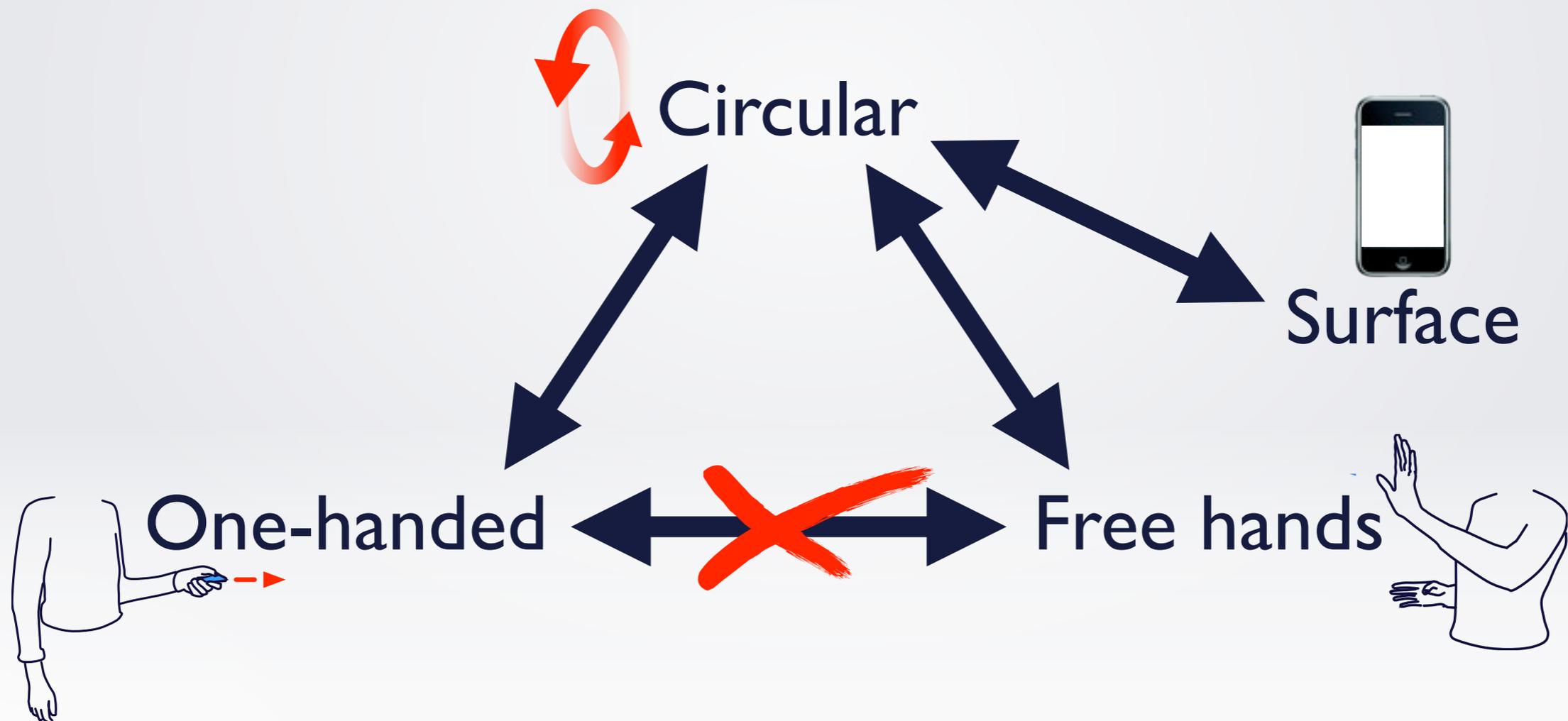
Summary

- Pan-and-zoom techniques on wall displays

  - Location-independent

  - Mid-air

Summary

- Pan-and-zoom techniques on wall displays

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- Design space of inputs

Summary

- Pan-and-zoom techniques on wall displays

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- Systematic evaluation of its combinations

Sunday, May 15, 2011

Summary

- Pan-and-zoom techniques on wall displays

  - Location-independent
  - Mid-air

- Design space of inputs

- Systematic evaluation of its combinations

- Useful results:

  - Design guidelines
  - Sets of efficient context-aware techniques

Summary

- Pan-and-zoom techniques on wall displays

    - Location-independent

    - Mid-air

- Design space of inputs

- Systematic evaluation of its combinations

- Useful results:

    - Design guidelines

    - Sets of efficient context-aware techniques

QUESTIONS?

Future Work

- Navigation in combination with other interaction techniques

Sunday, May 15, 2011

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- Caroline Appert & Stéphane Huot

- The anonymous reviewers

- The participants!