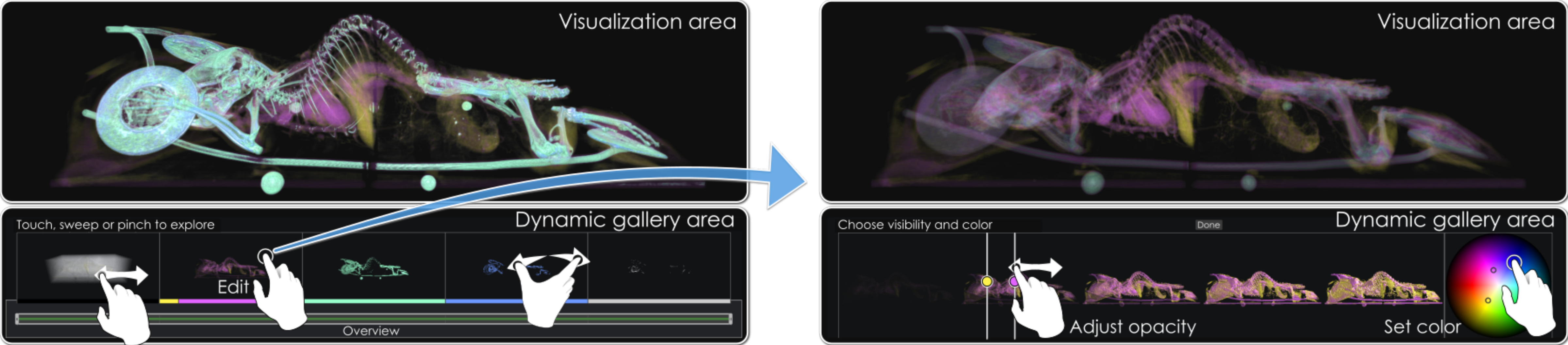# Interactive 3D Data Exploration using Hybrid Tactile/Tangible Interaction
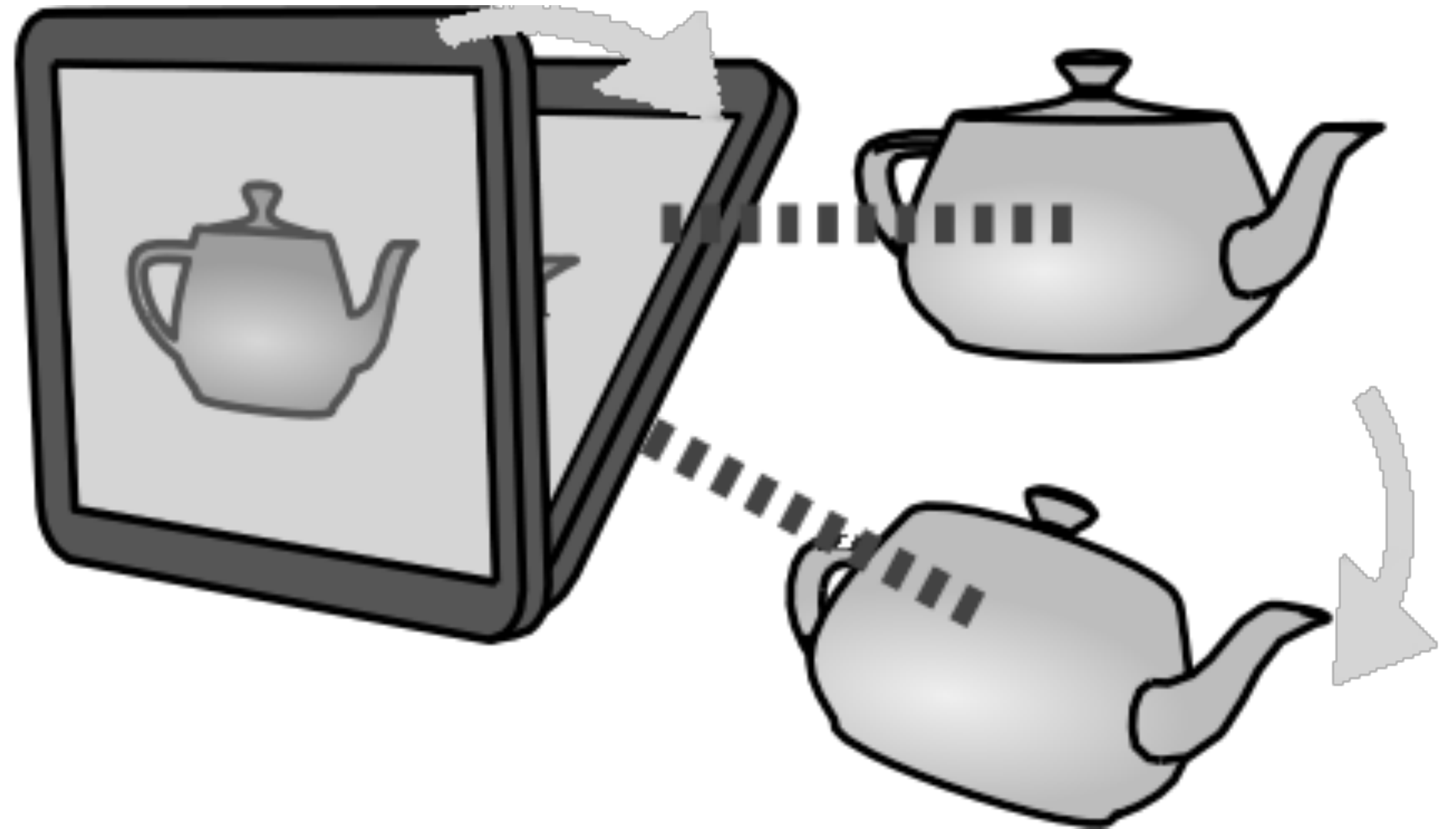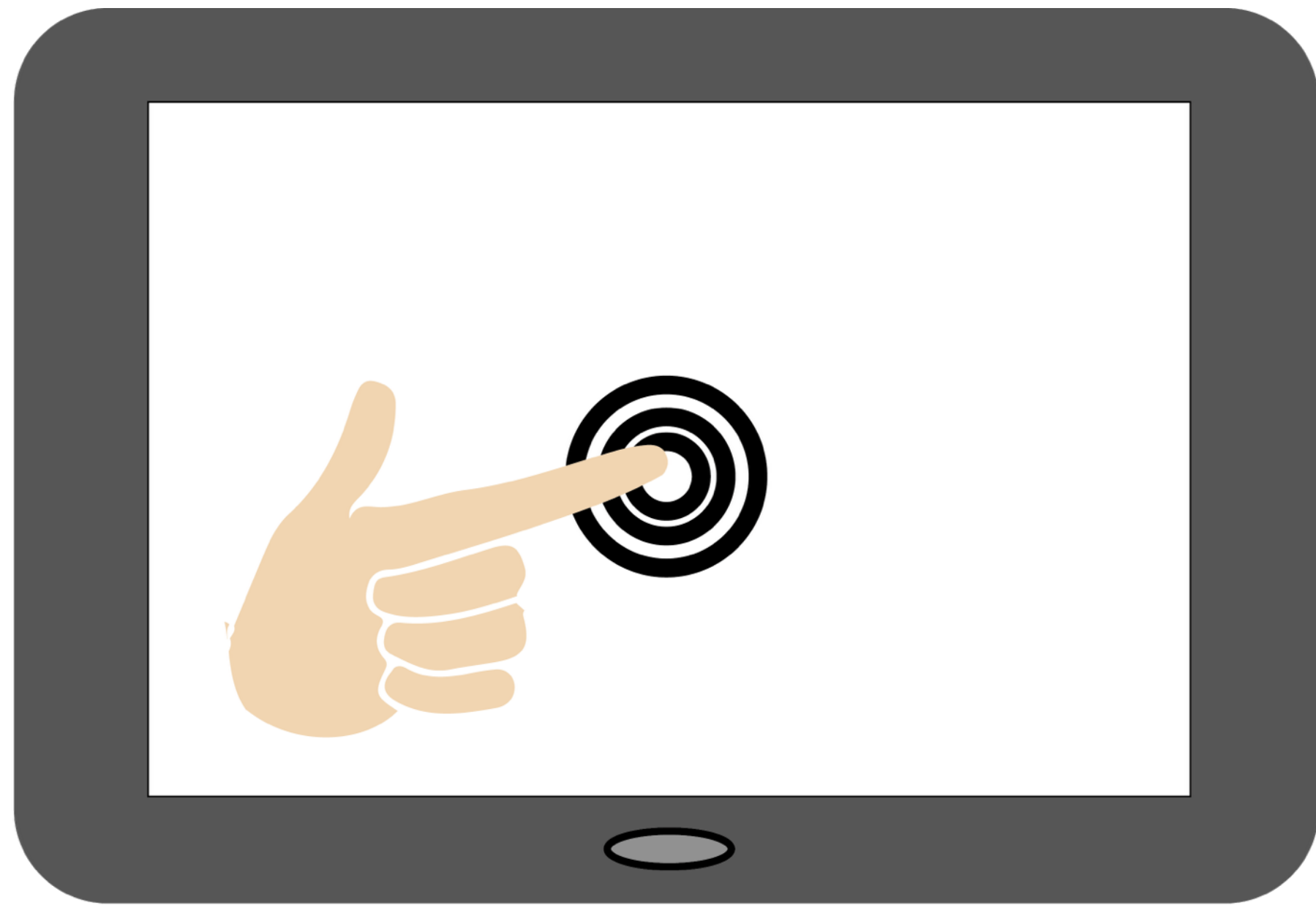
Lonni Besançon, Paul Issartel, Mehdi Ammi, Tobias Isenberg

Problem
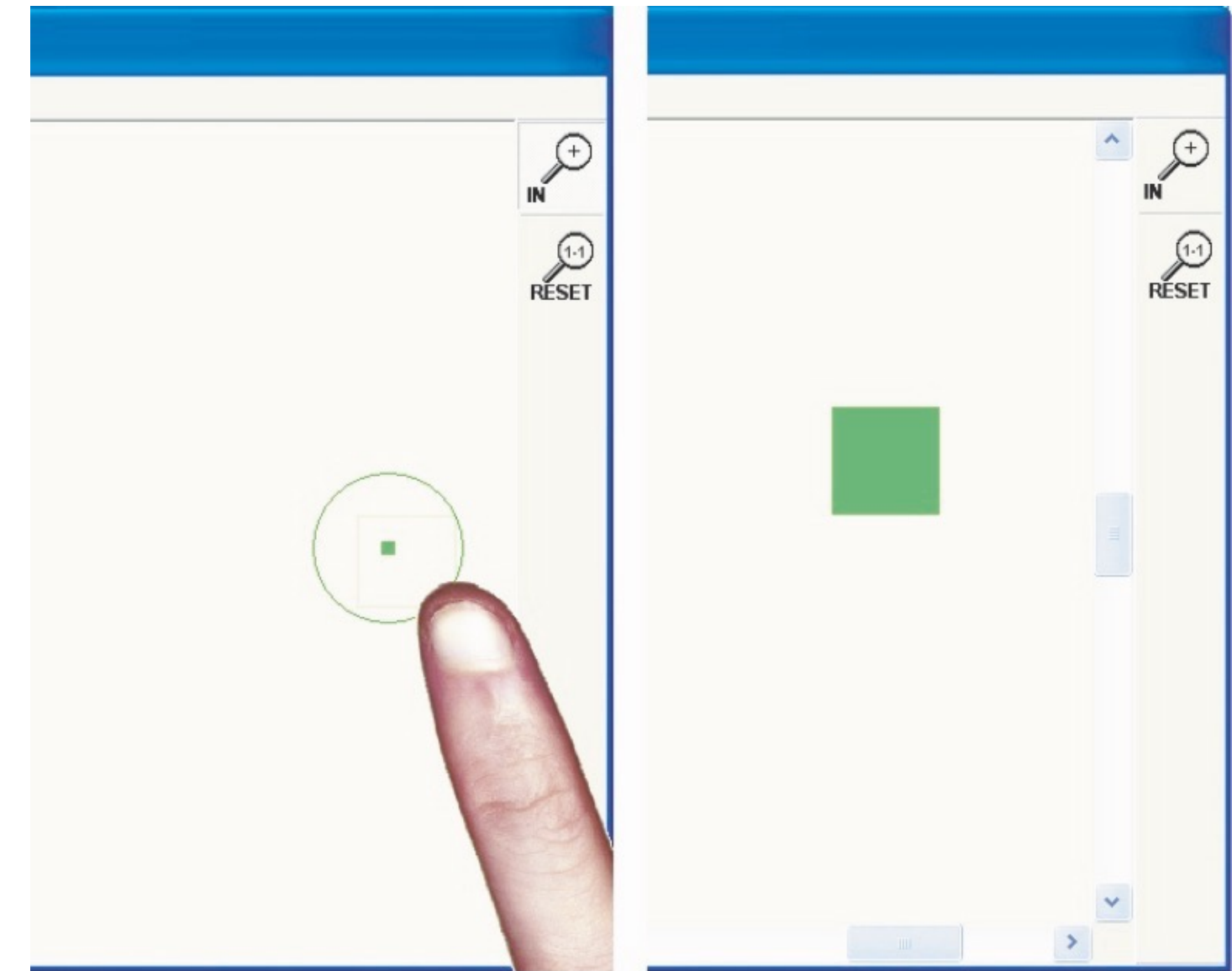

Jönsson et al. (2016)

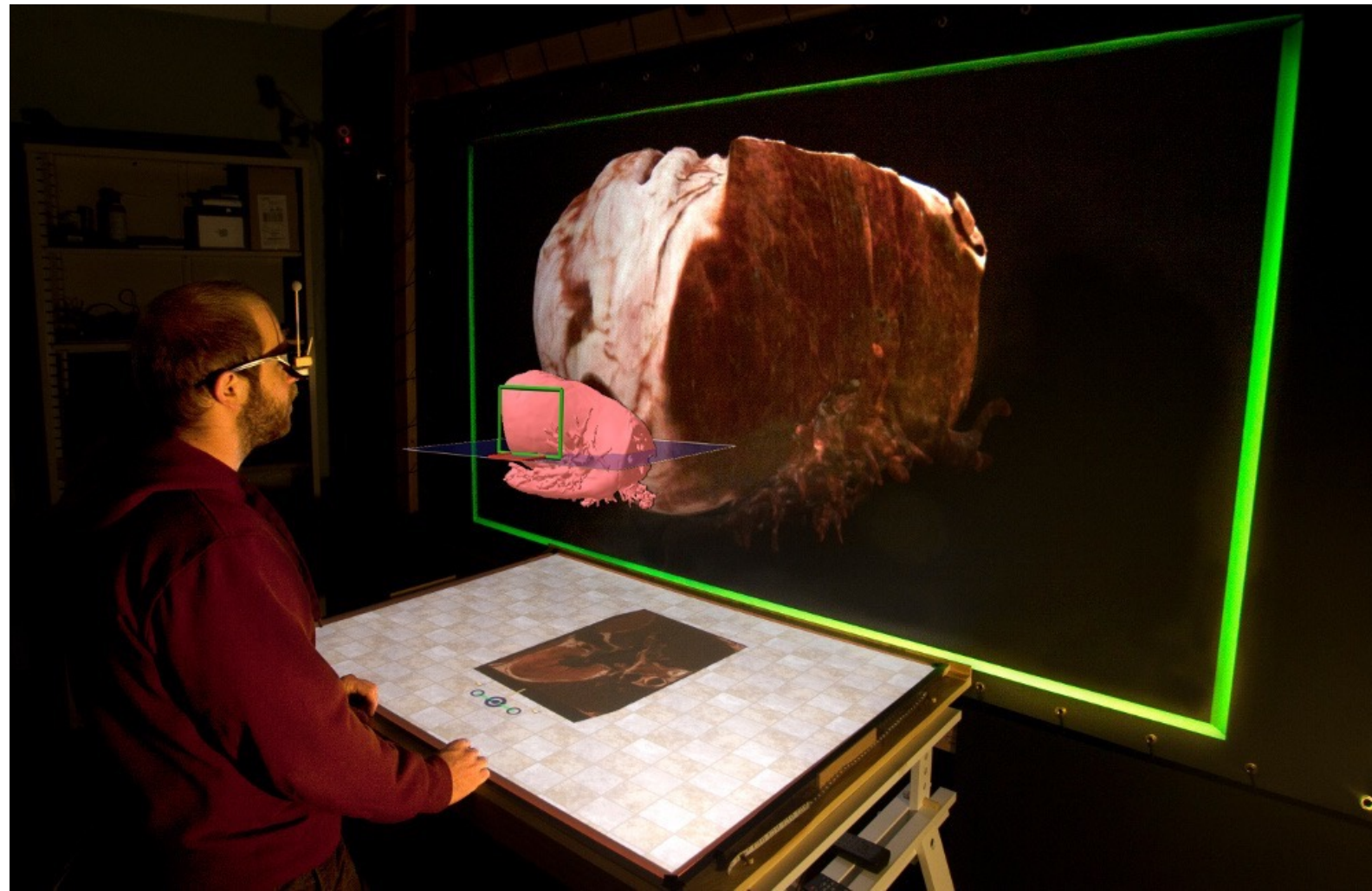# Problem

Tactile interaction

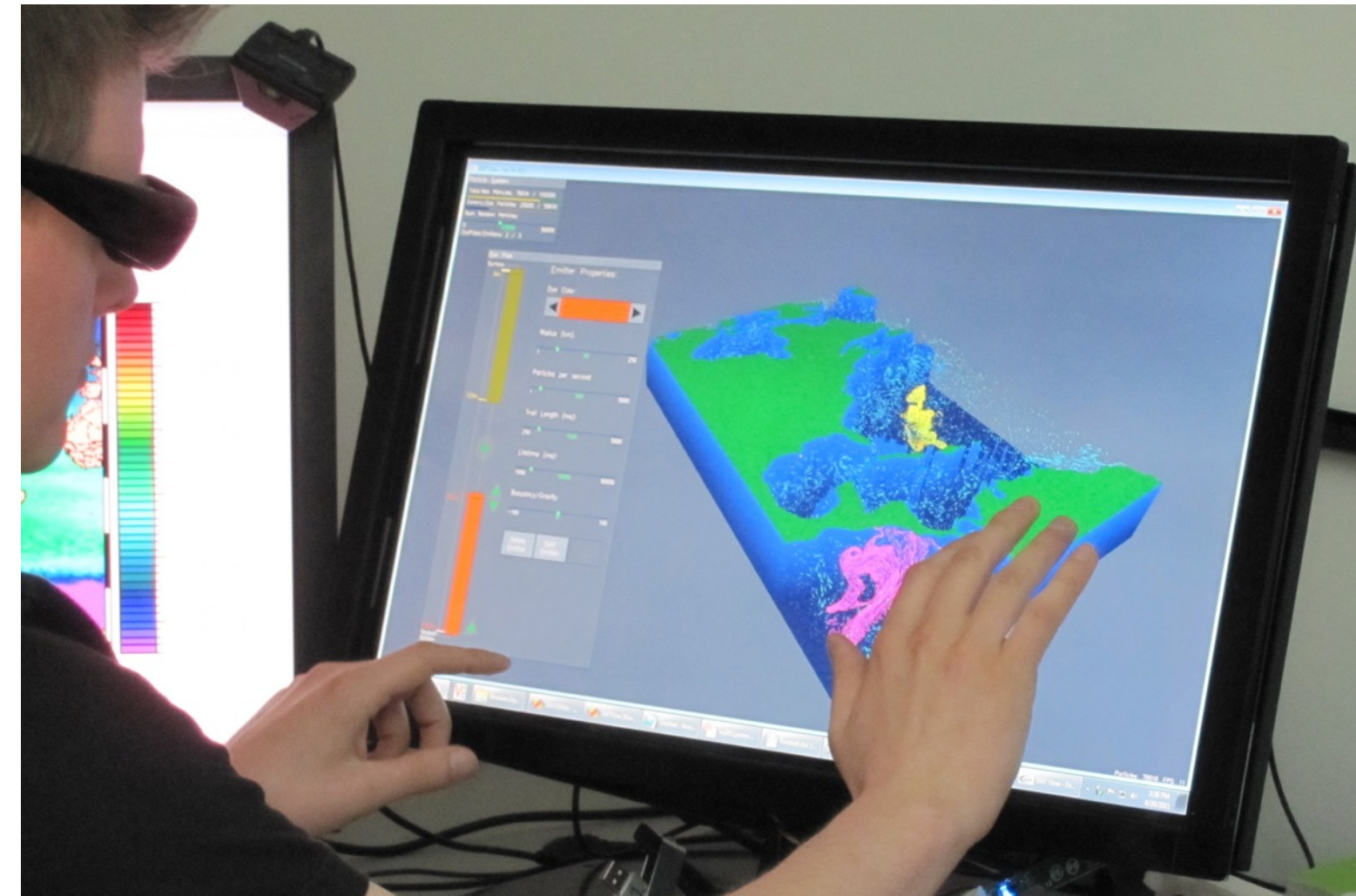

Yu et al. (2010)

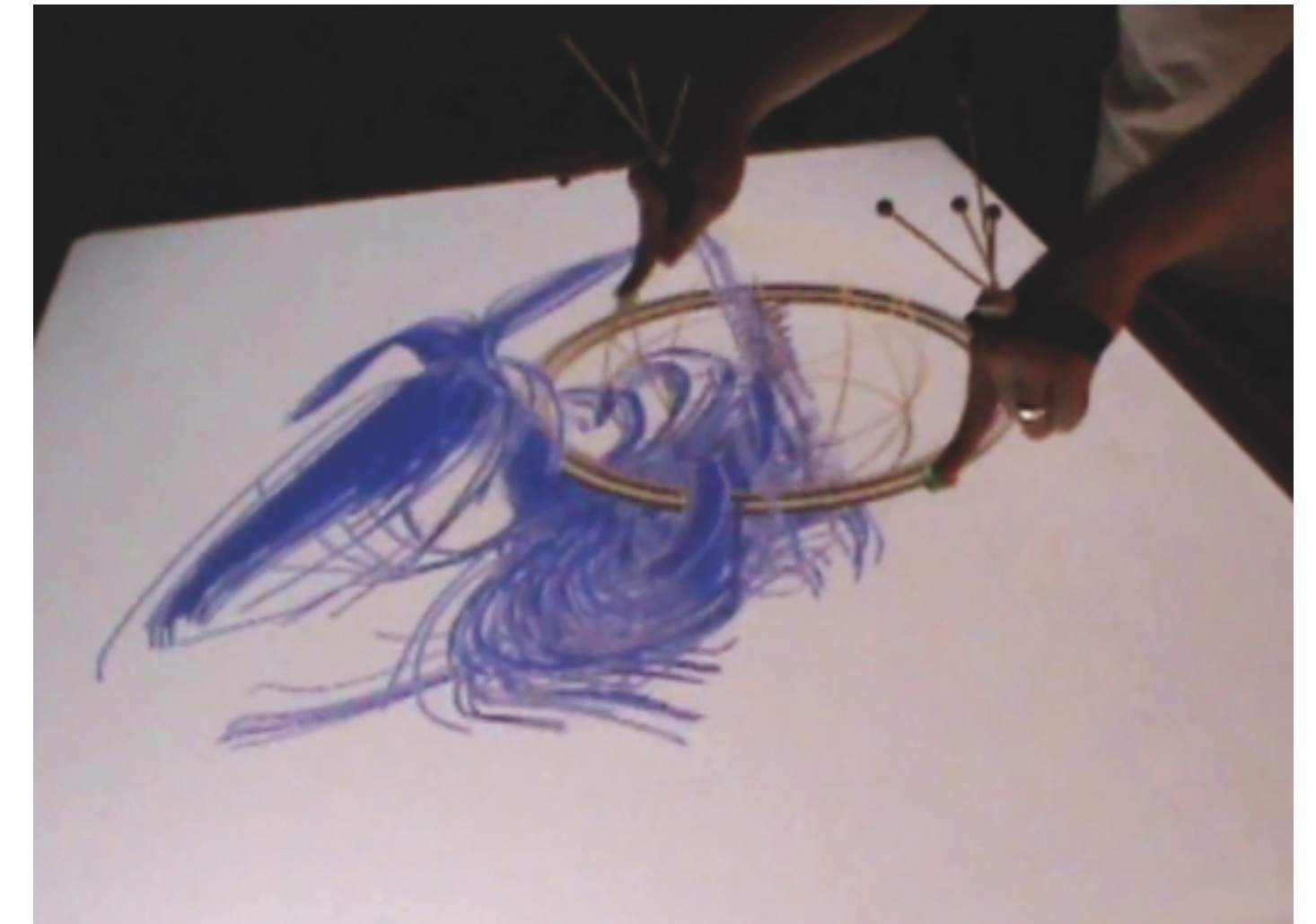Albinson & Zhai. (2003)

Tactile interaction
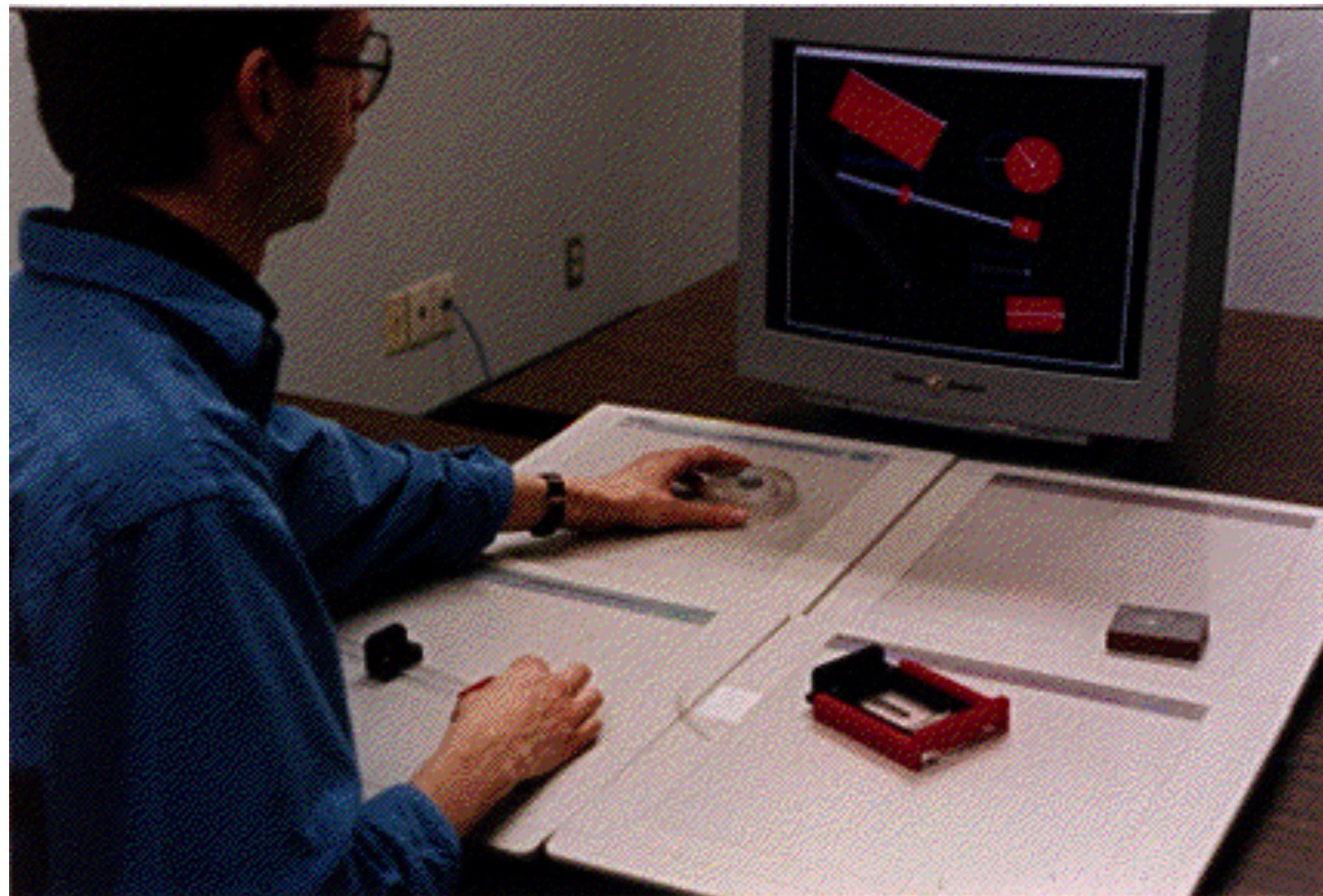

Coffey et al. (2012)

Butkiewicz & Ware (2012)

Jackson et al. (2012)

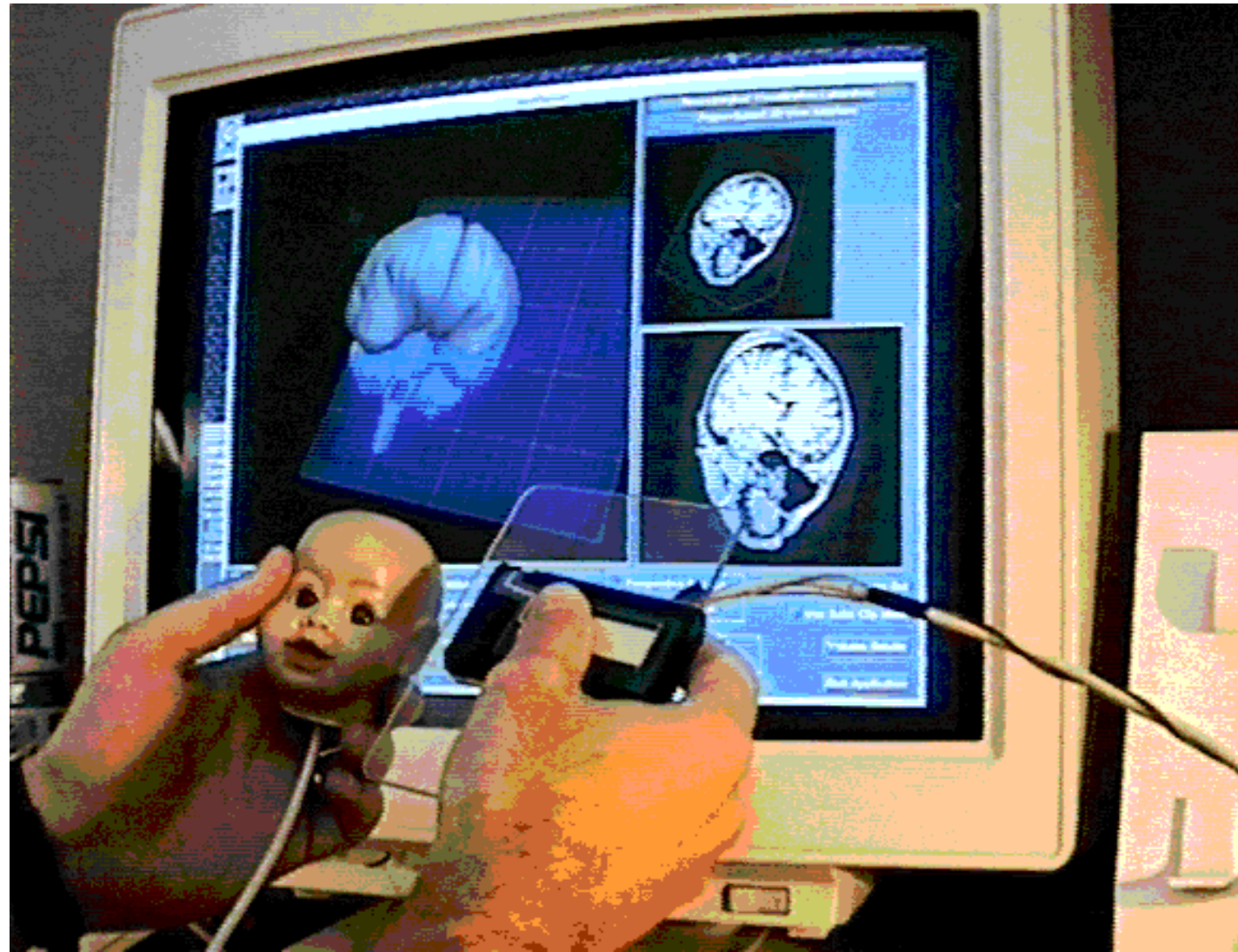# Tangible Interaction

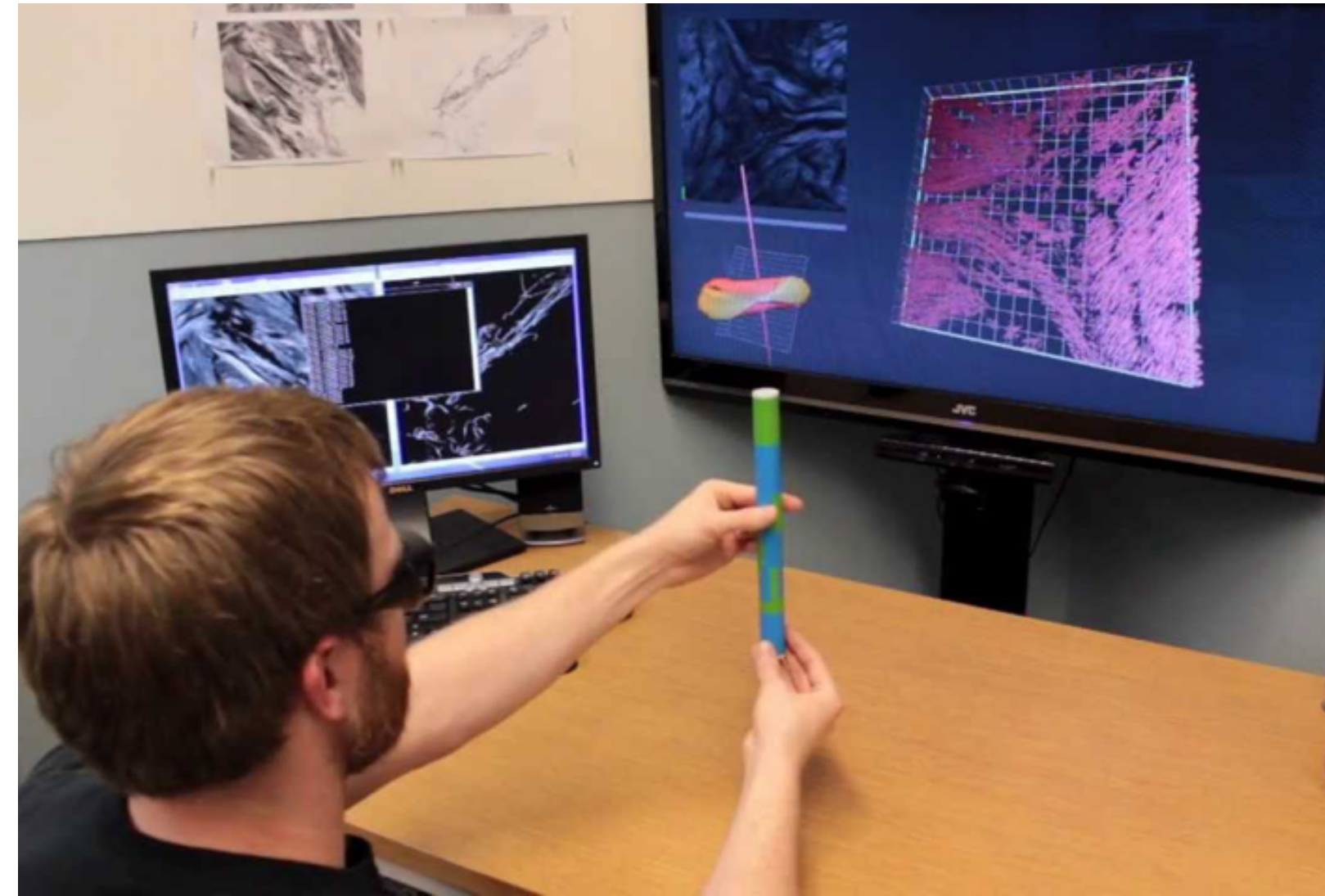Fitzmaurice & Buxton (1997)

Besançon et al. (2015)

Tangible Interaction
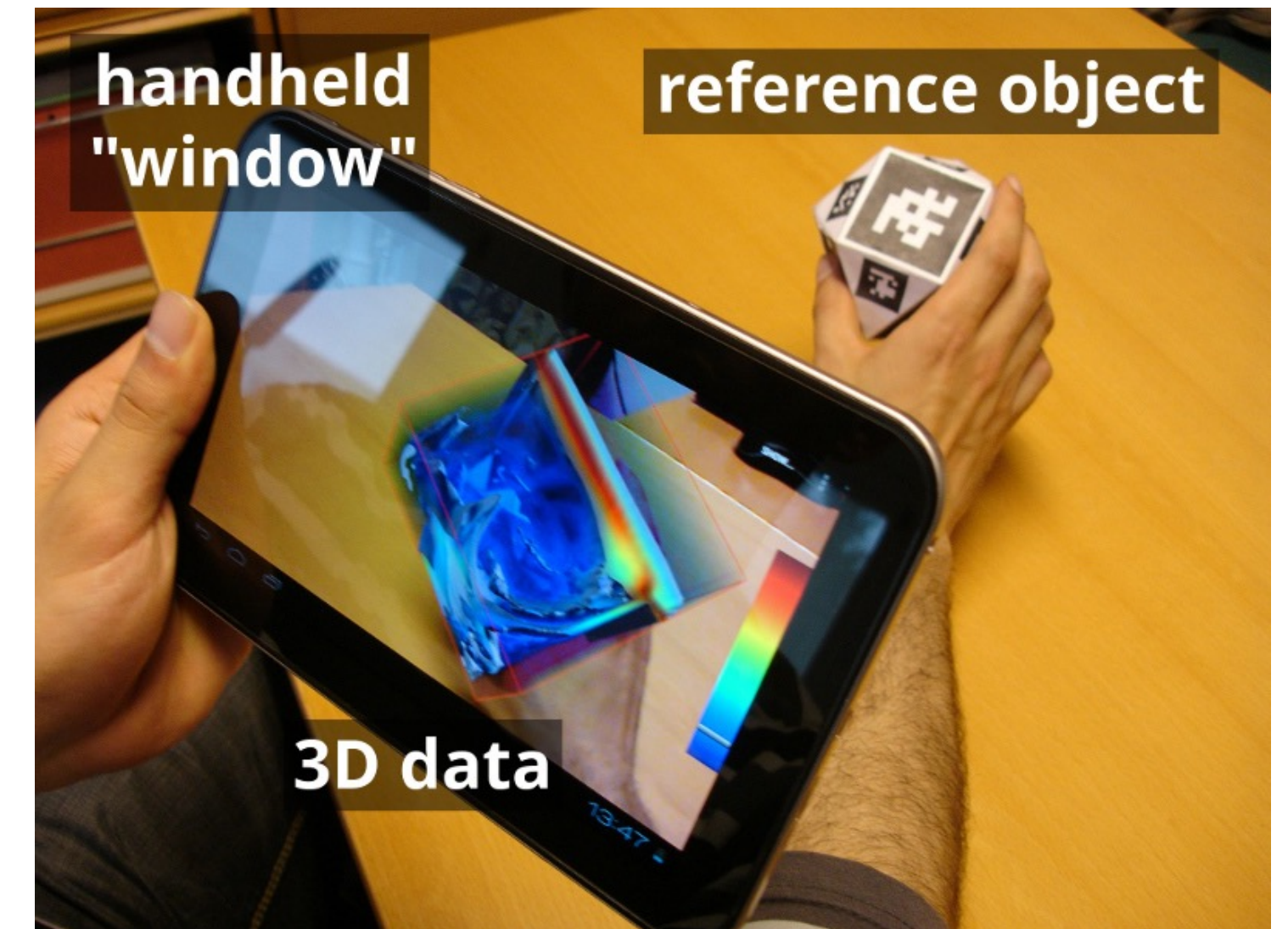

Hinckley et al. (1994)

Jackson et al. (2013)

handheld "window"

reference object

3D data

Issartel et al. (2014)

Problem

and tangi... ...be combined ...pport 3D ... ...ion?
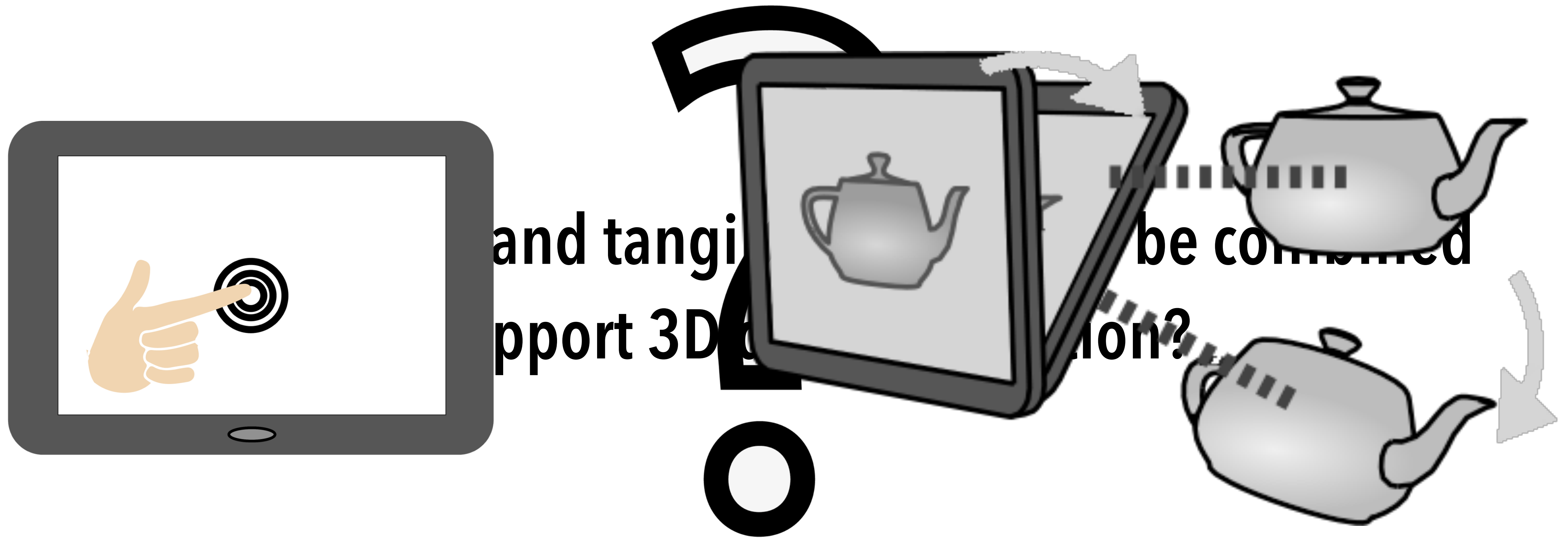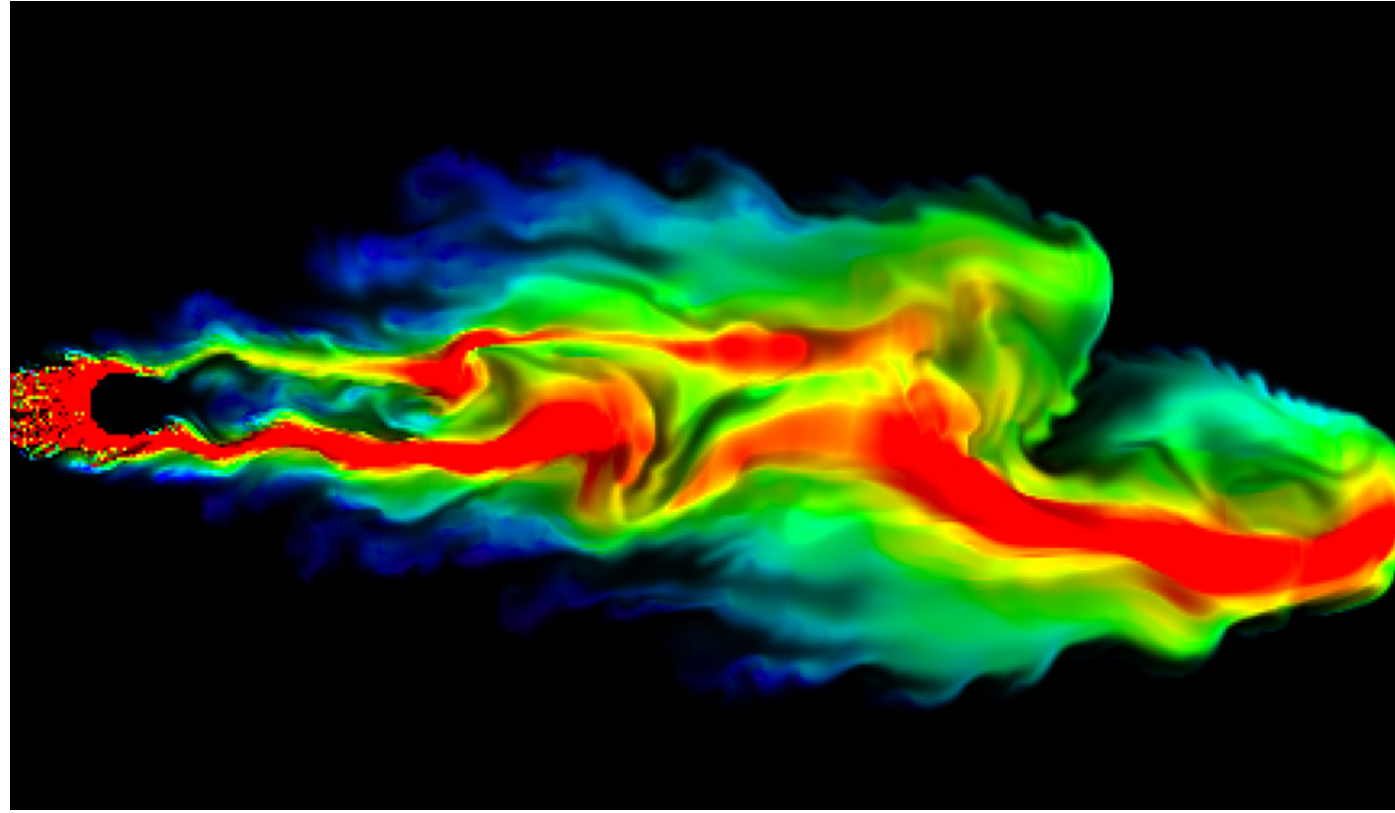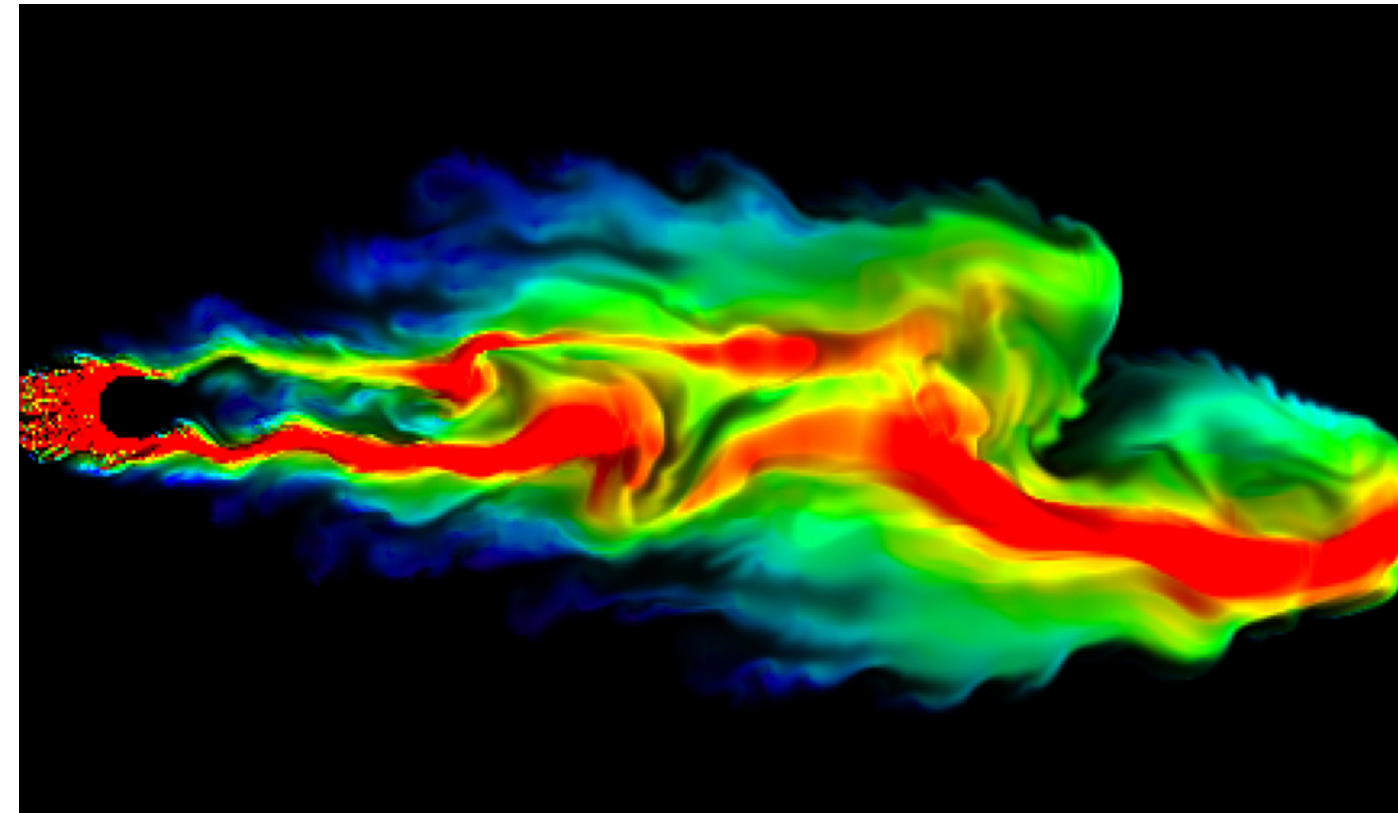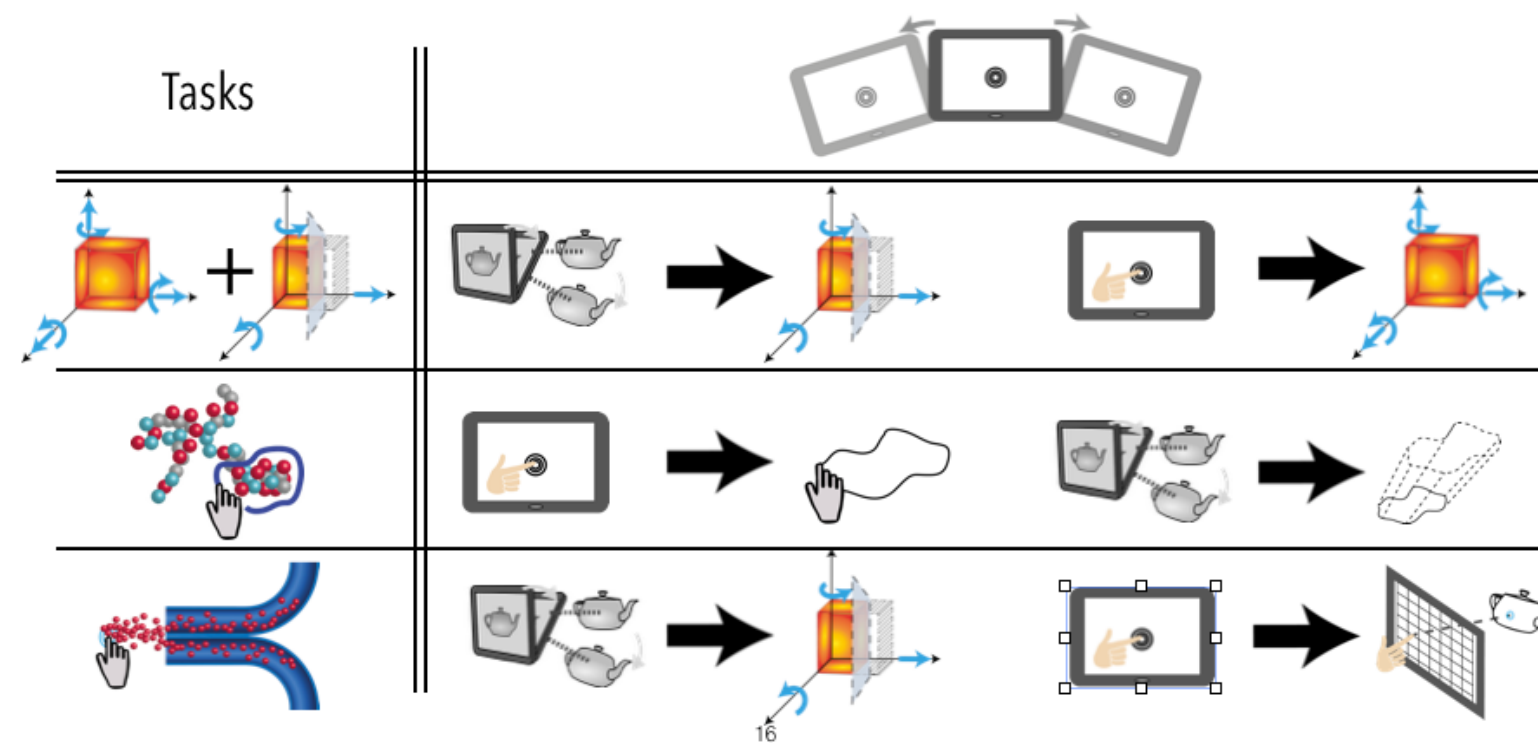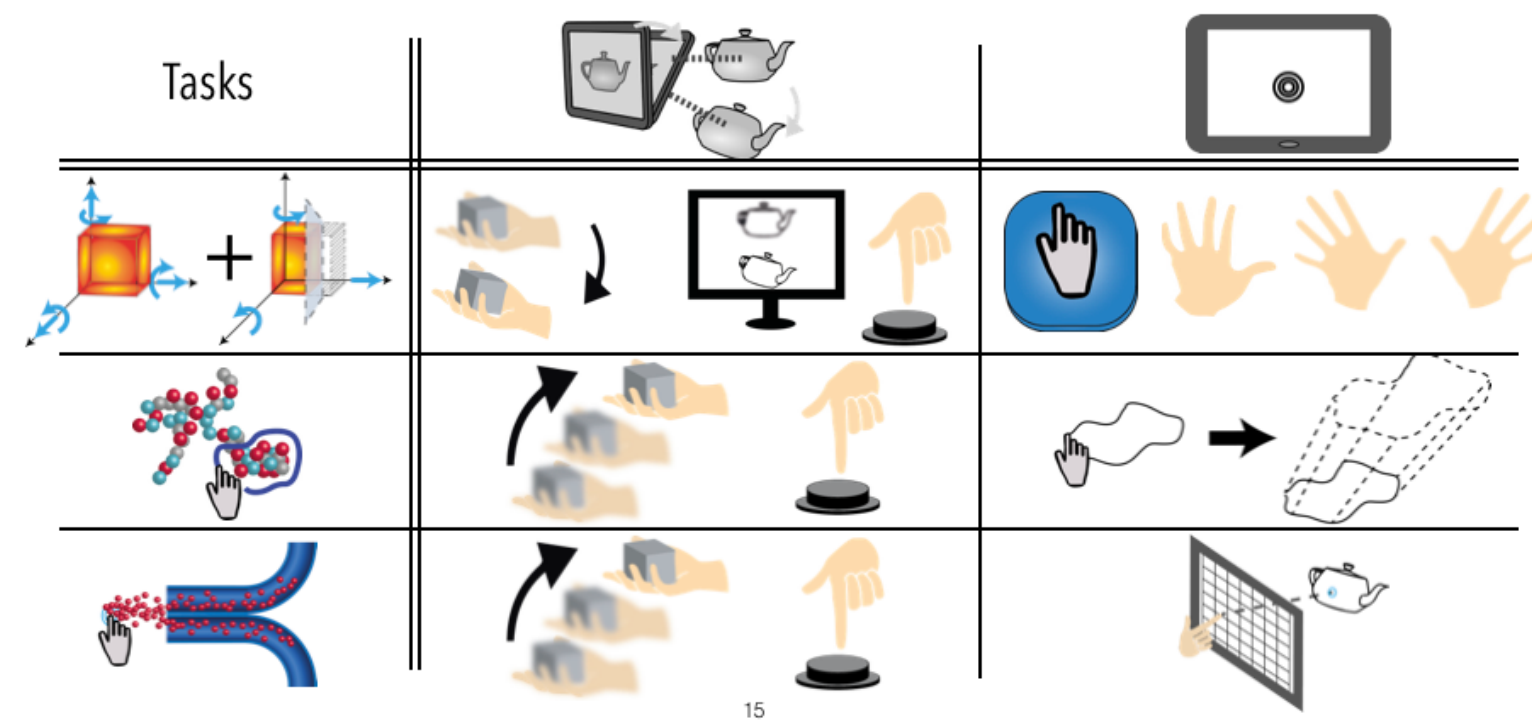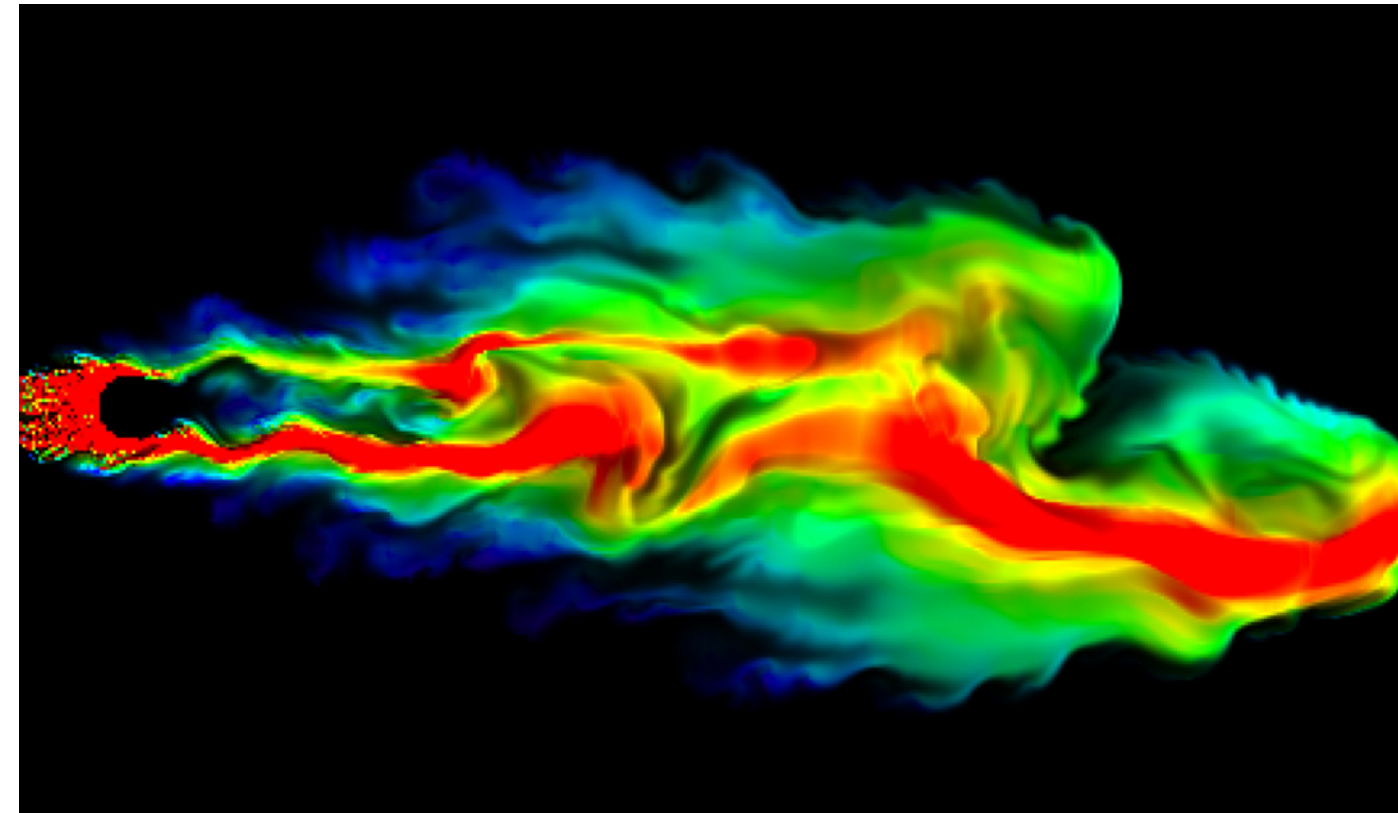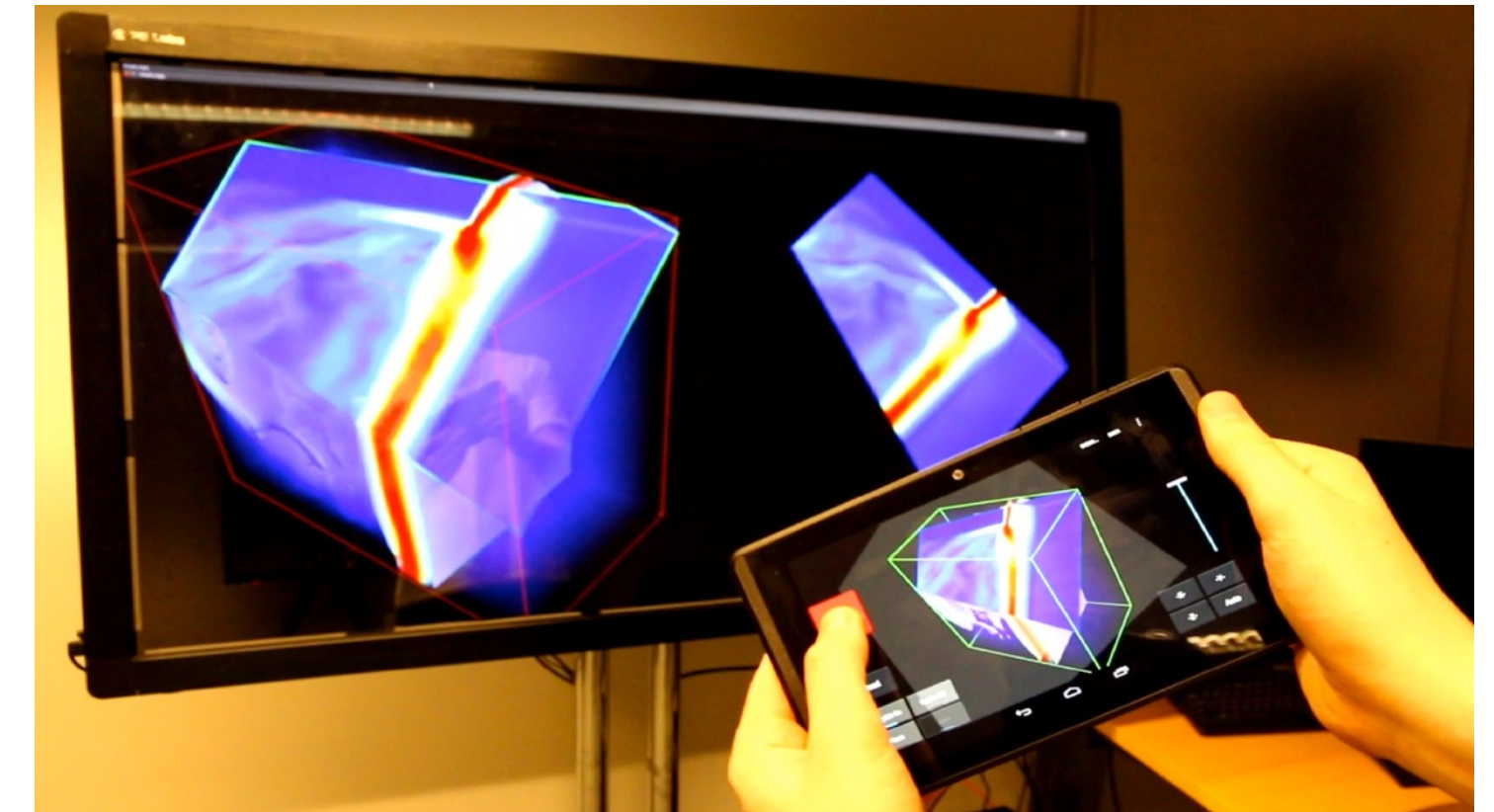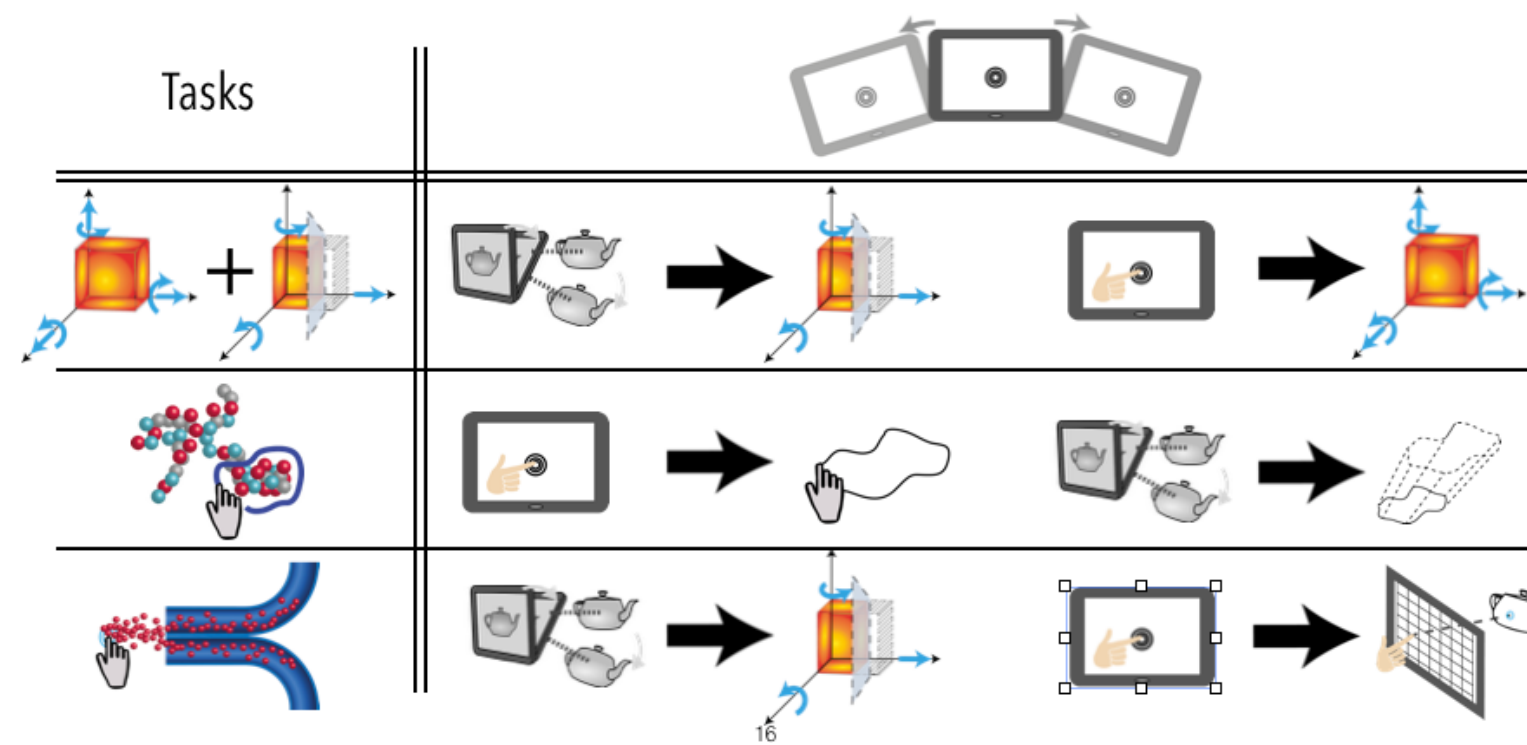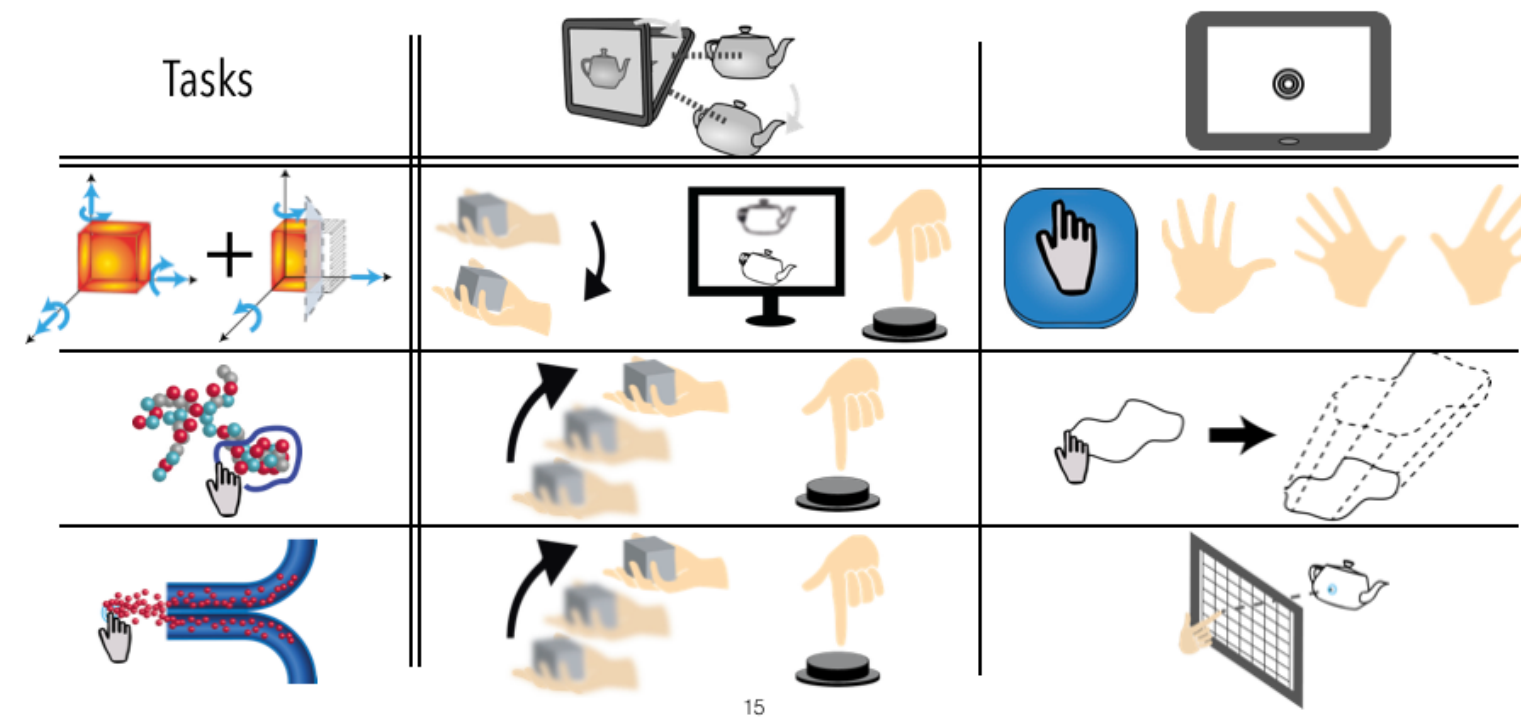
Contributions

Tsigkari et al. (2012)

Contributions
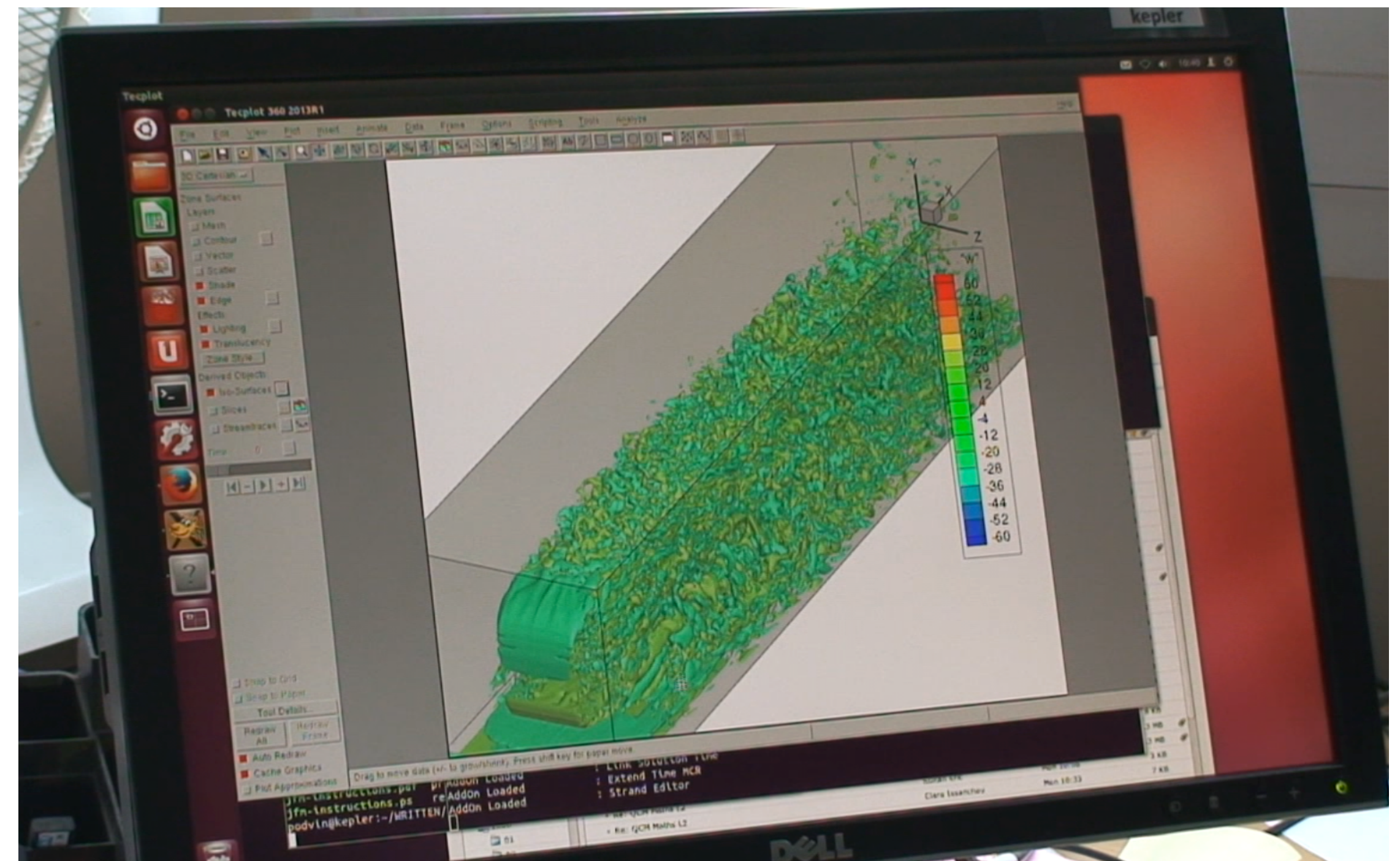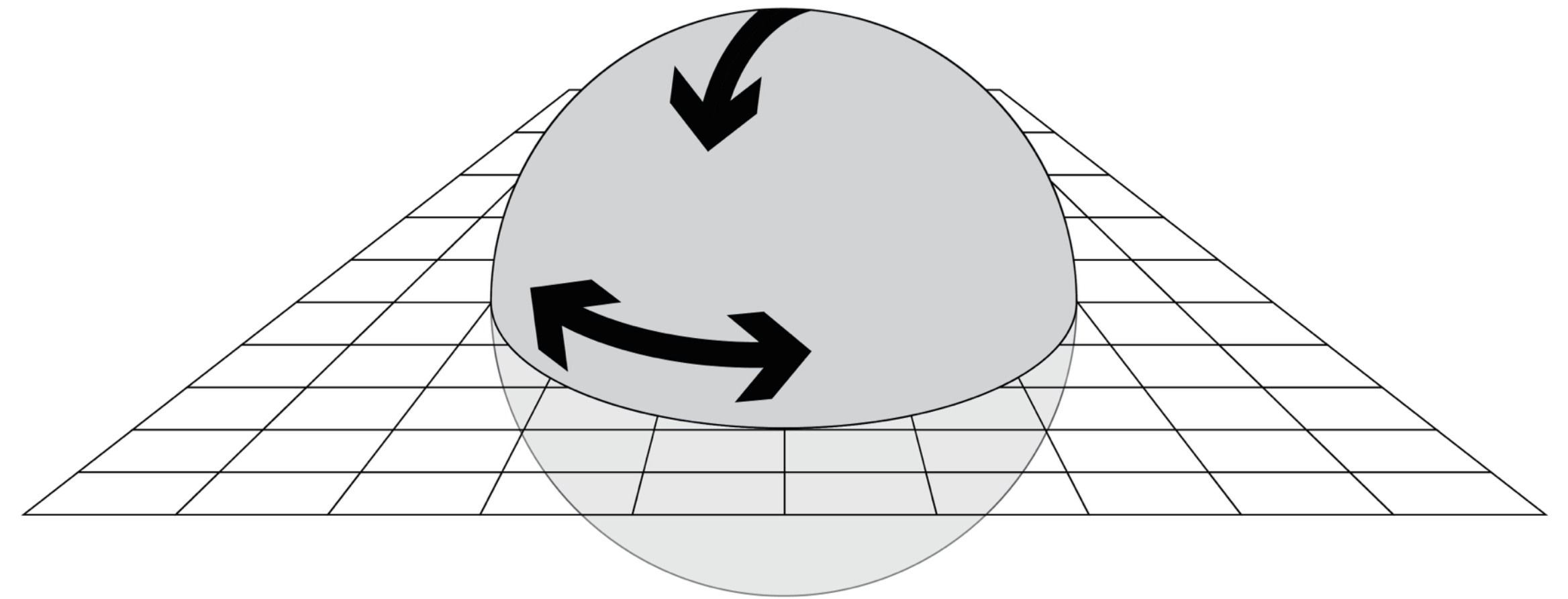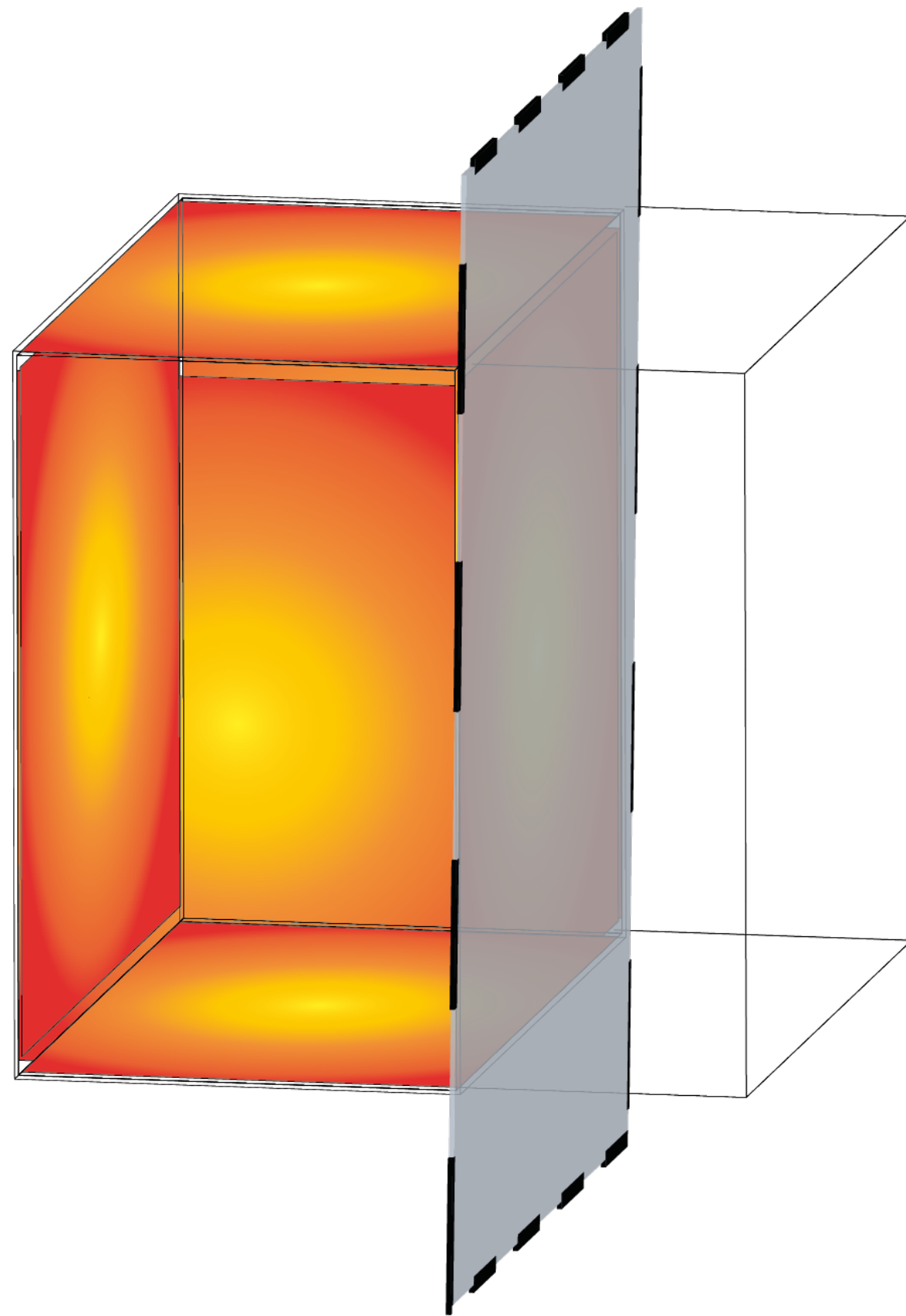

Tsigkari et al. (2012)

10

Contributions

Tsigkari et al. (2012)

Contribution #1:
Understanding the needs of fluid dynamic experts

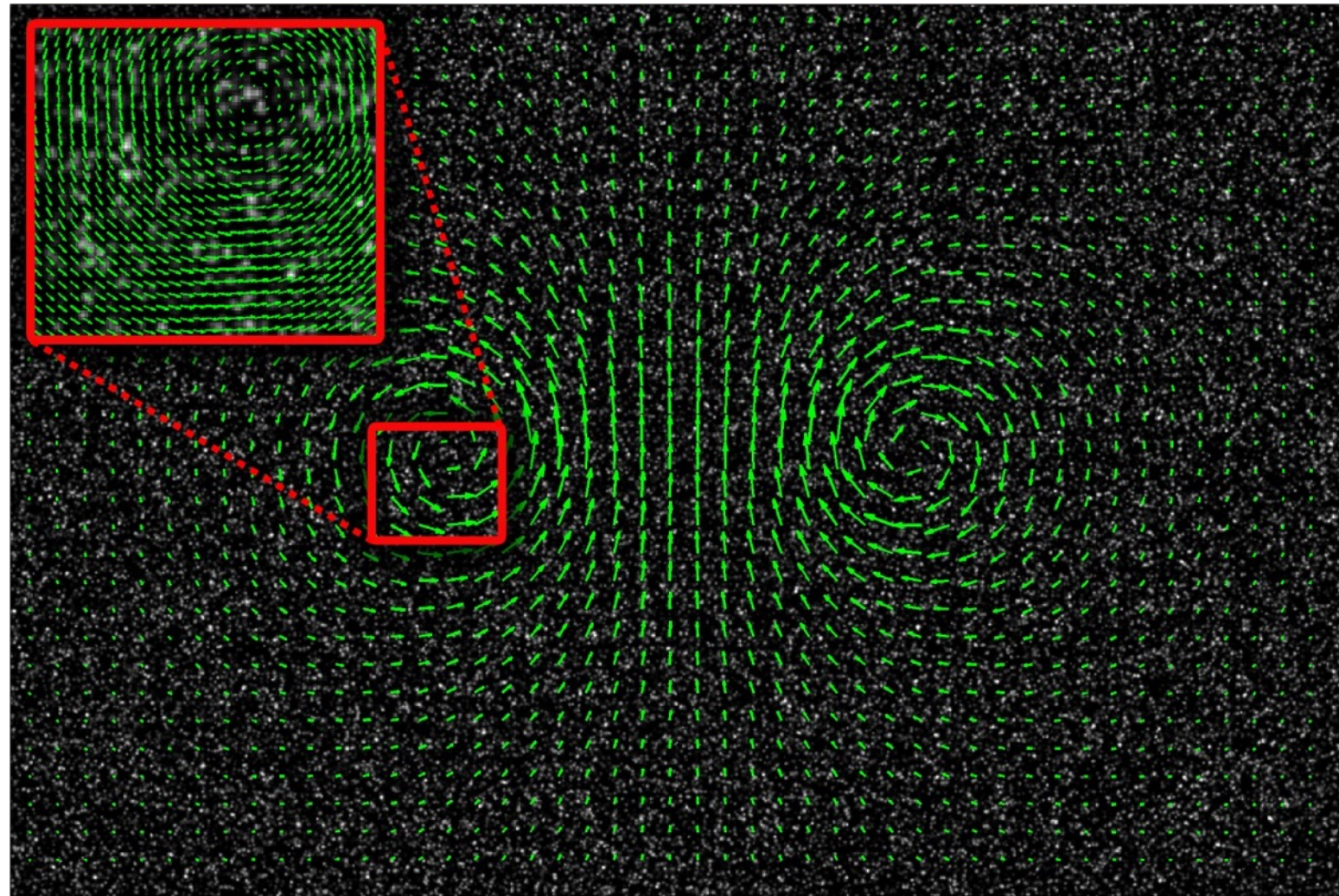# Preliminary study: understanding experts needs

- Field study with experts

- Five fluid dynamic researchers

- Observations and video-recordings

- Semi-structured interviews
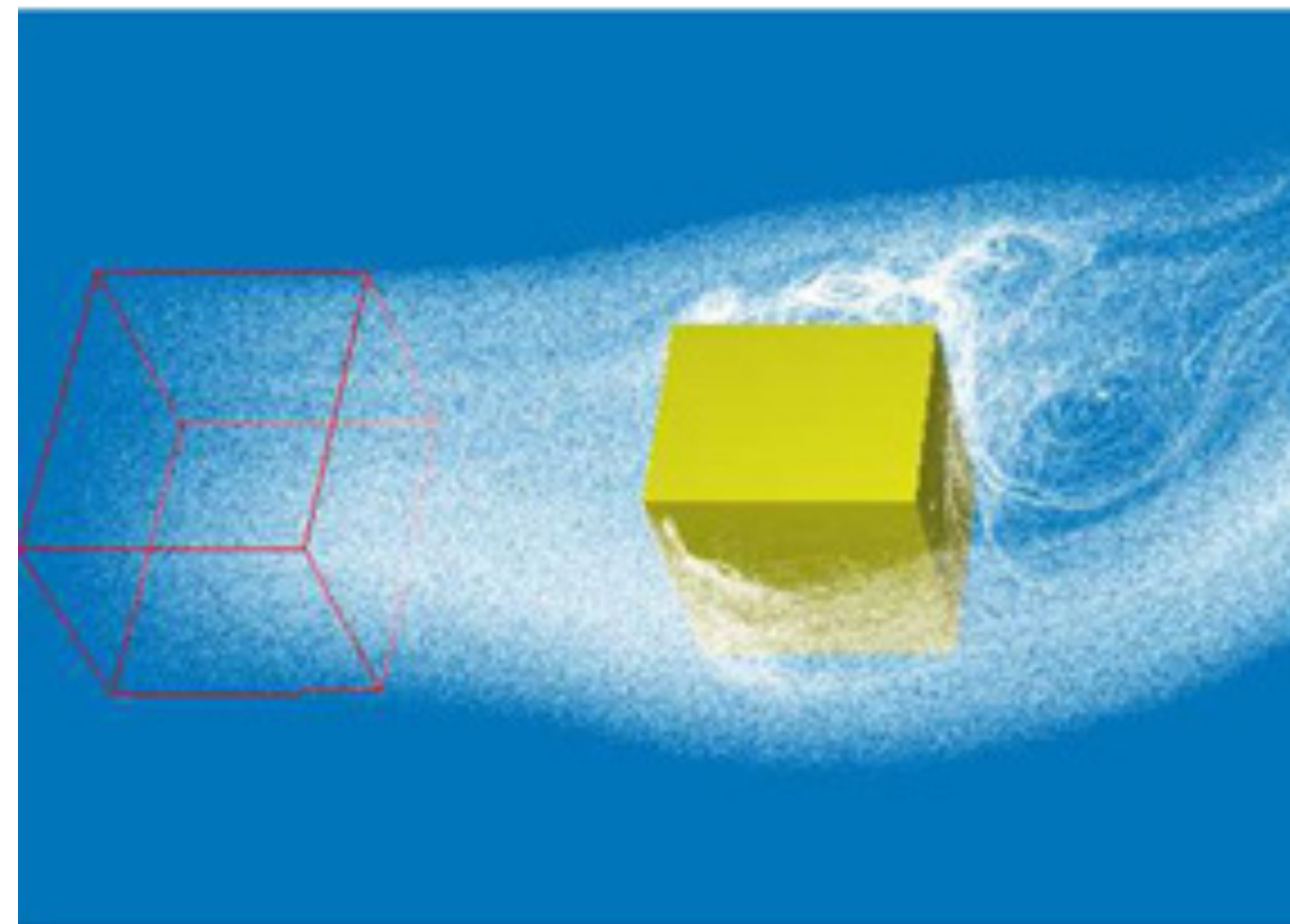
Preliminary study results
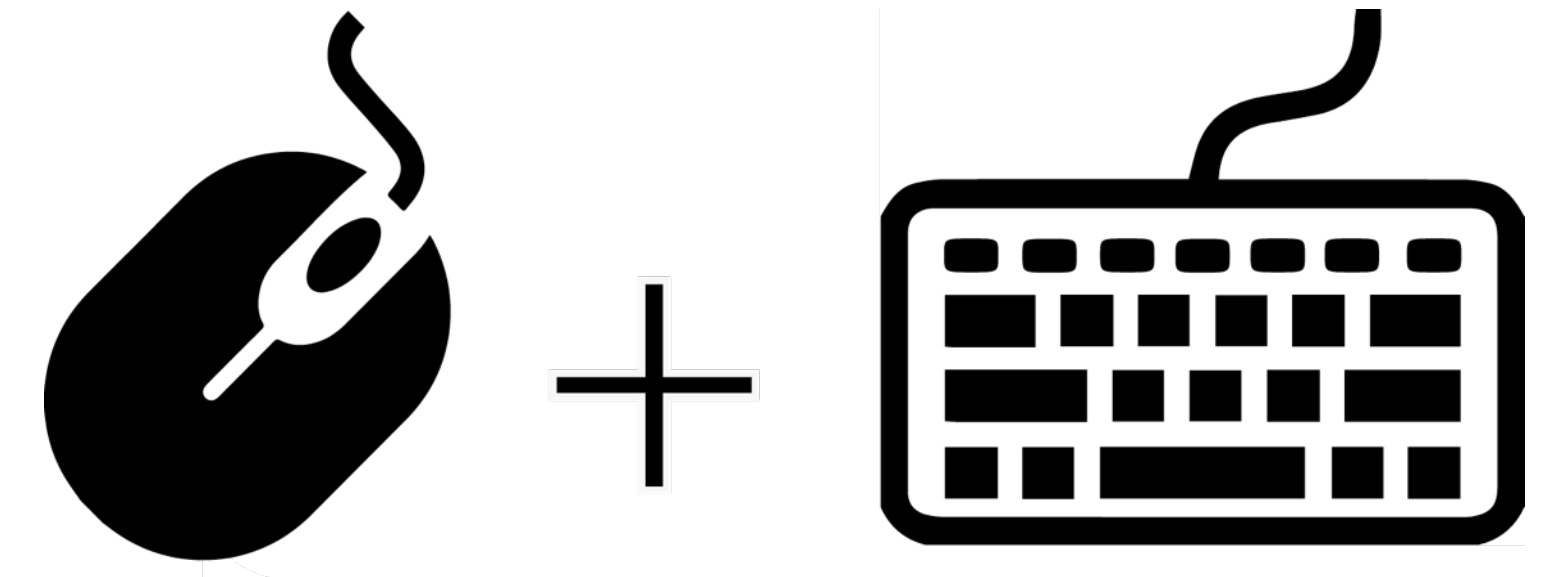
Preliminary study results
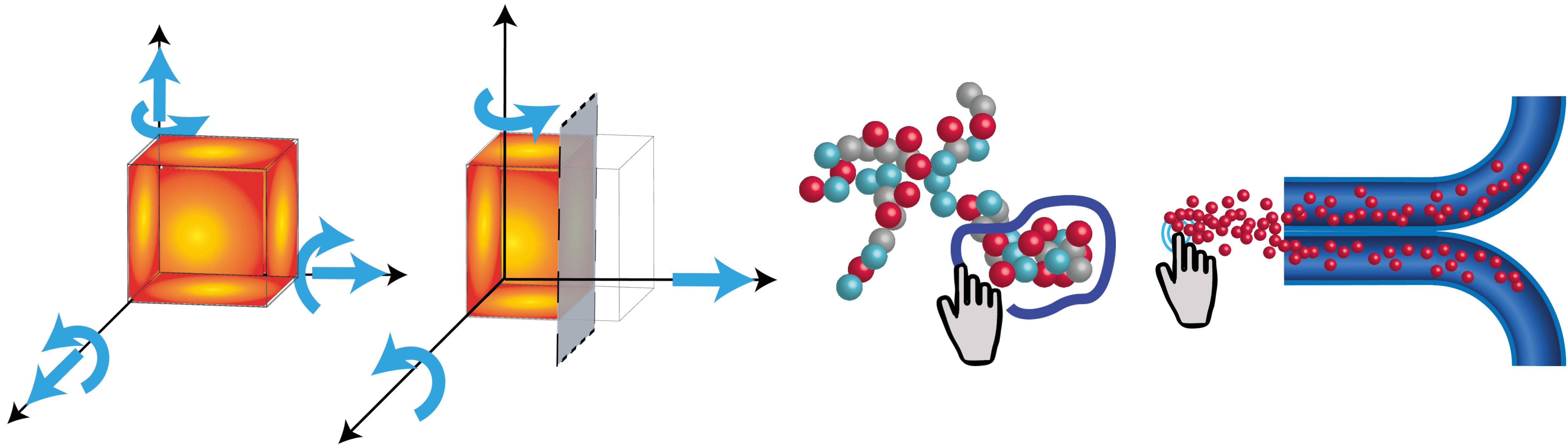

PIVlab multipass ©Willa
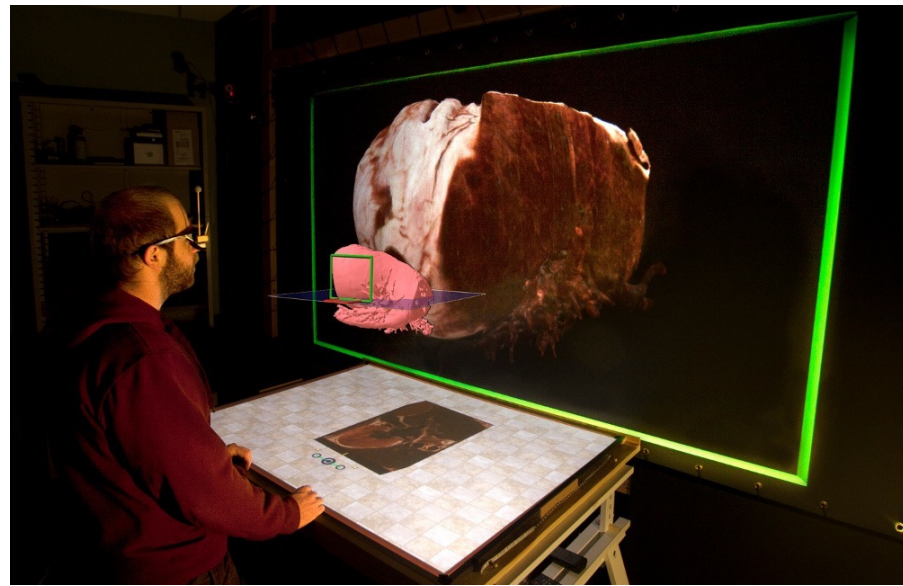Creative Commons Attribution-Share Alike 3.0 Unported

Kruger et al. (2005)

Interaction Tasks in Spatial 3D data
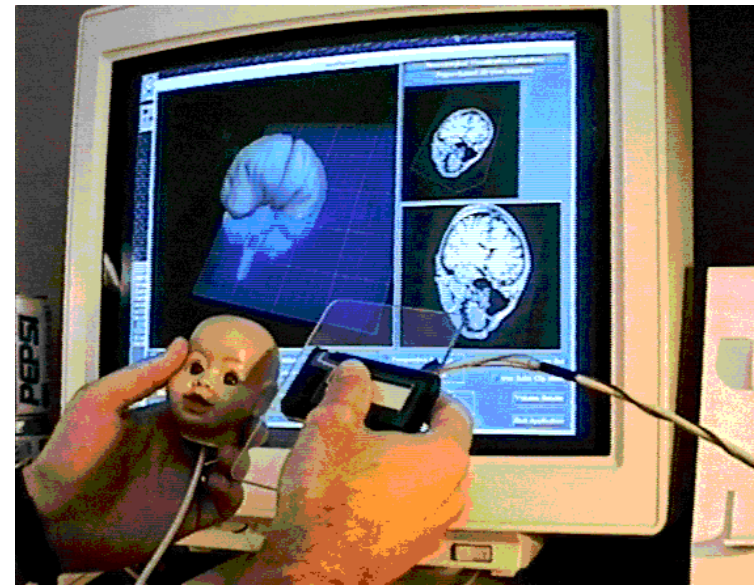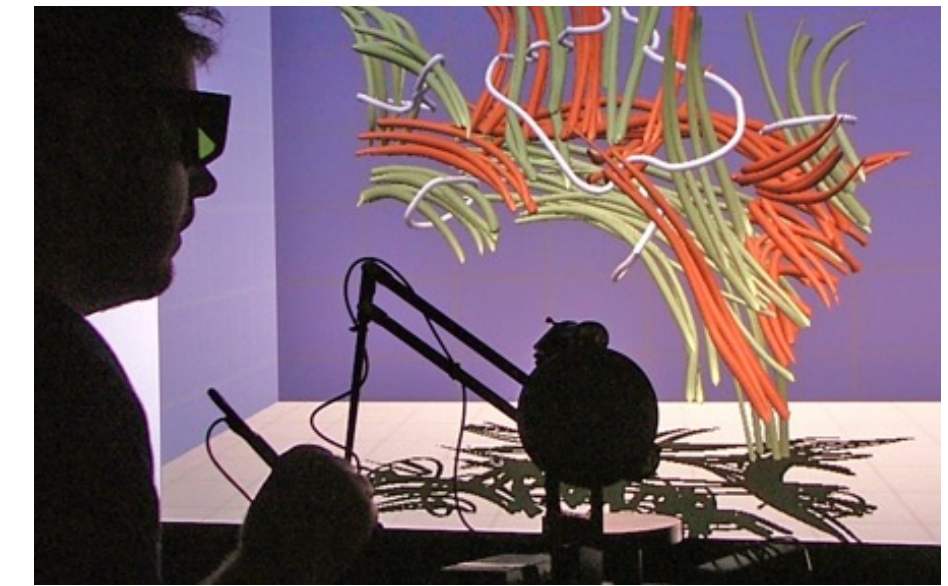
Contribution #2:
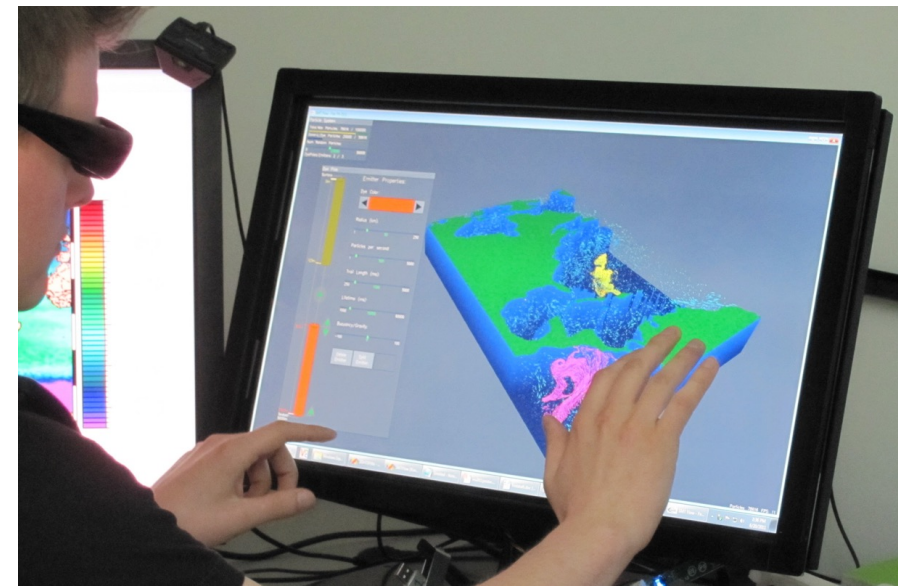# Design space exploration

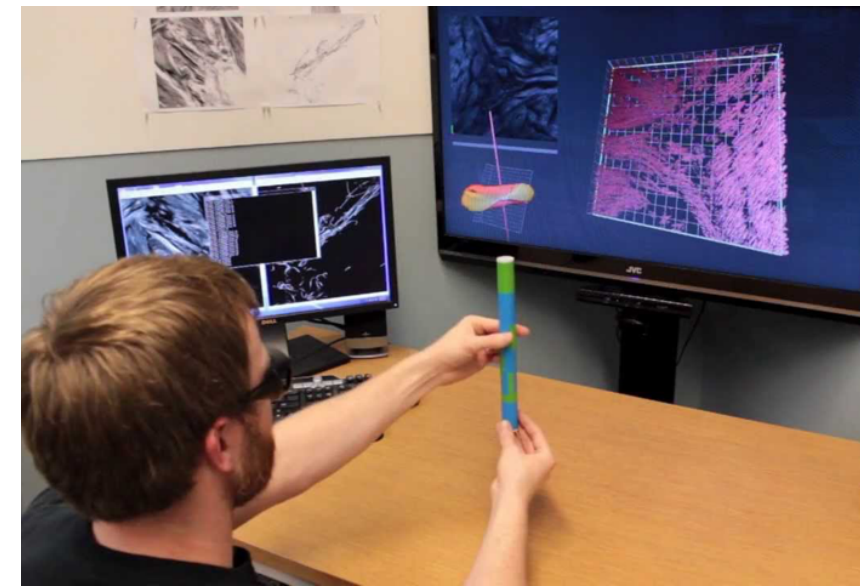# Examples

Coffey et al. (2012)

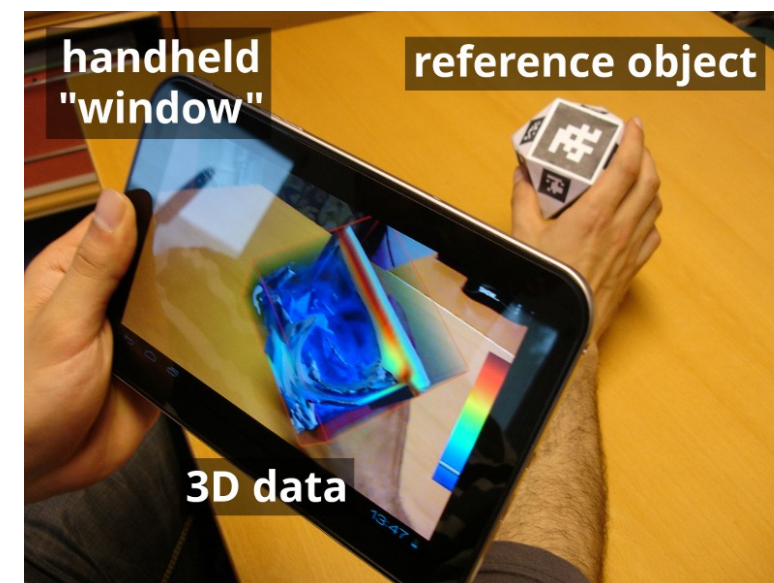Hinckley et al. (1994)
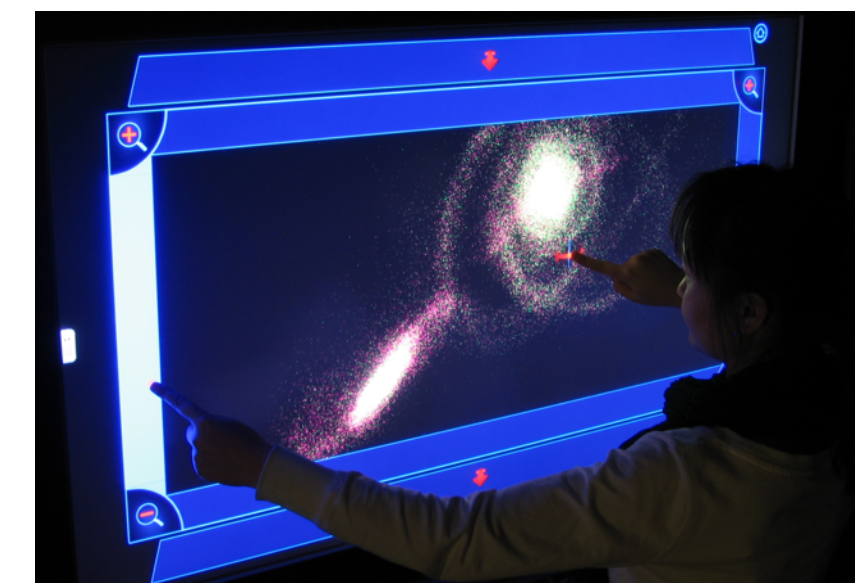

Keefe (2010)

Butkiewicz & Ware (2012)

Jackson et al. (2013)
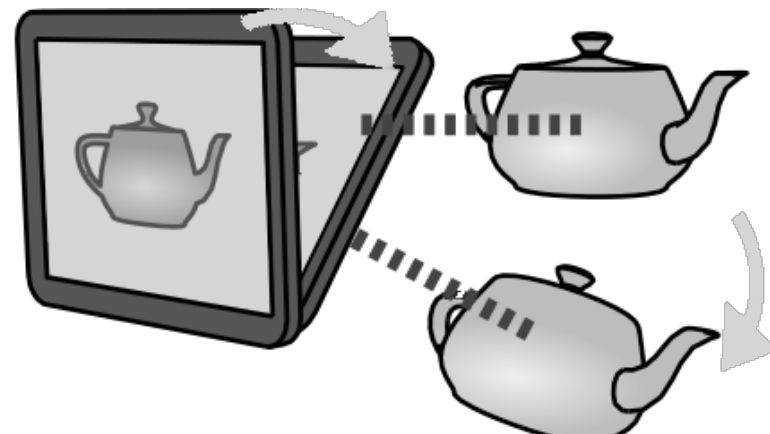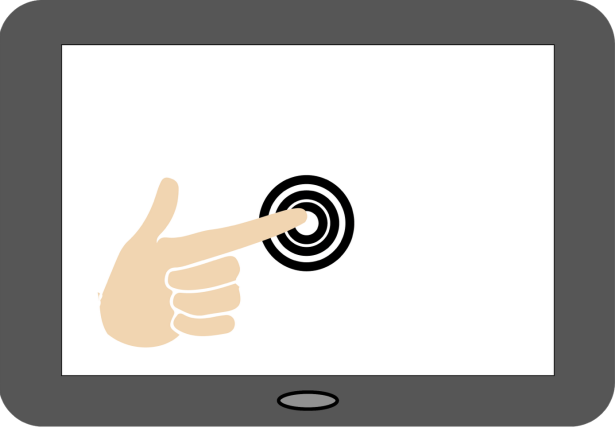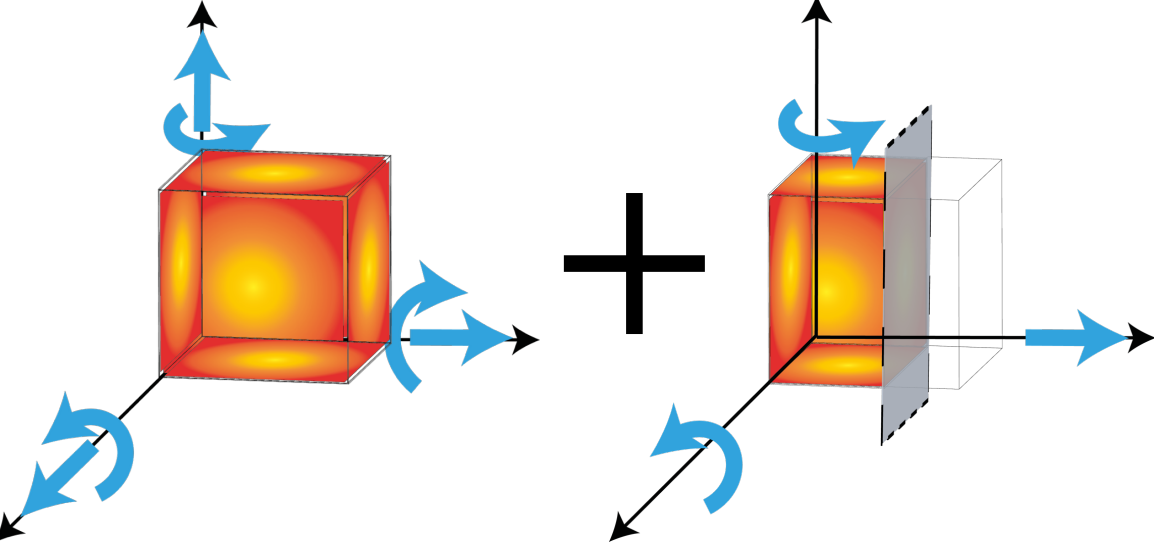

Schkolne et al. (2012)

Jackson et al. (2012)
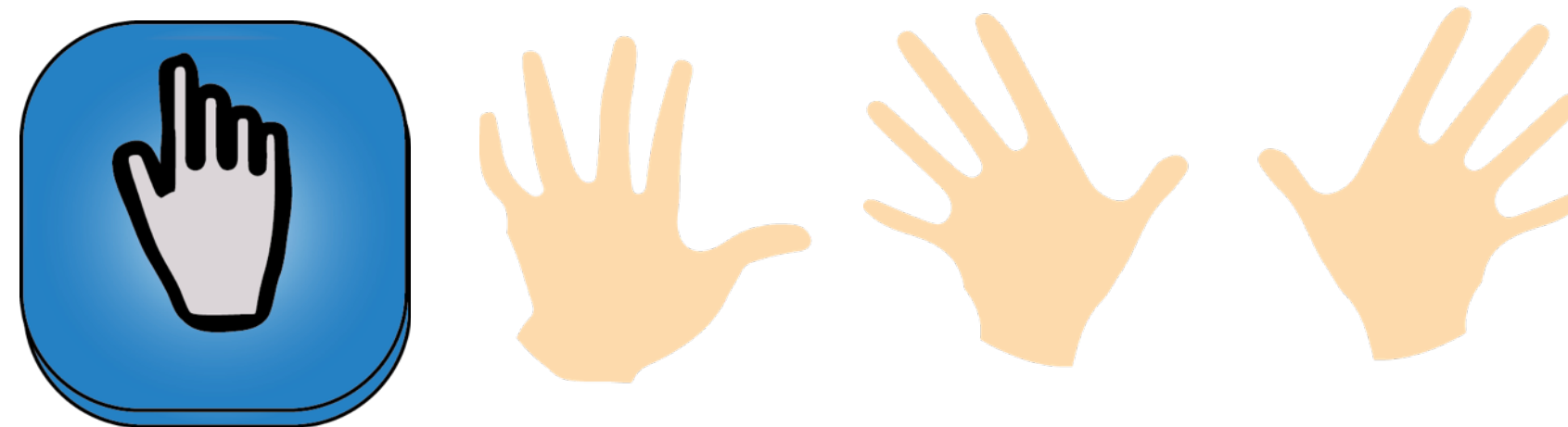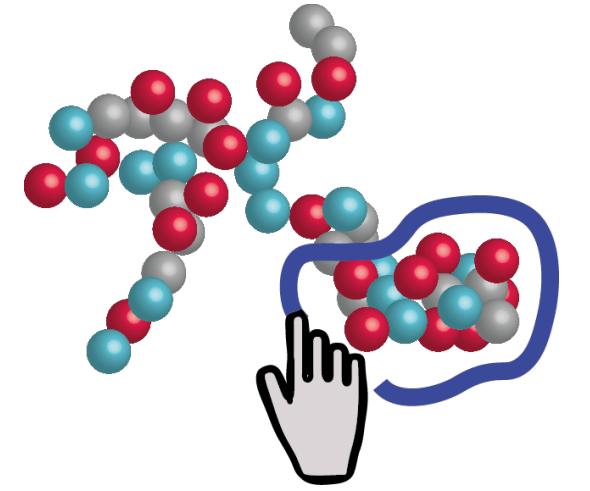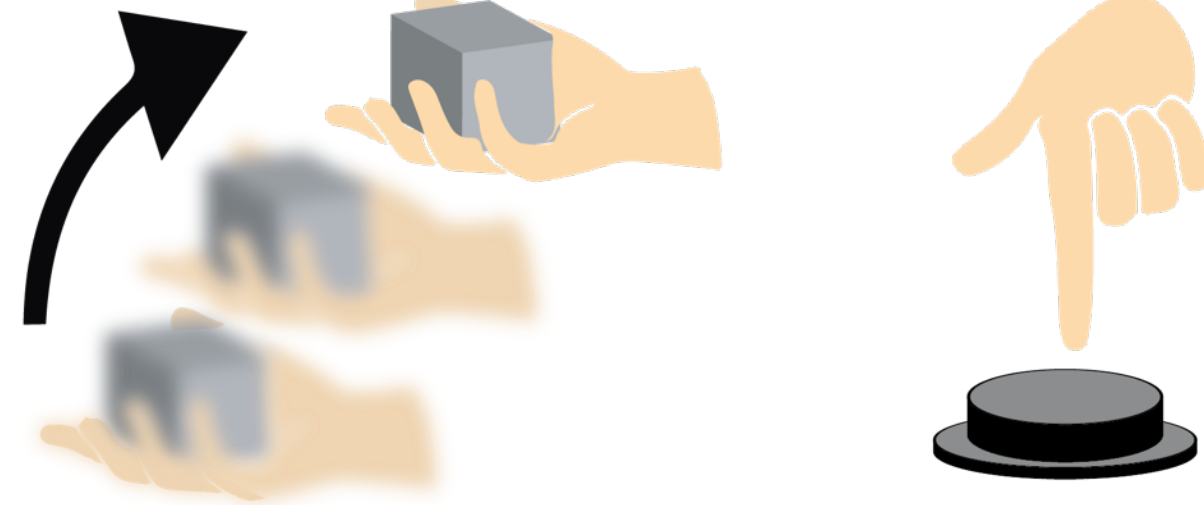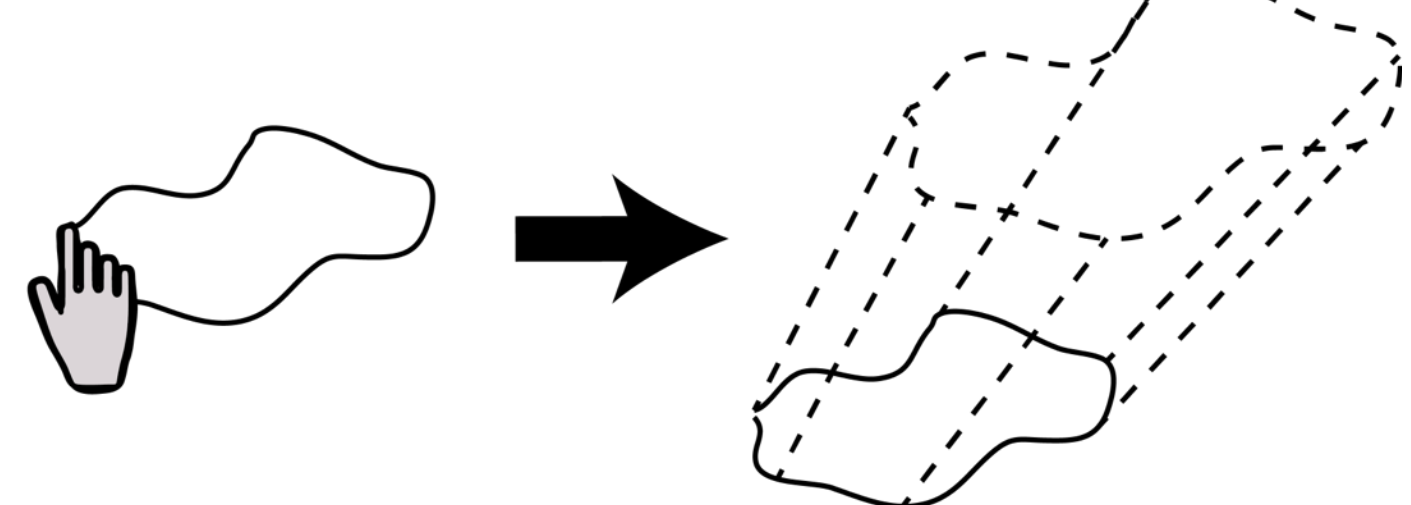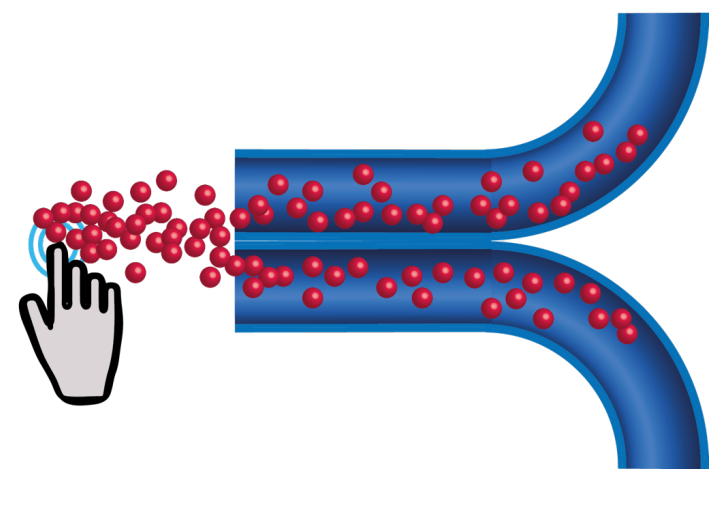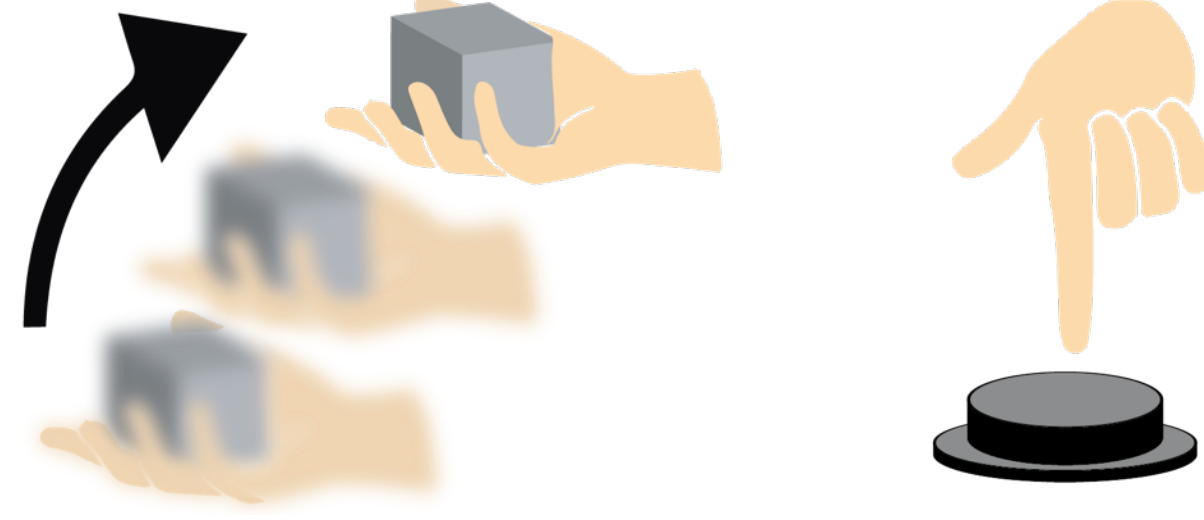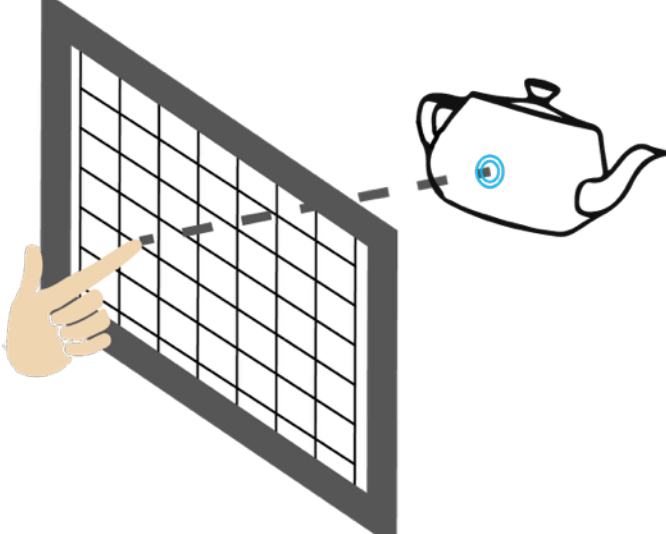
handheld "window"
reference object
3D data
Issartel et al. (2014)

Yu et al. (2014)

Design Space Exploration: tactile-only and tangible-only settings

Design Space Exploration: Hybrid interaction

Tasks
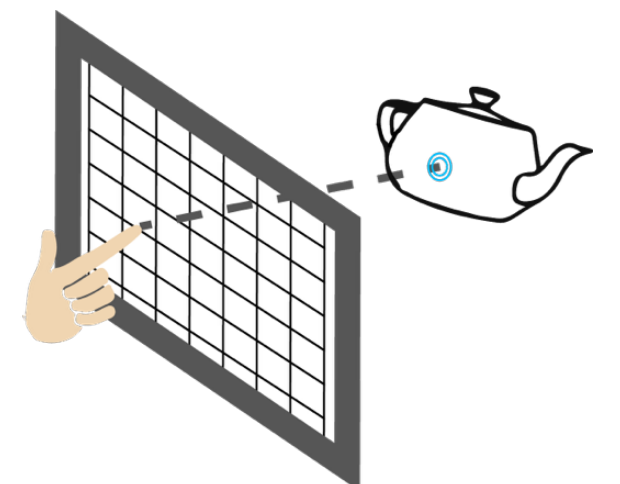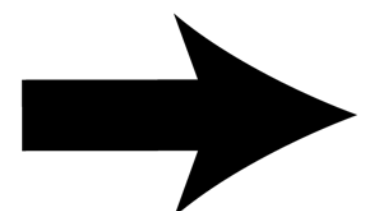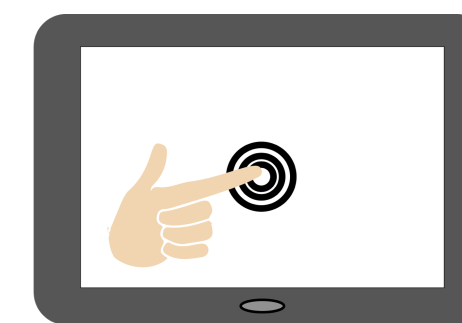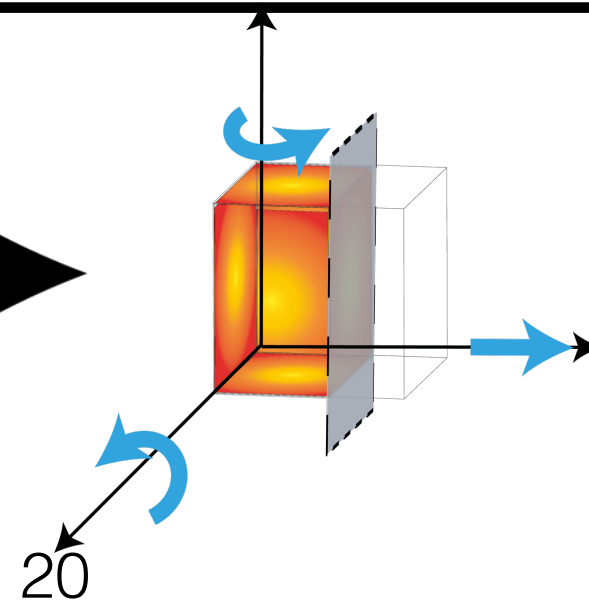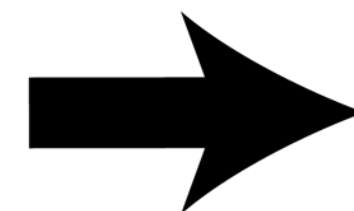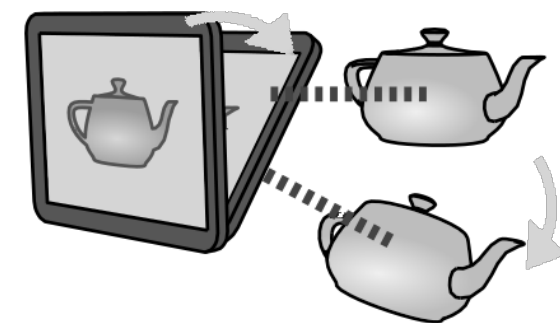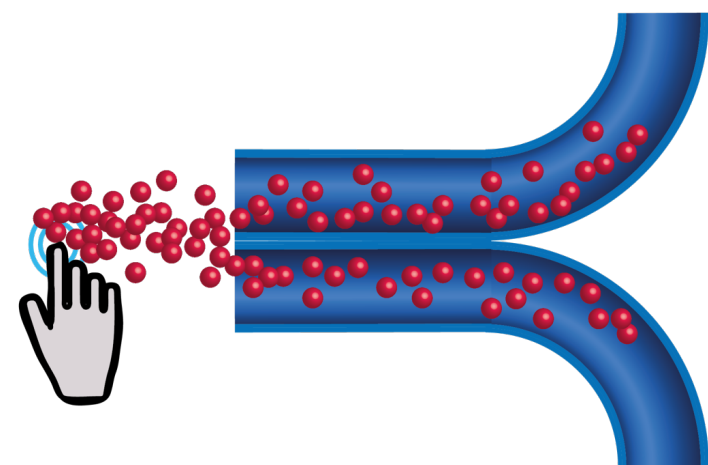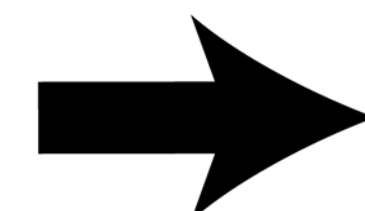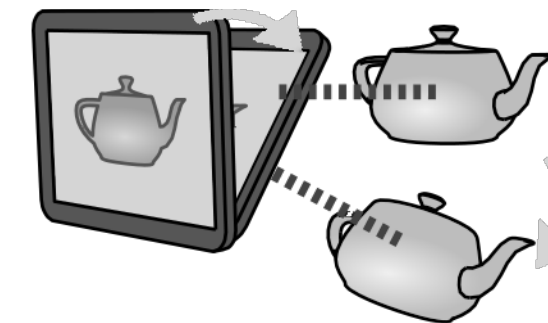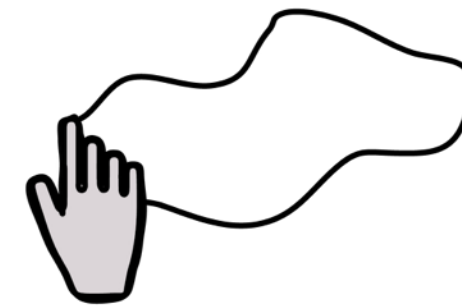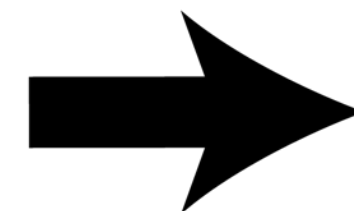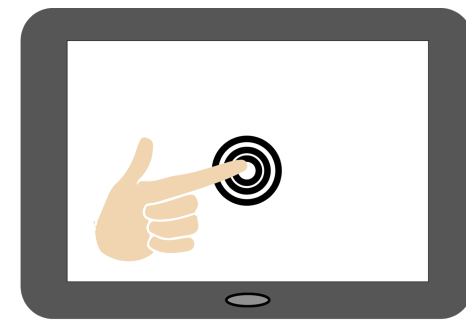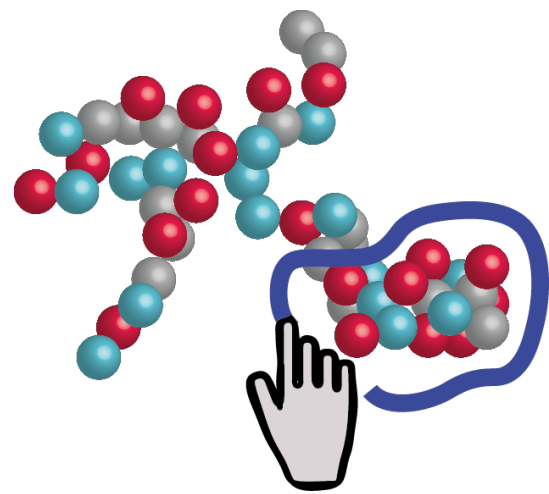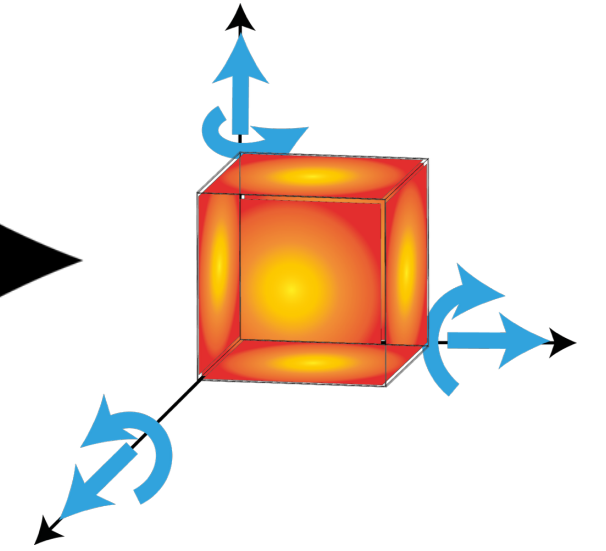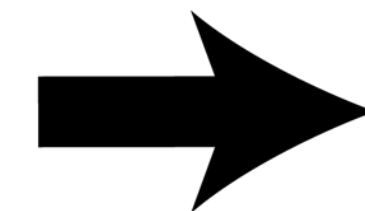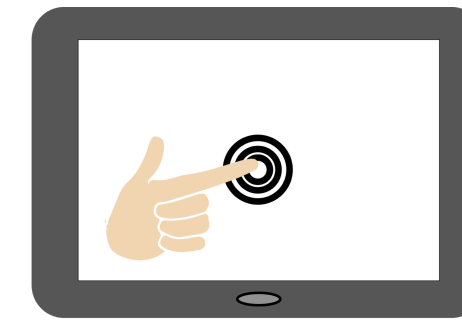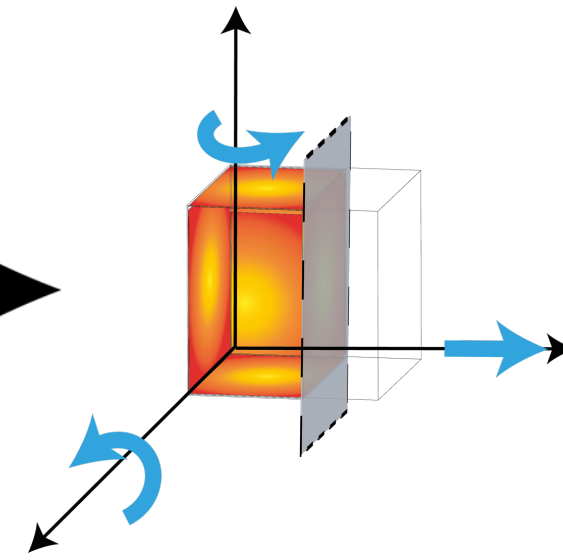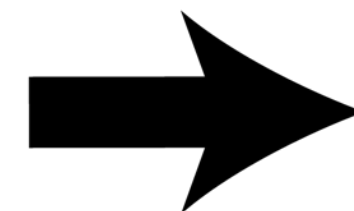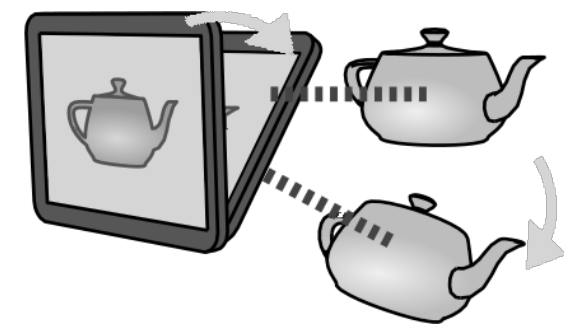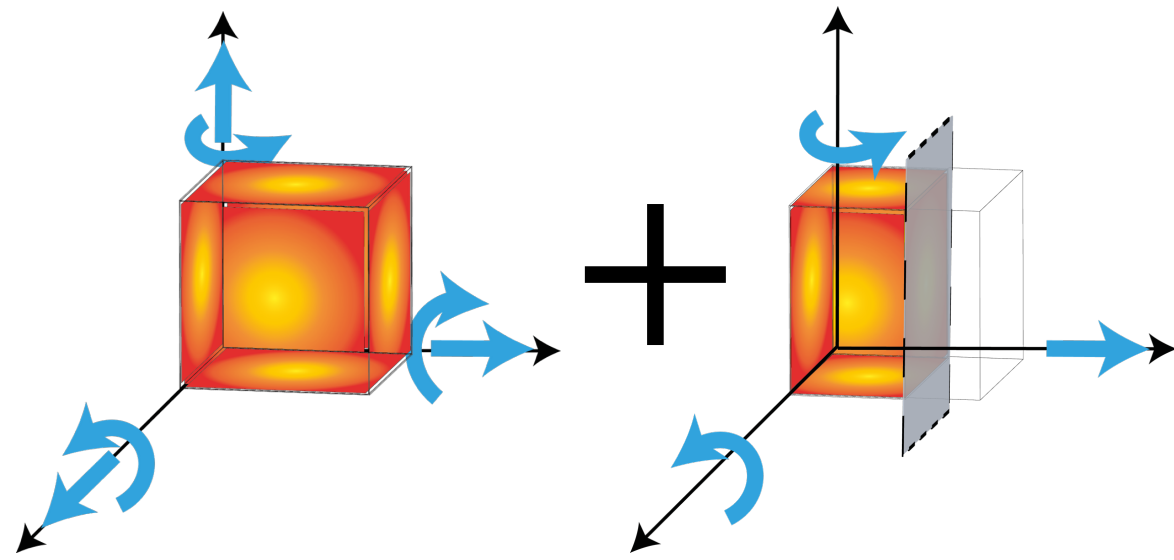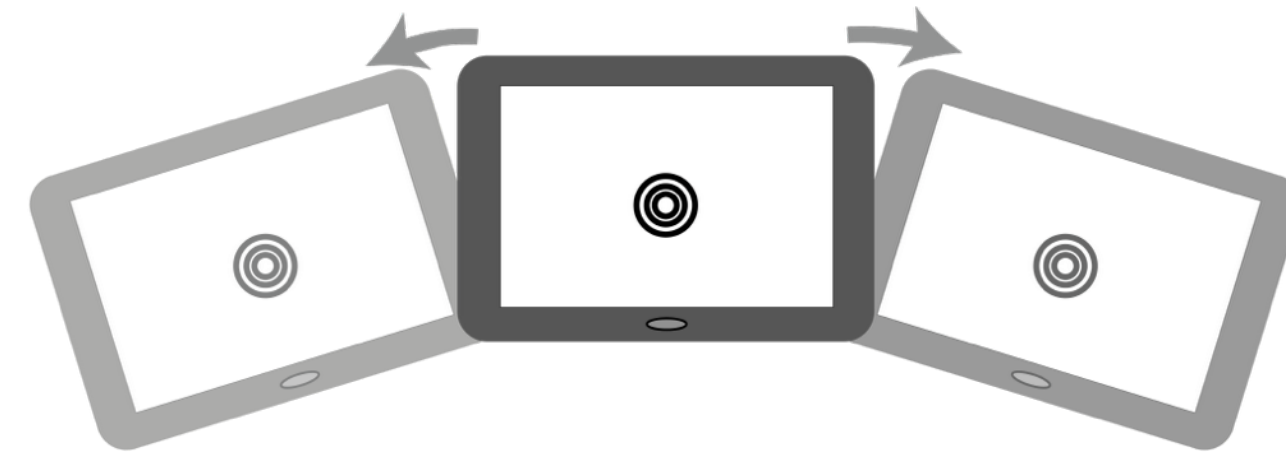
Contribution #3:
Hybrid interaction prototype and user study

Prototype

Prototype
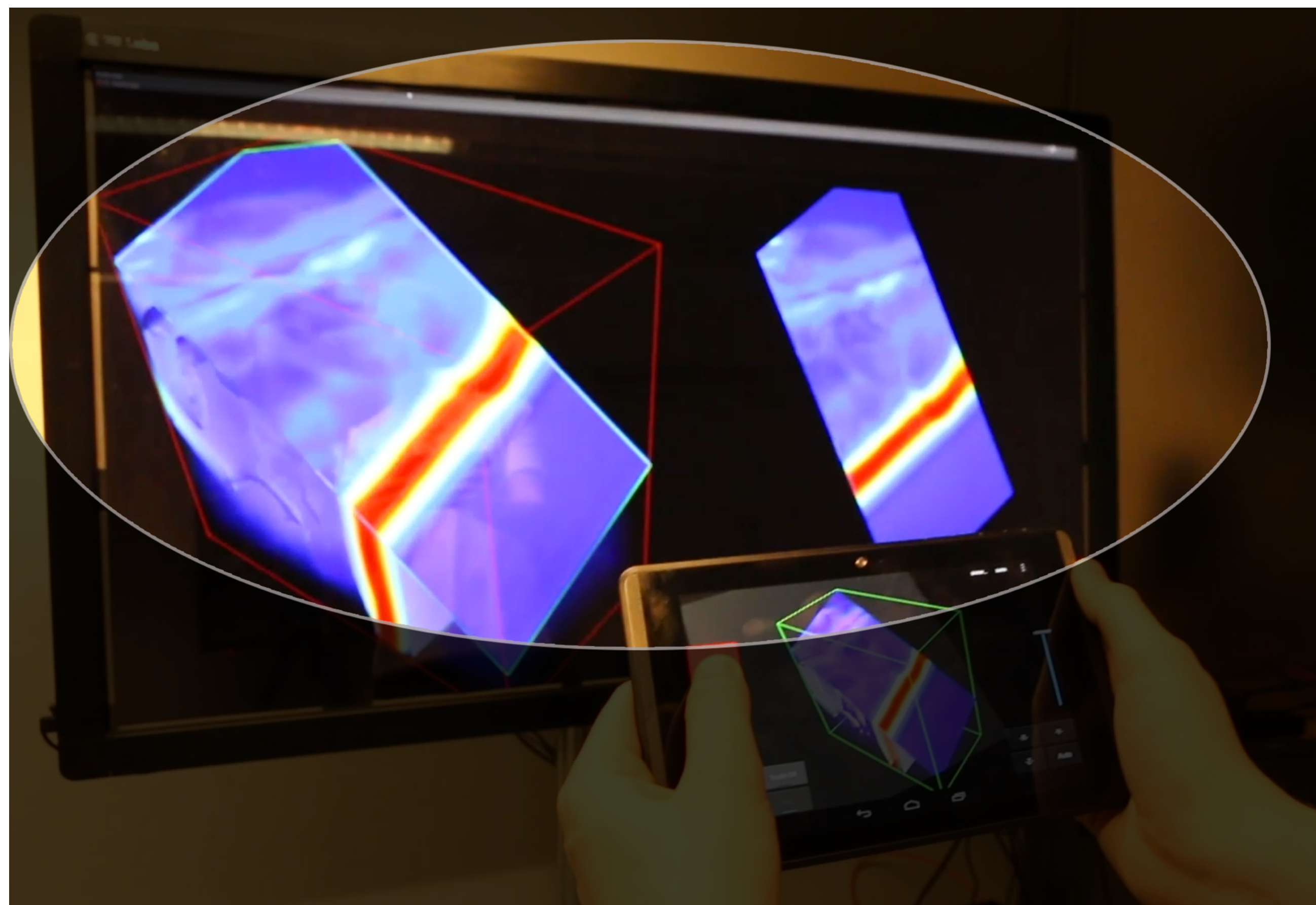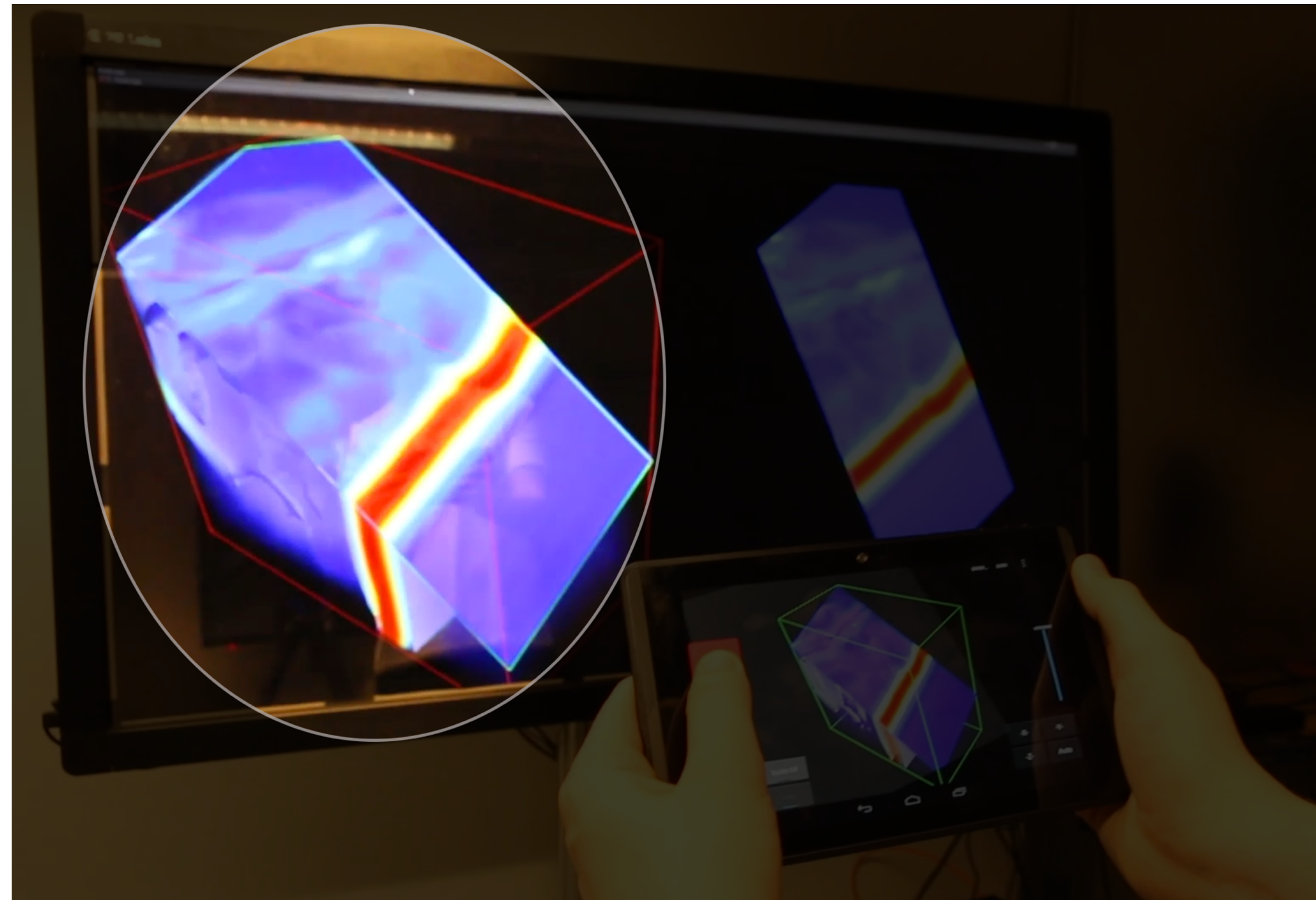
Prototype

Prototype
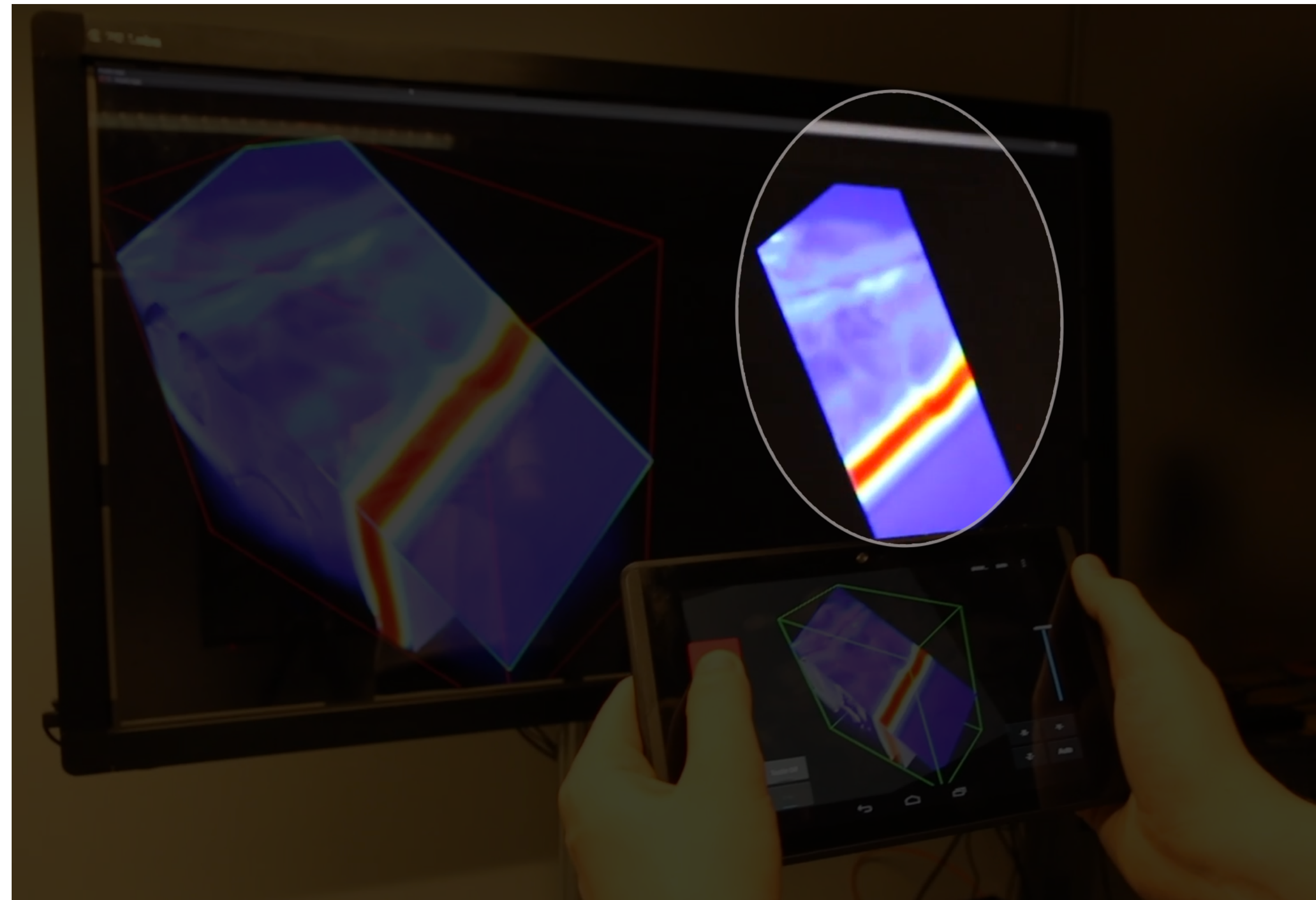
User Interface
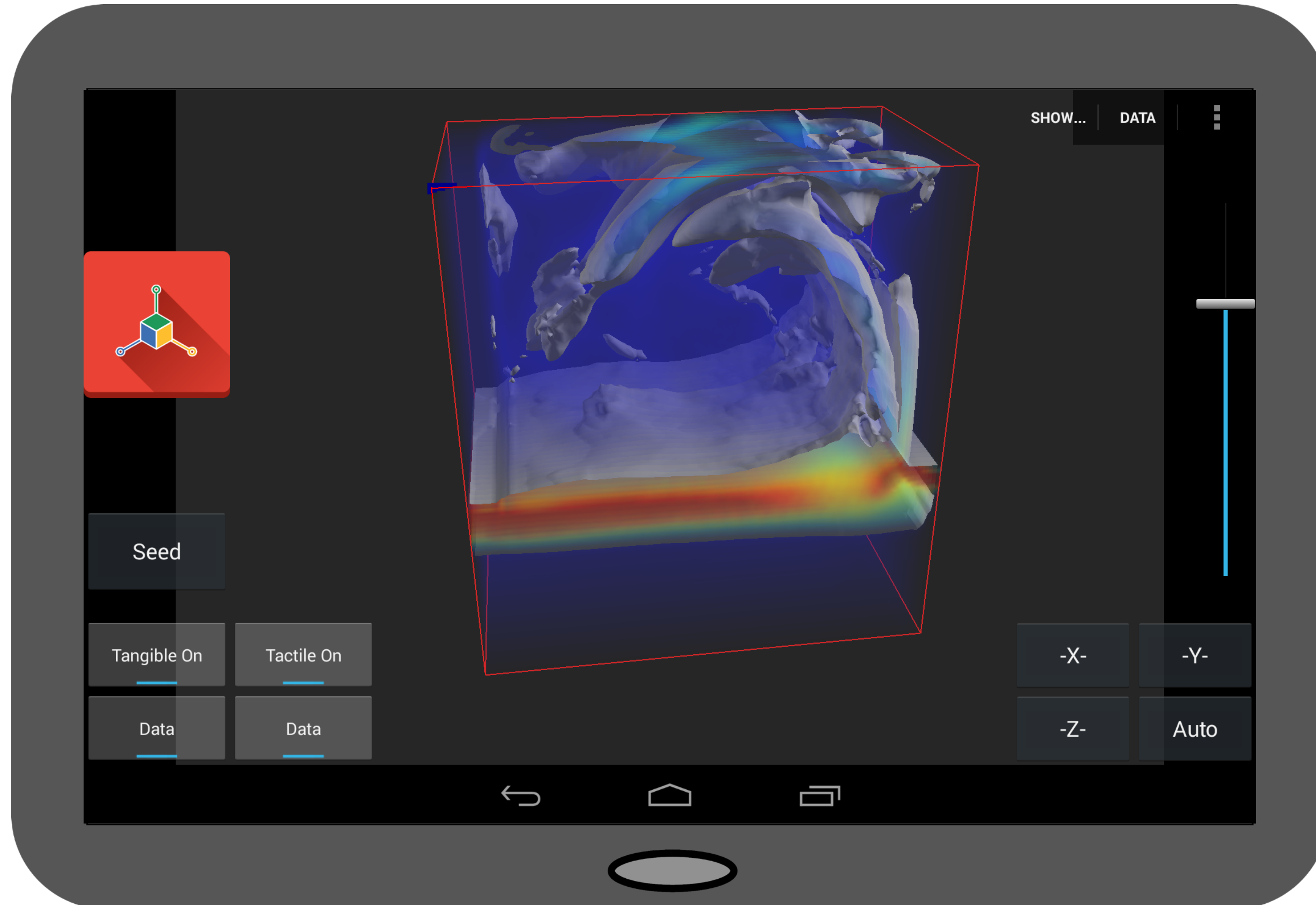
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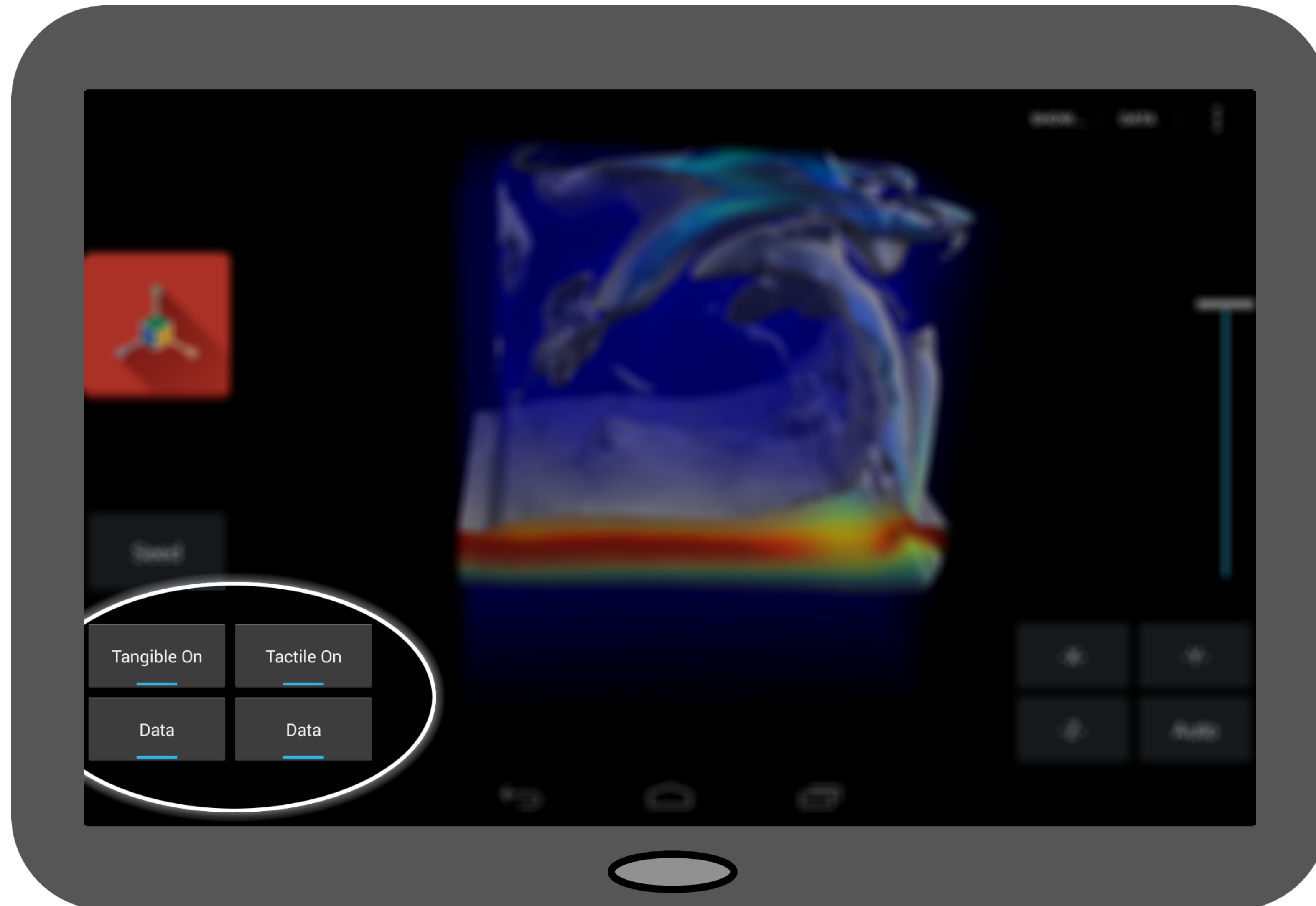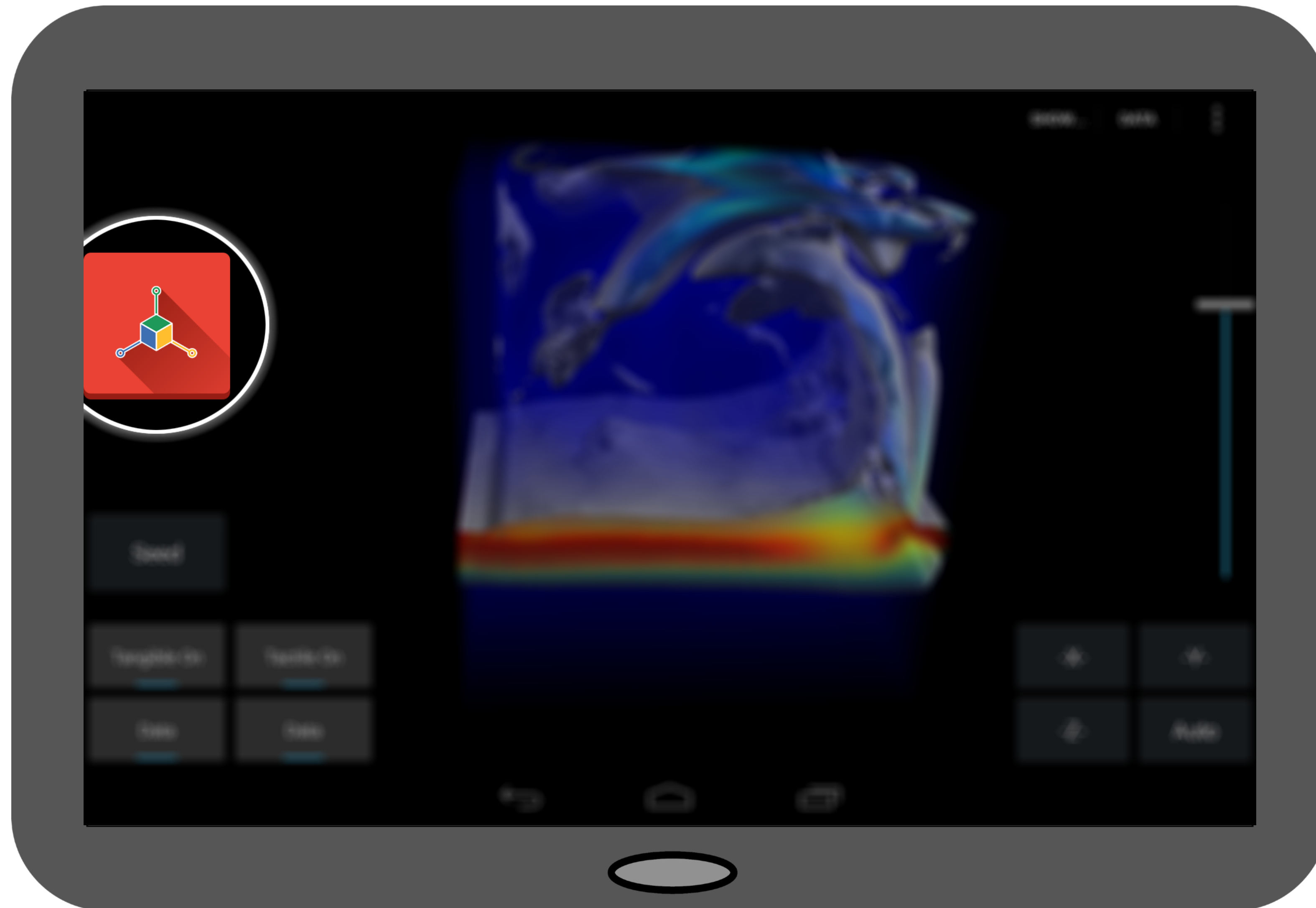
User Interface
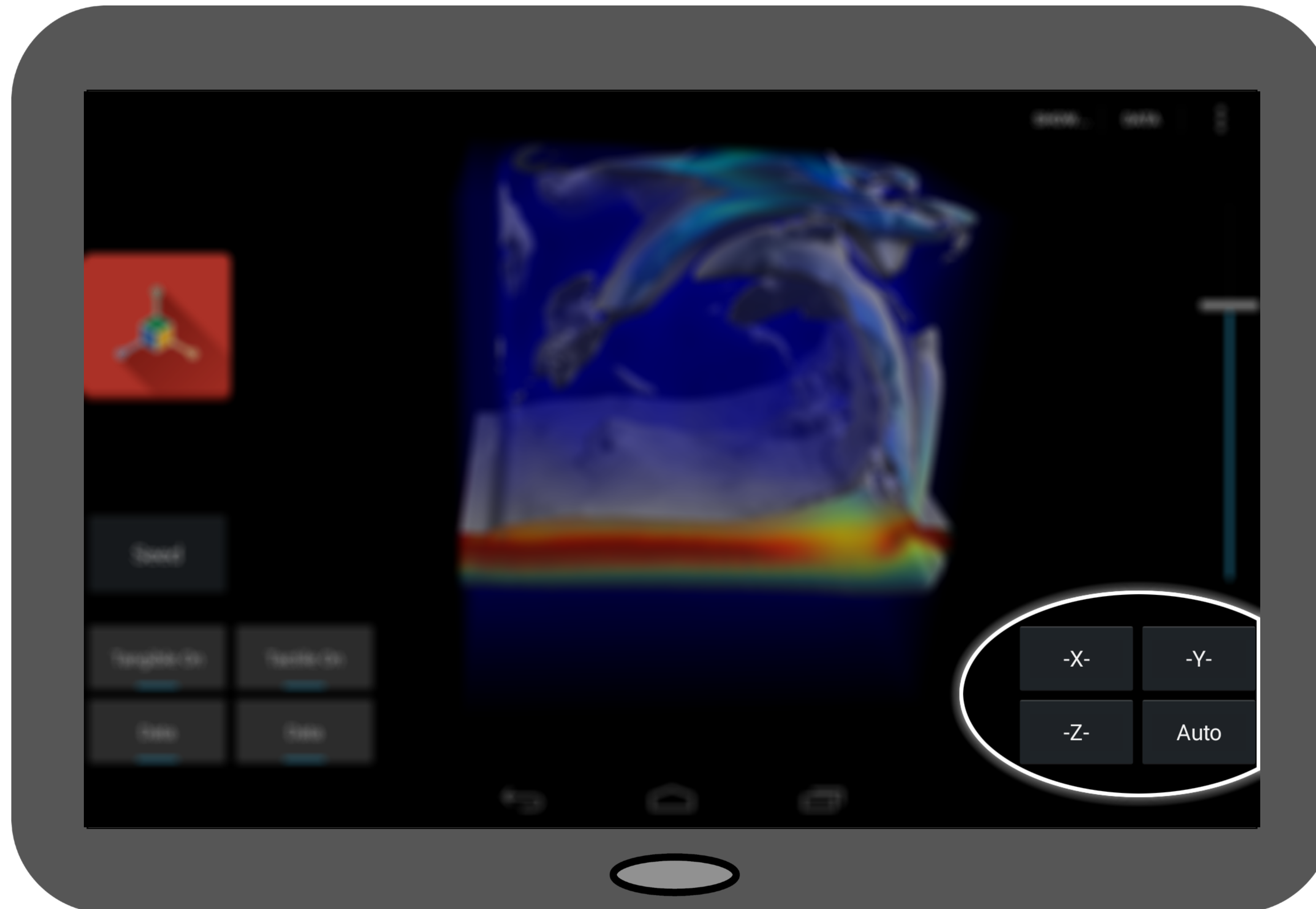
User Interface

User Interface
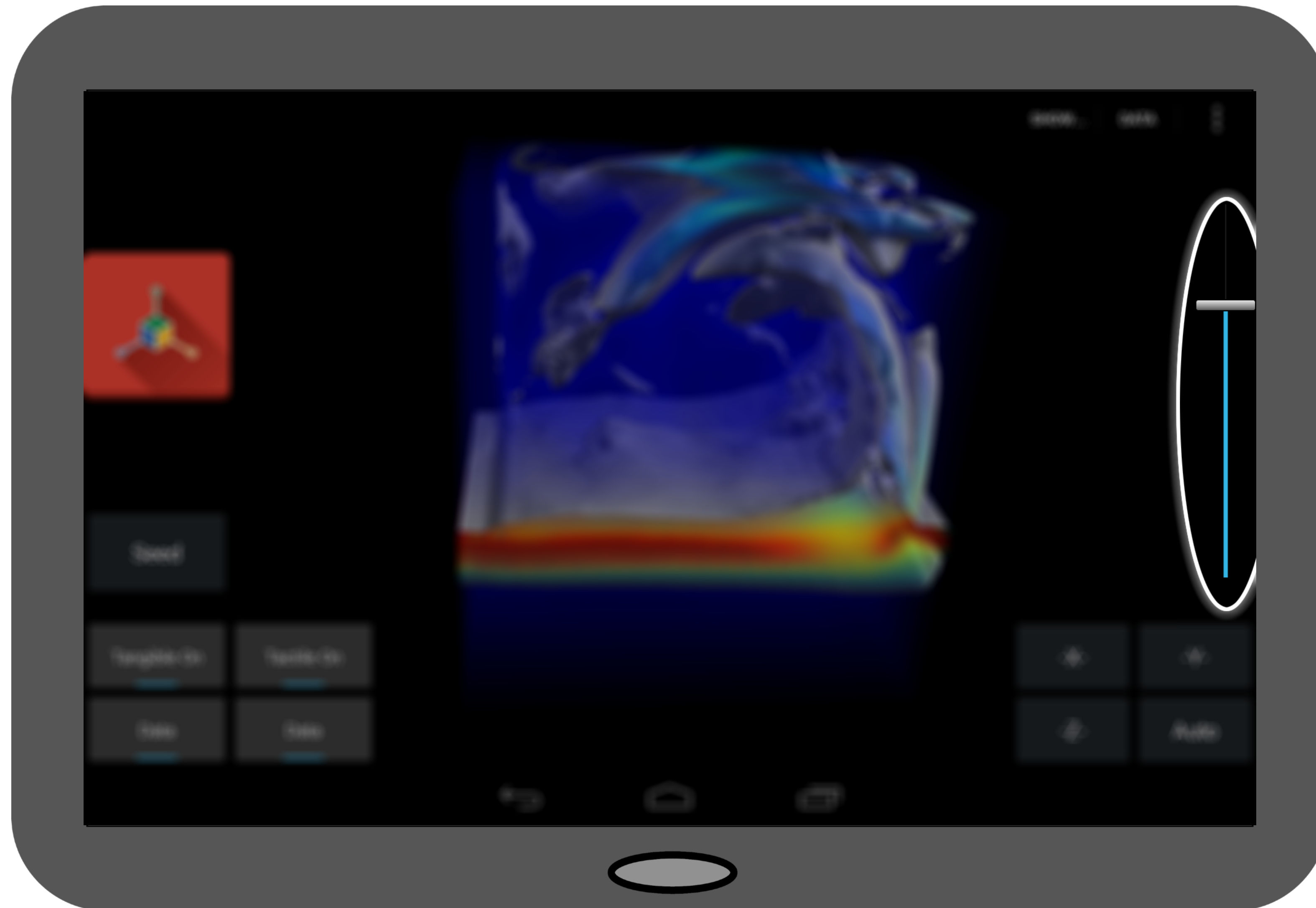
3D data space navigation
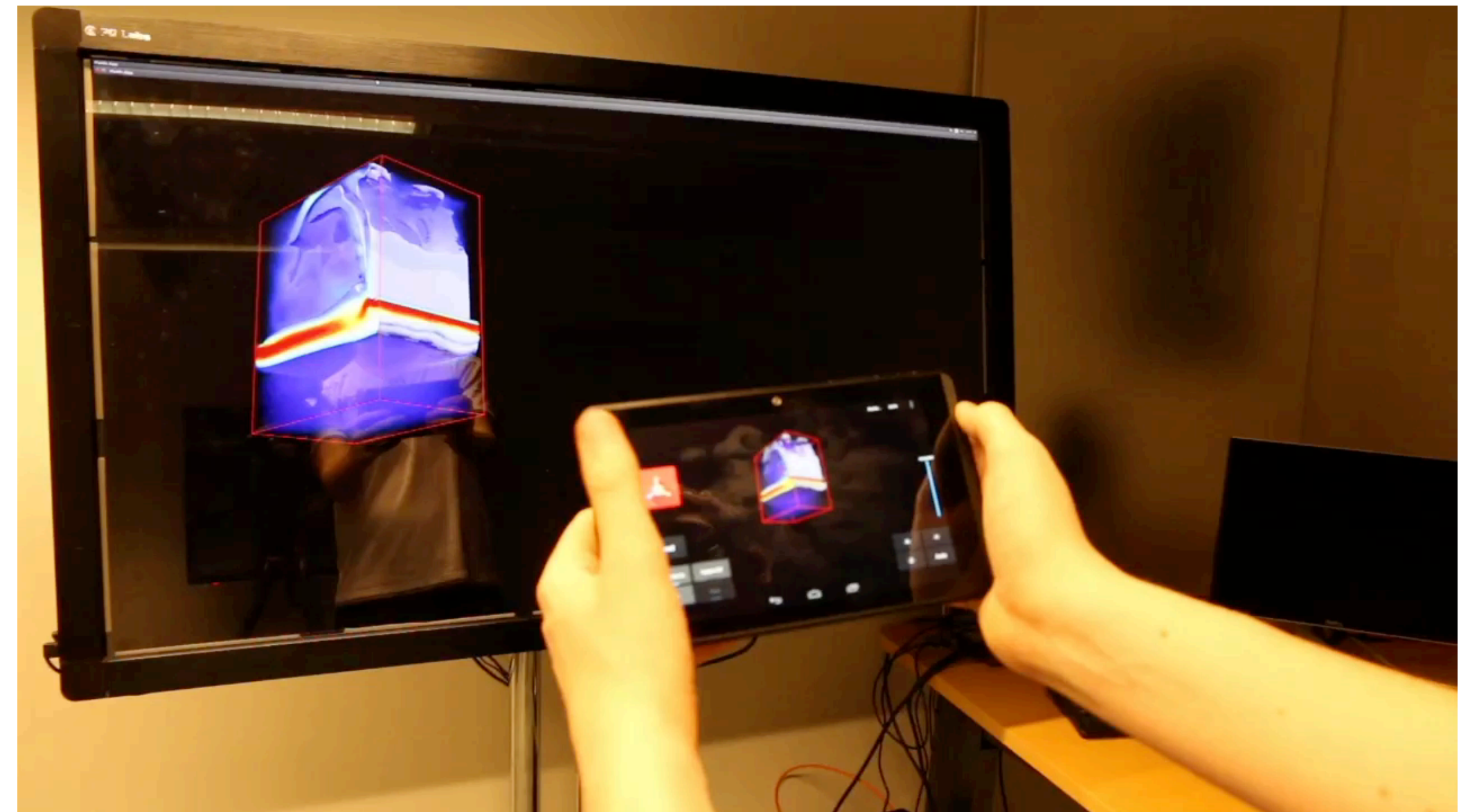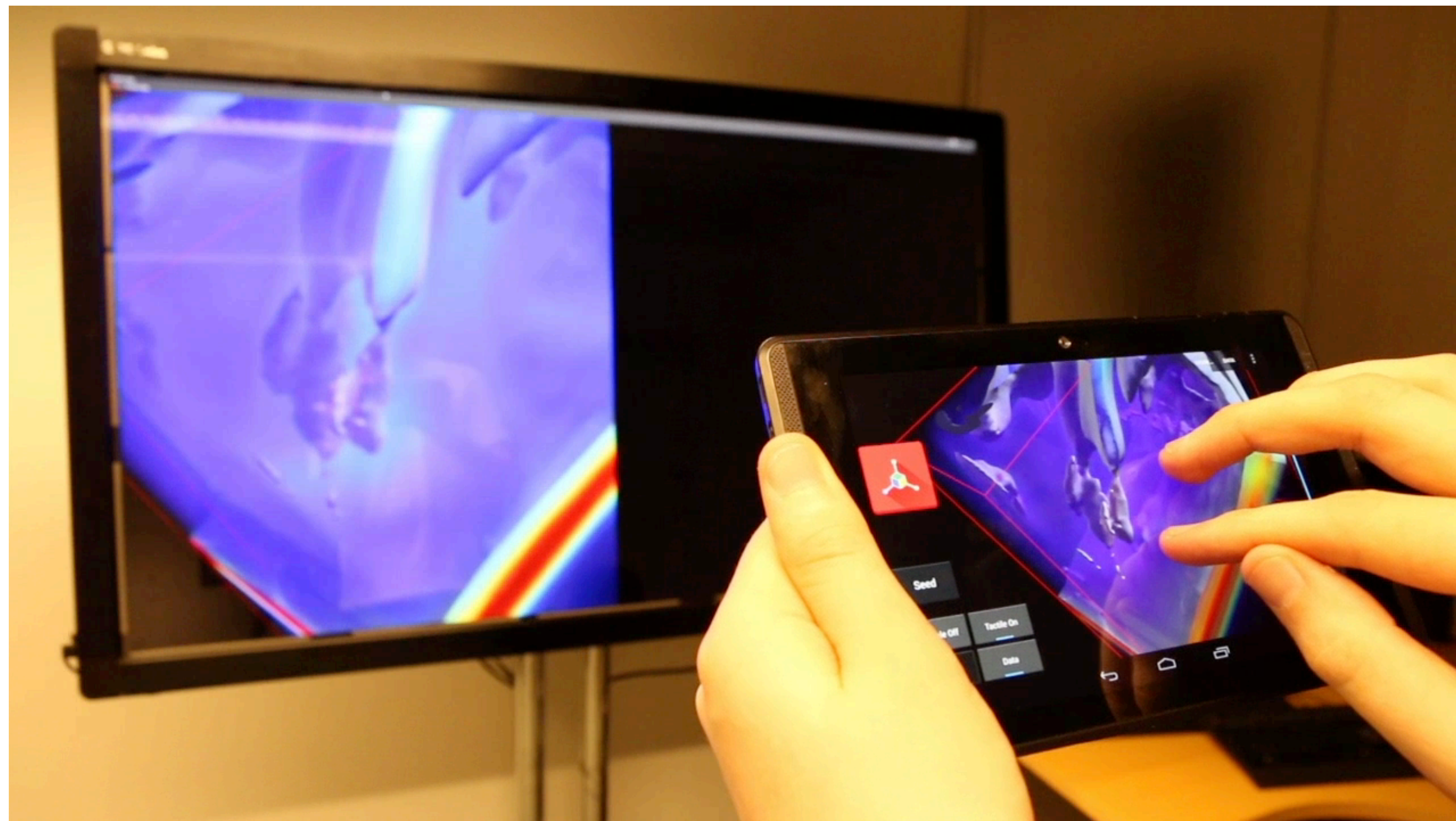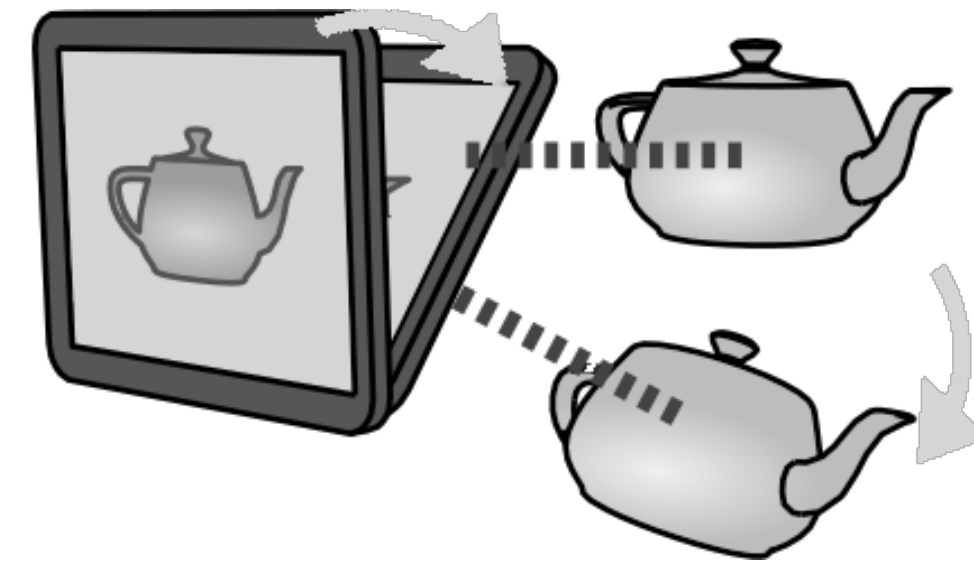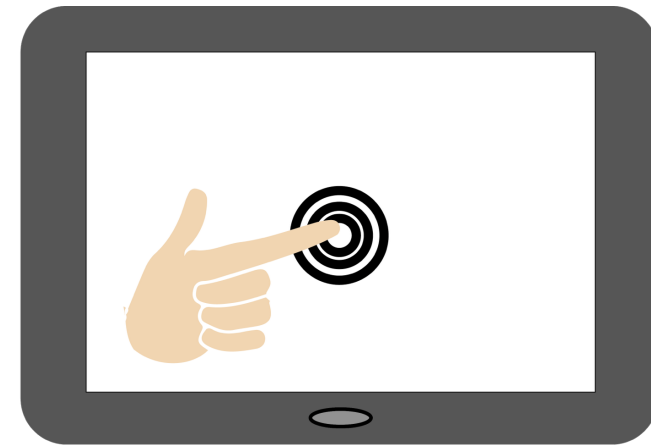
3D cutting plane manipulations
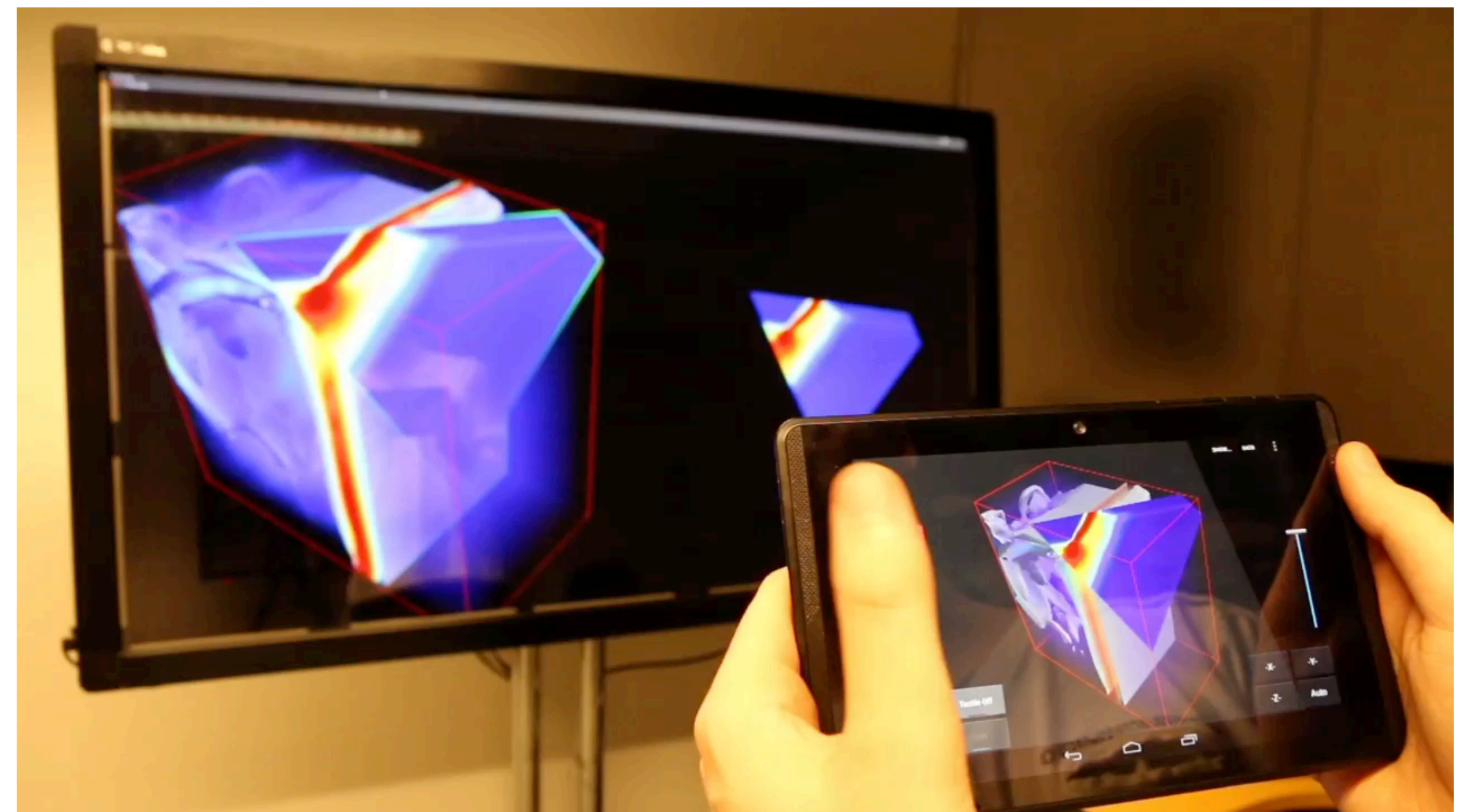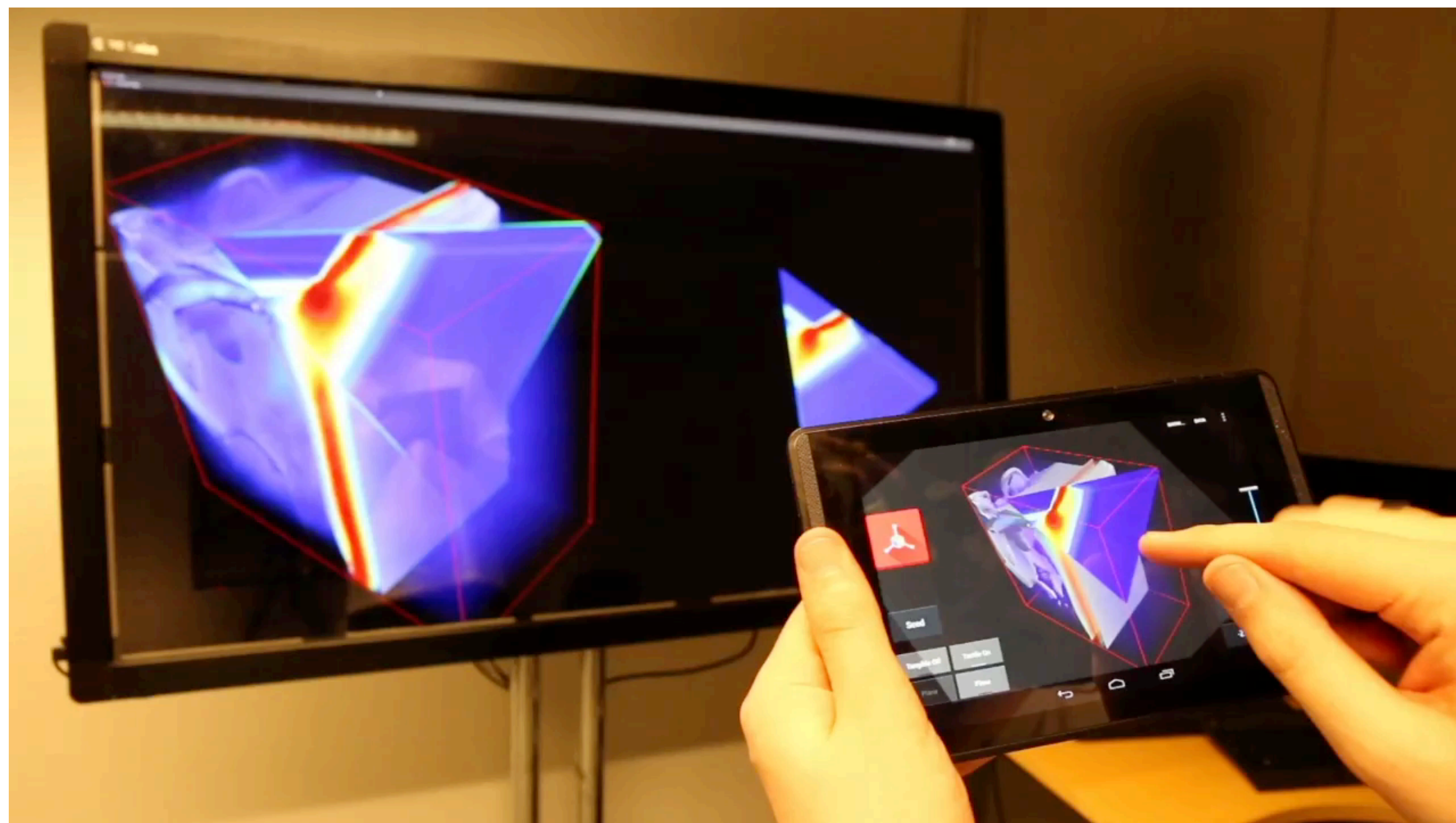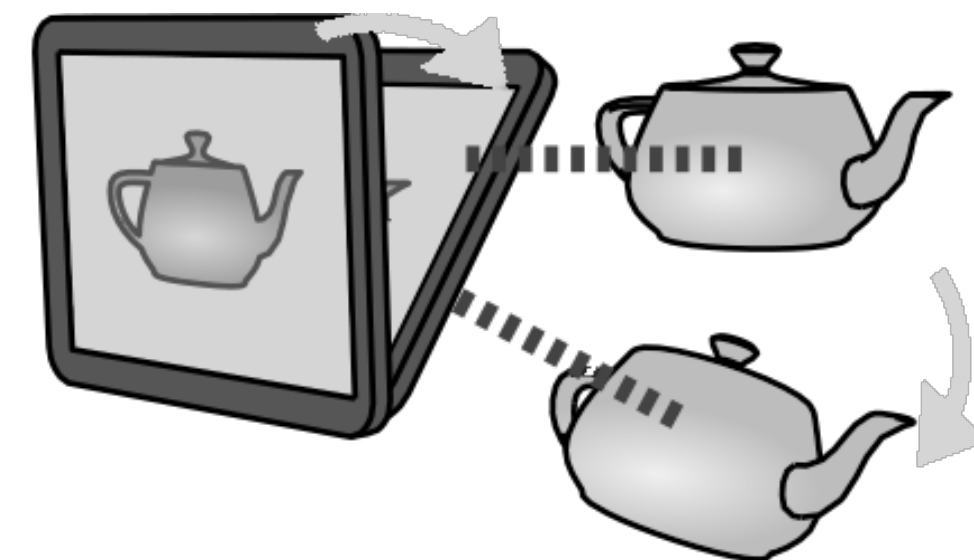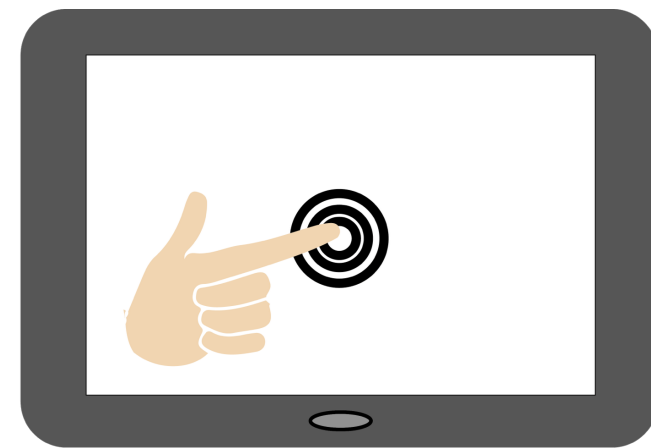
Hybrid Tactile/Tangible manipulations
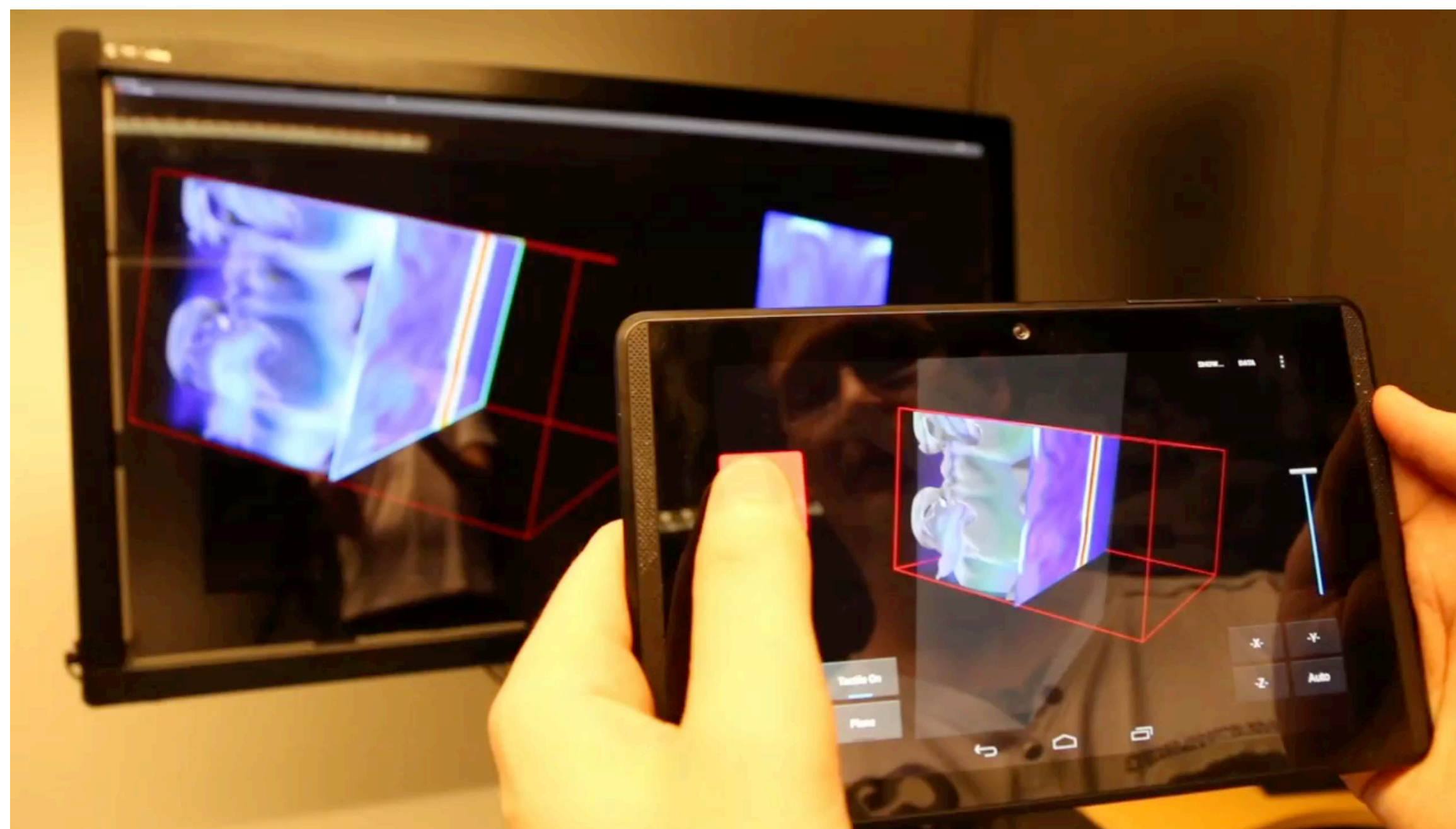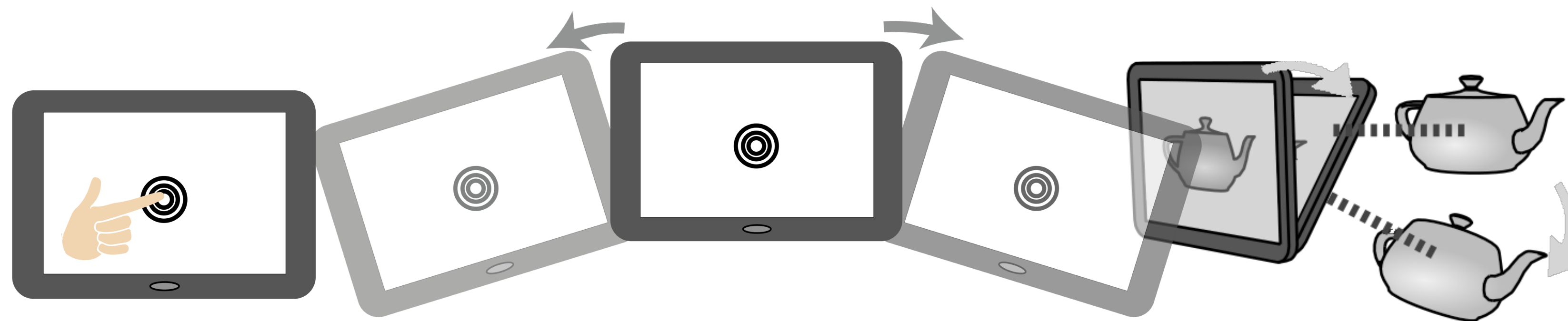
Gain-factor manipulations
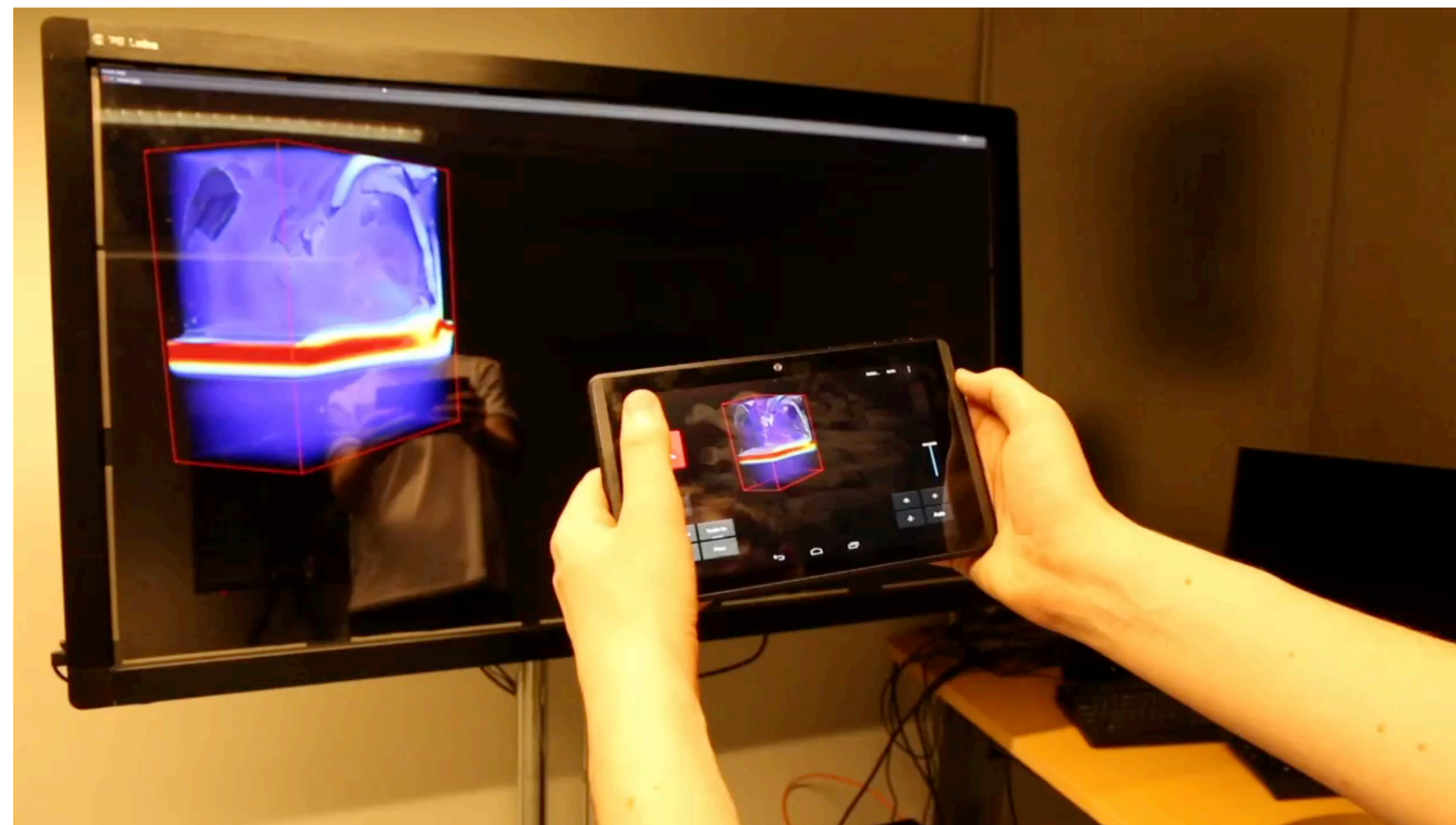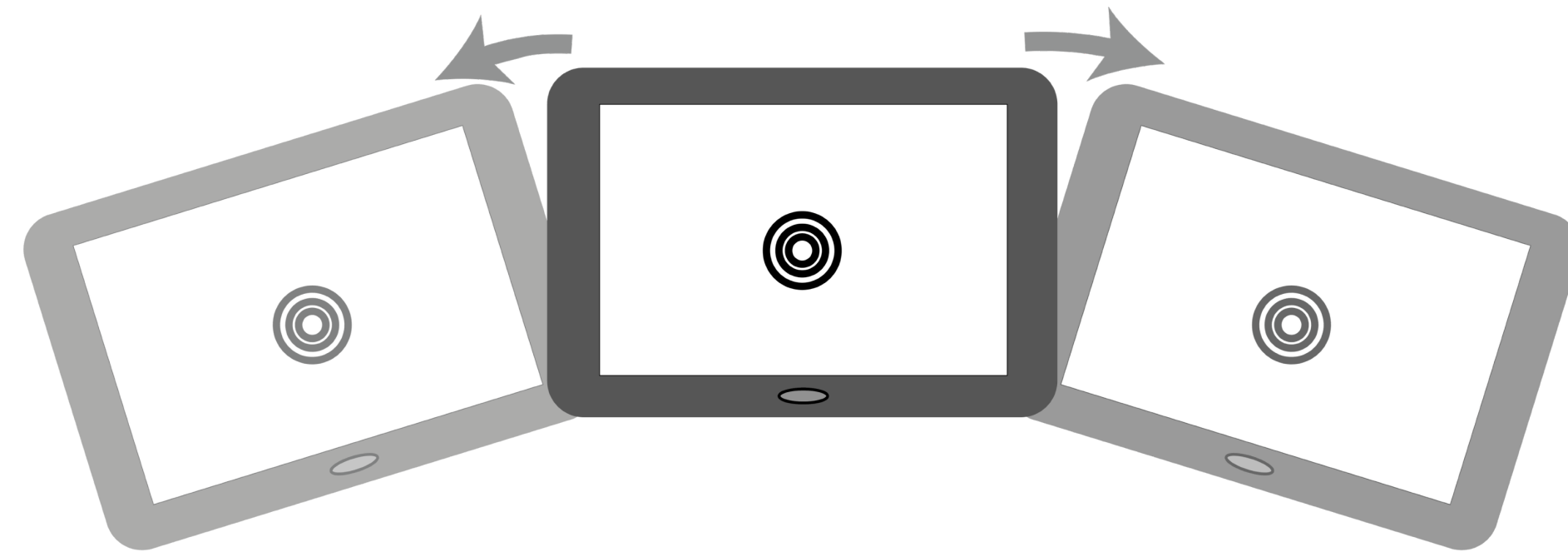
Seeding point Placement
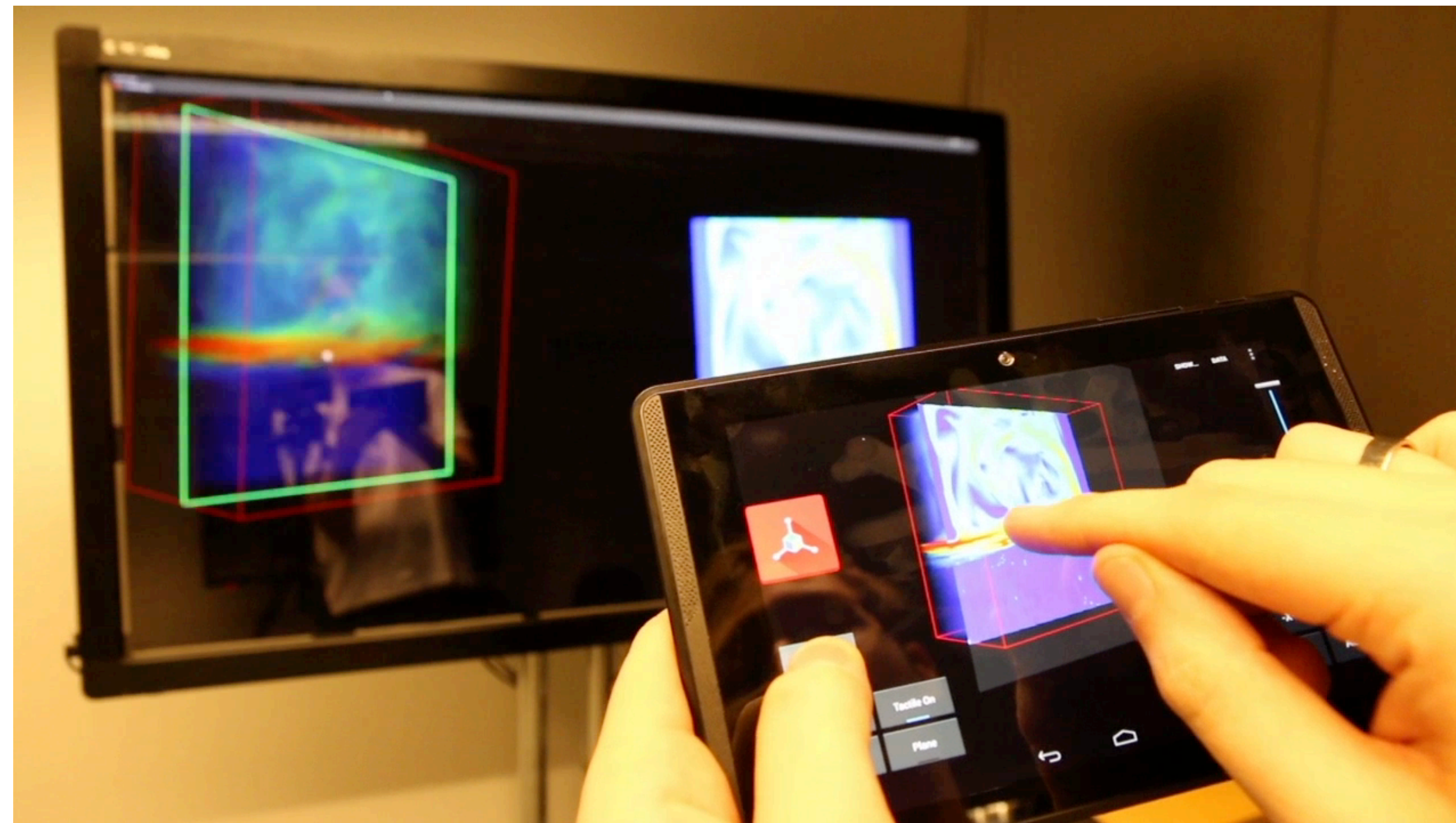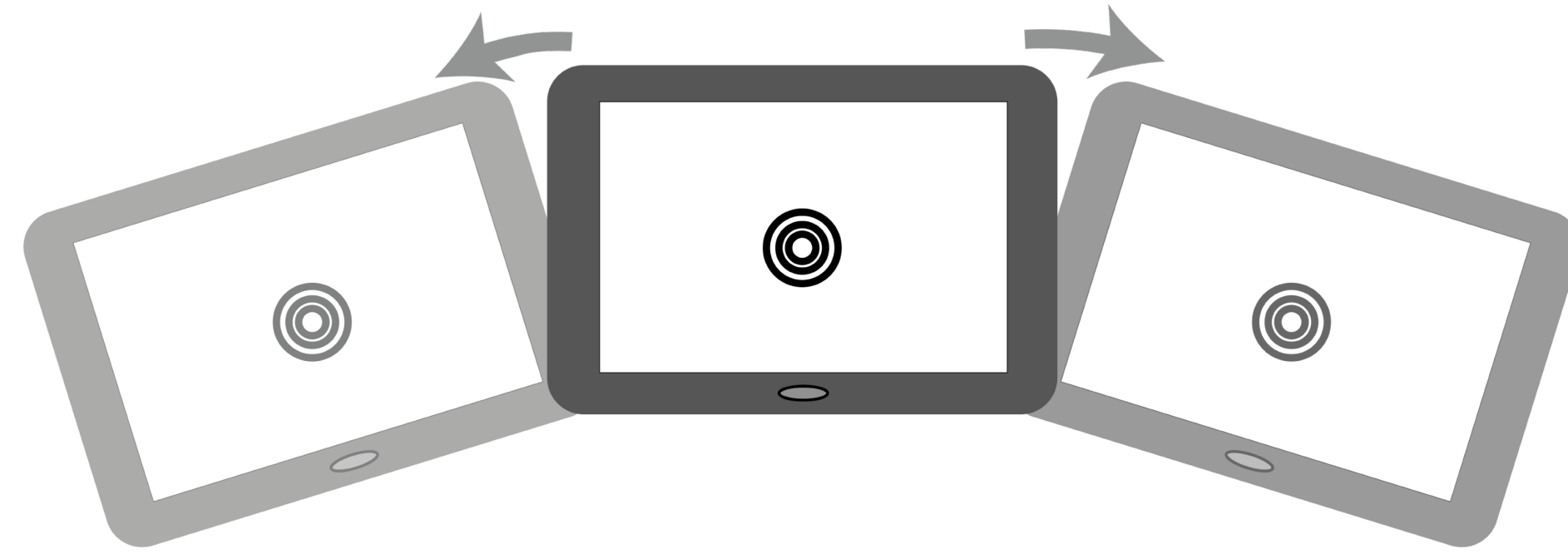
Hybrid Interaction Study

- 7 fluid dynamic researchers (mean 12.8 years of experience)

- Free exploration task with a FTLE dataset

- Questionnaires
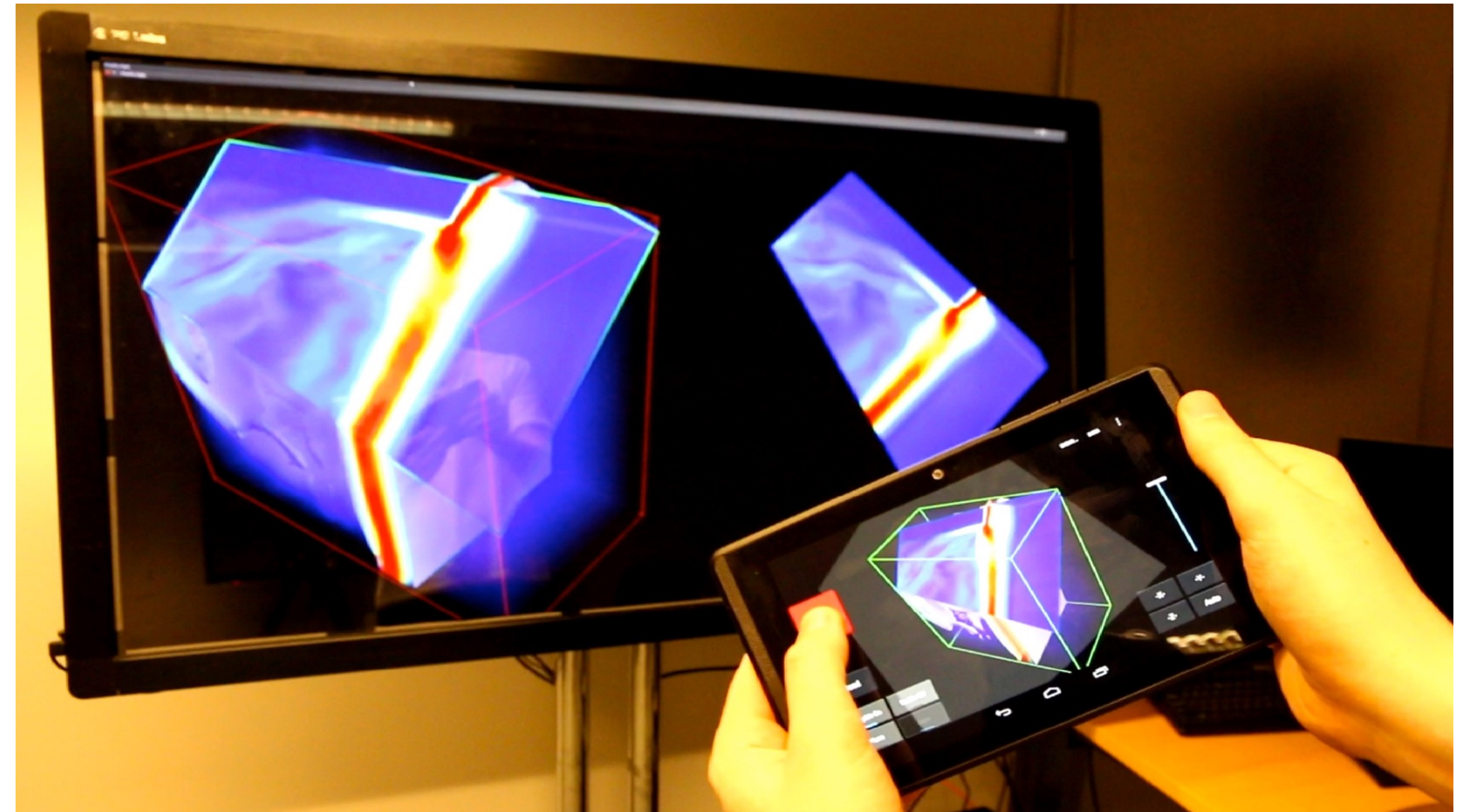
Quantitative Results
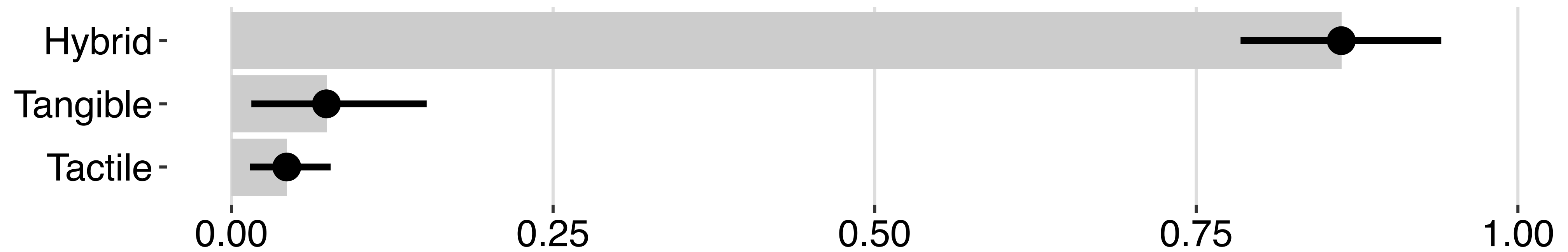
ratio of time spent interacting in the different conditions, error bars 95% CI

Quantitative Results
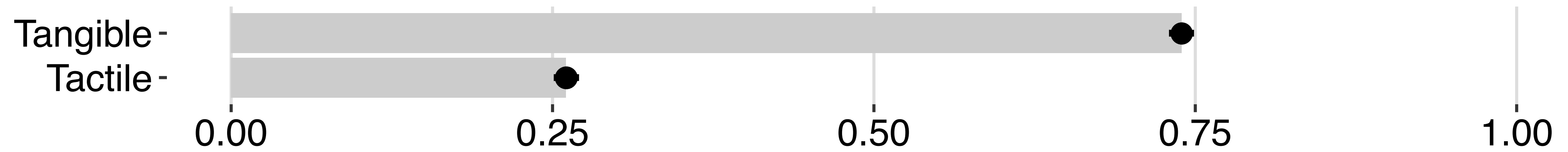
ratio of time spent using the tactile and tangible conditions in hybrid, error bars 95% CI

Quantitative Results
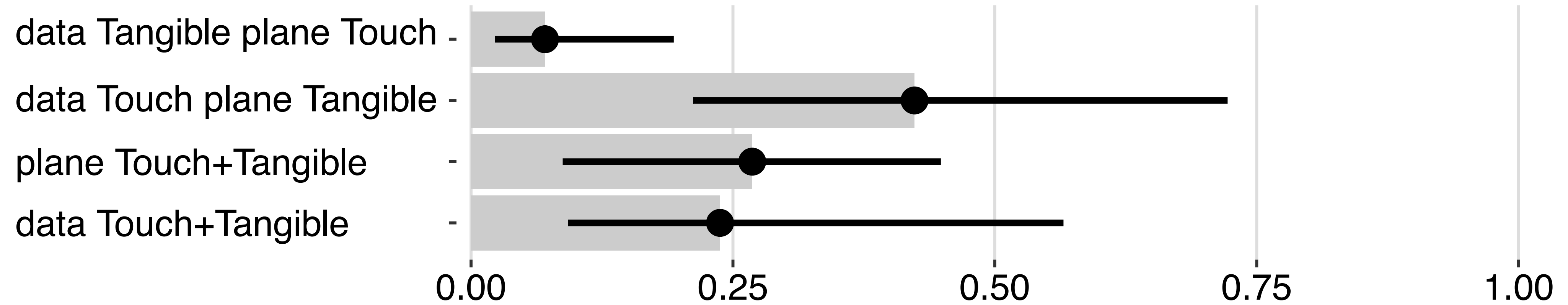
ratio of time spent interacting with the different plane/data associations in Hybrid Interaction, error bars 95% CI

Qualitative Results: Preferences

Legend: ☐ Ranked 1st · ◨ Ranked 2nd · ■ Ranked 3rd

	P1	P2	P3	P4	P5	P6	P7
HYBRID RANKING	☐	◨	☐	☐	☐	☐	☐
TOUCH RANKING	■	☐	■	◨	■	◨	◨
TANGIBLE RANKING	◨	■	◨	■	◨	■	■
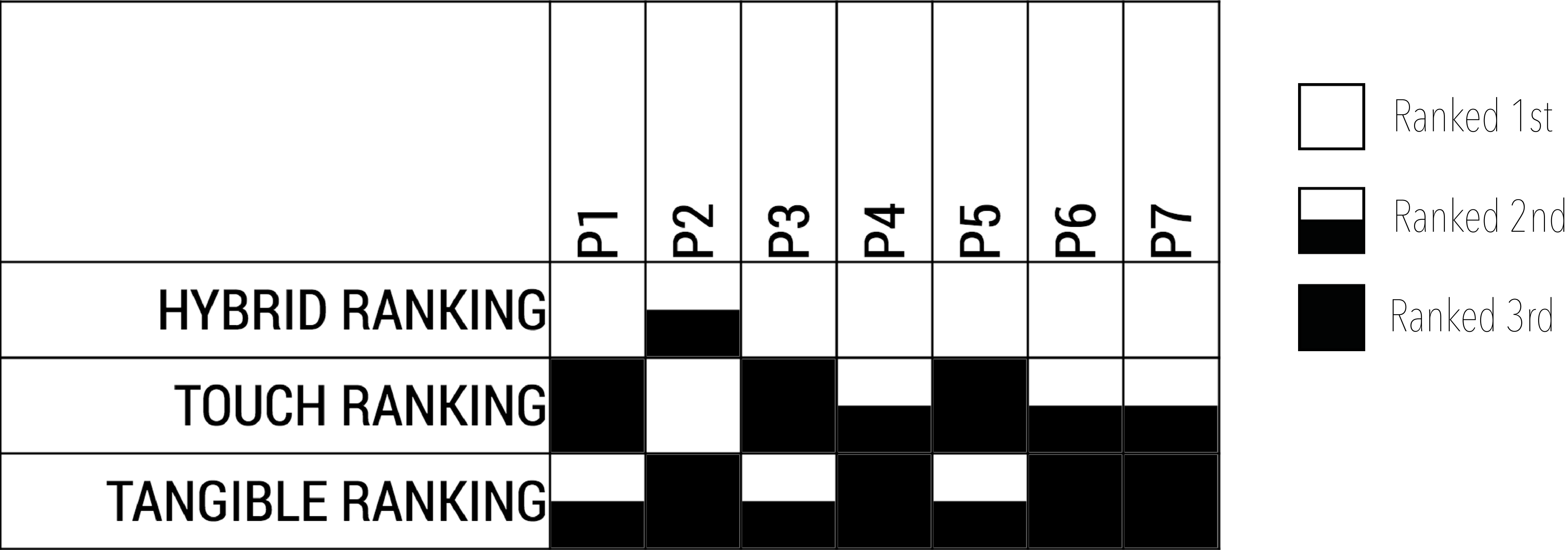
Qualitative Results

- "The system is a reproduction of what I can do with a PC but with better interaction techniques"

- "Seed point placement is more engaging and flexible"

- "I could achieve rotations or translation difficult to perform with a mouse-only approach"

- "Could be used as an extra visualization tool for primary analysis before getting back to a PC for more in depth analysis that requires scripts"

Qualitative Results

- Only 1 participant did not consider the tool as being fit for practical work yet

- 5 participants would gladly use it if synchronises with their desktop stations

Limitations

Limitations

90

130

150

500

100

60
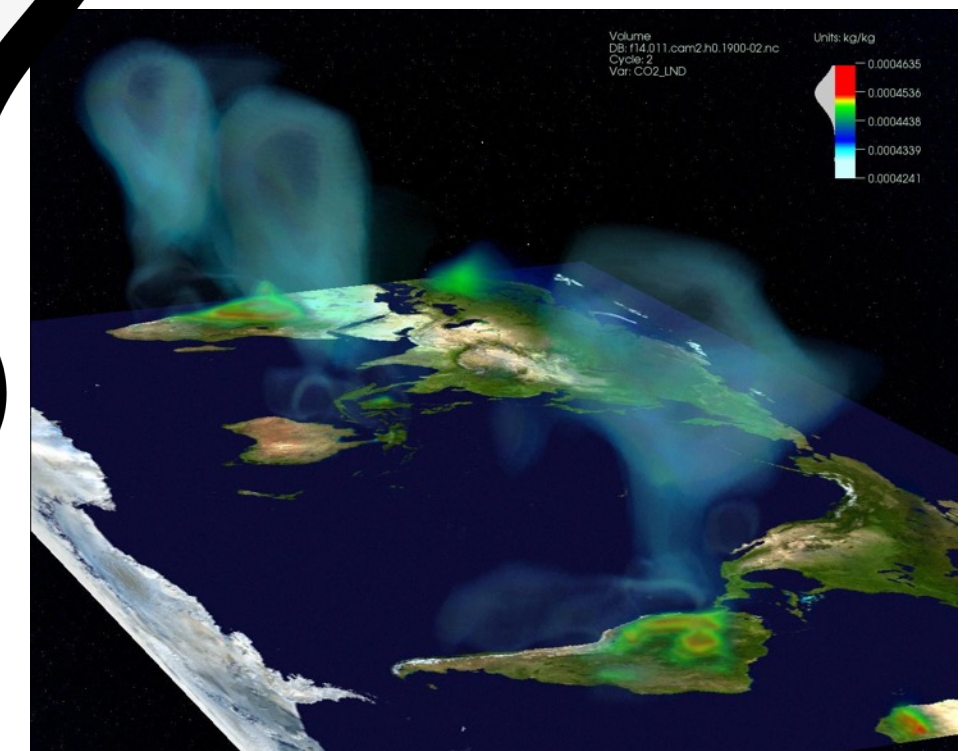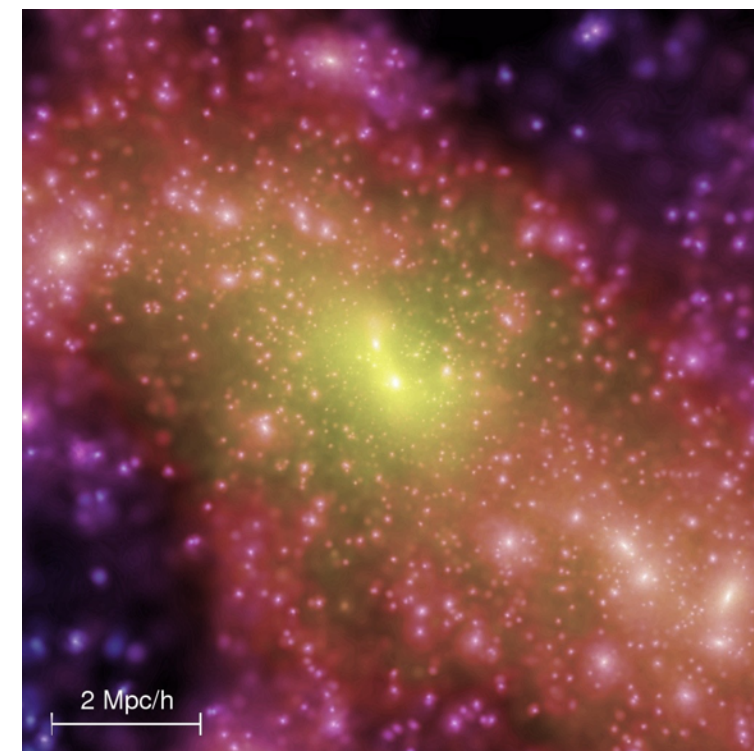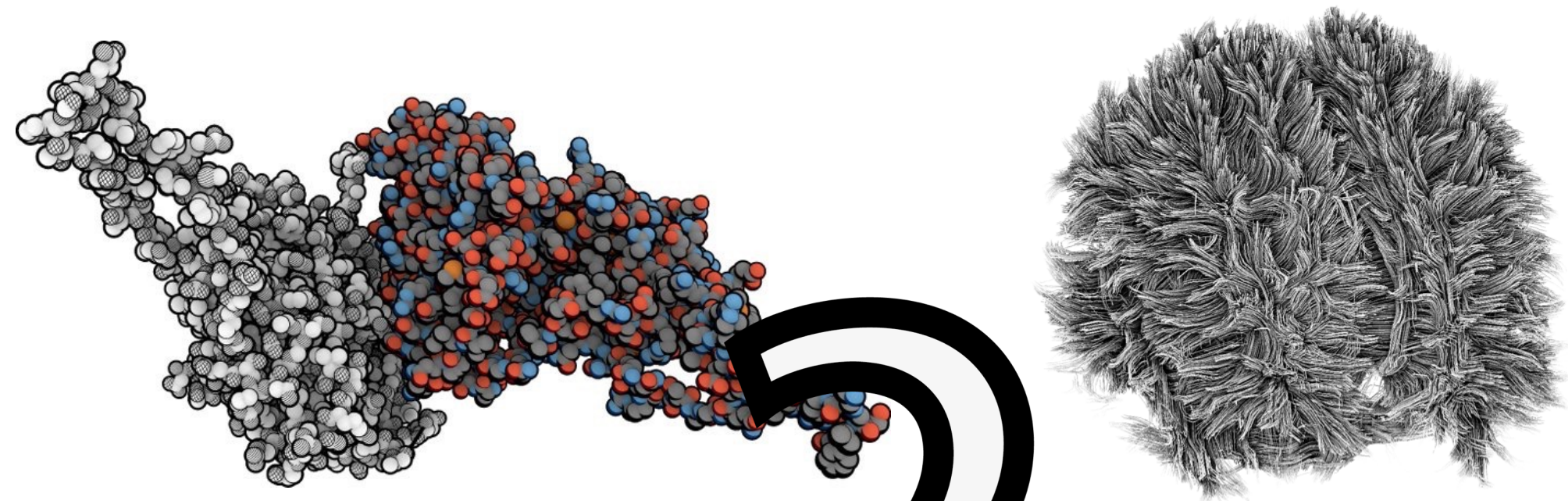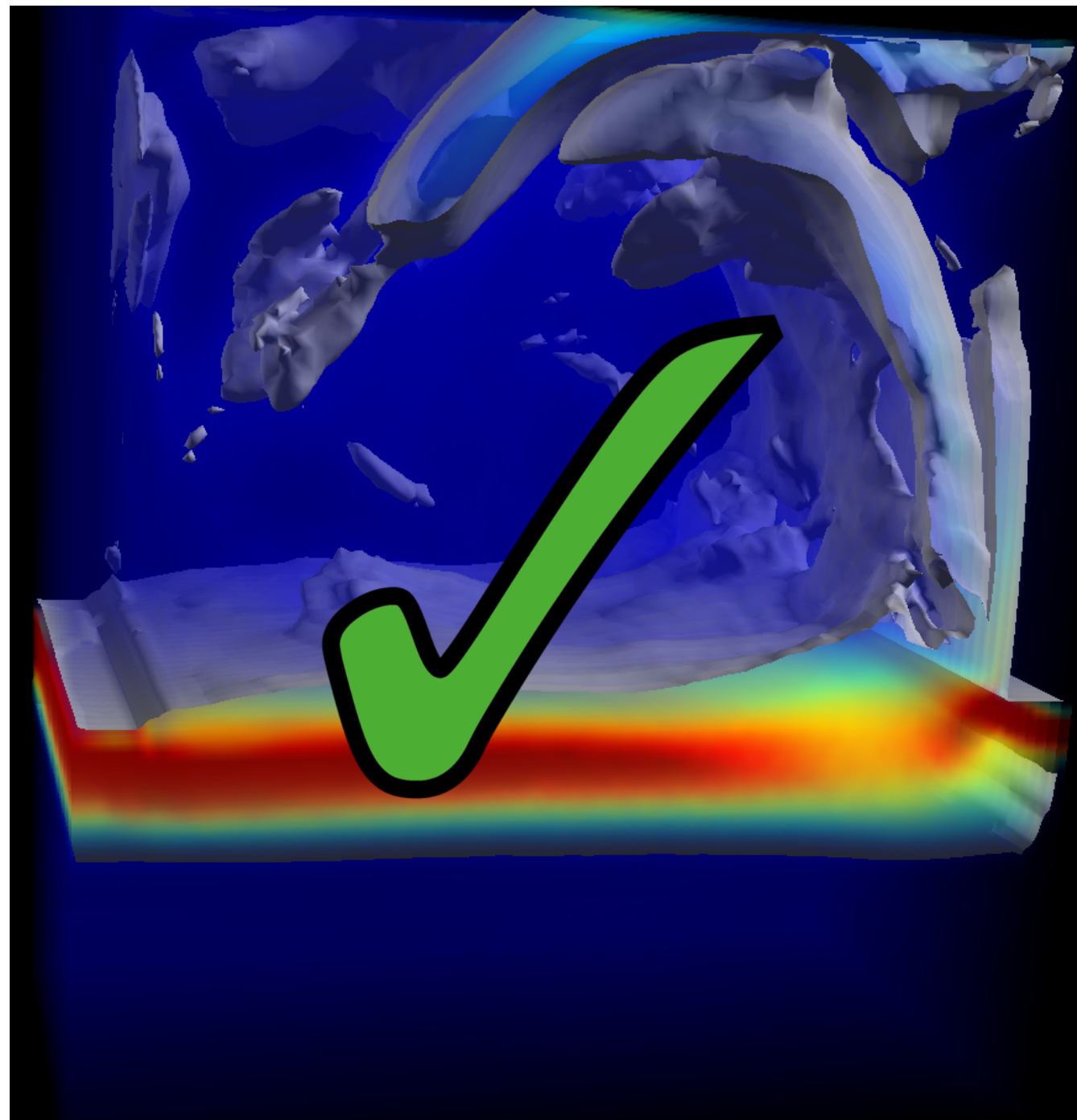
Limitations

Conclusion

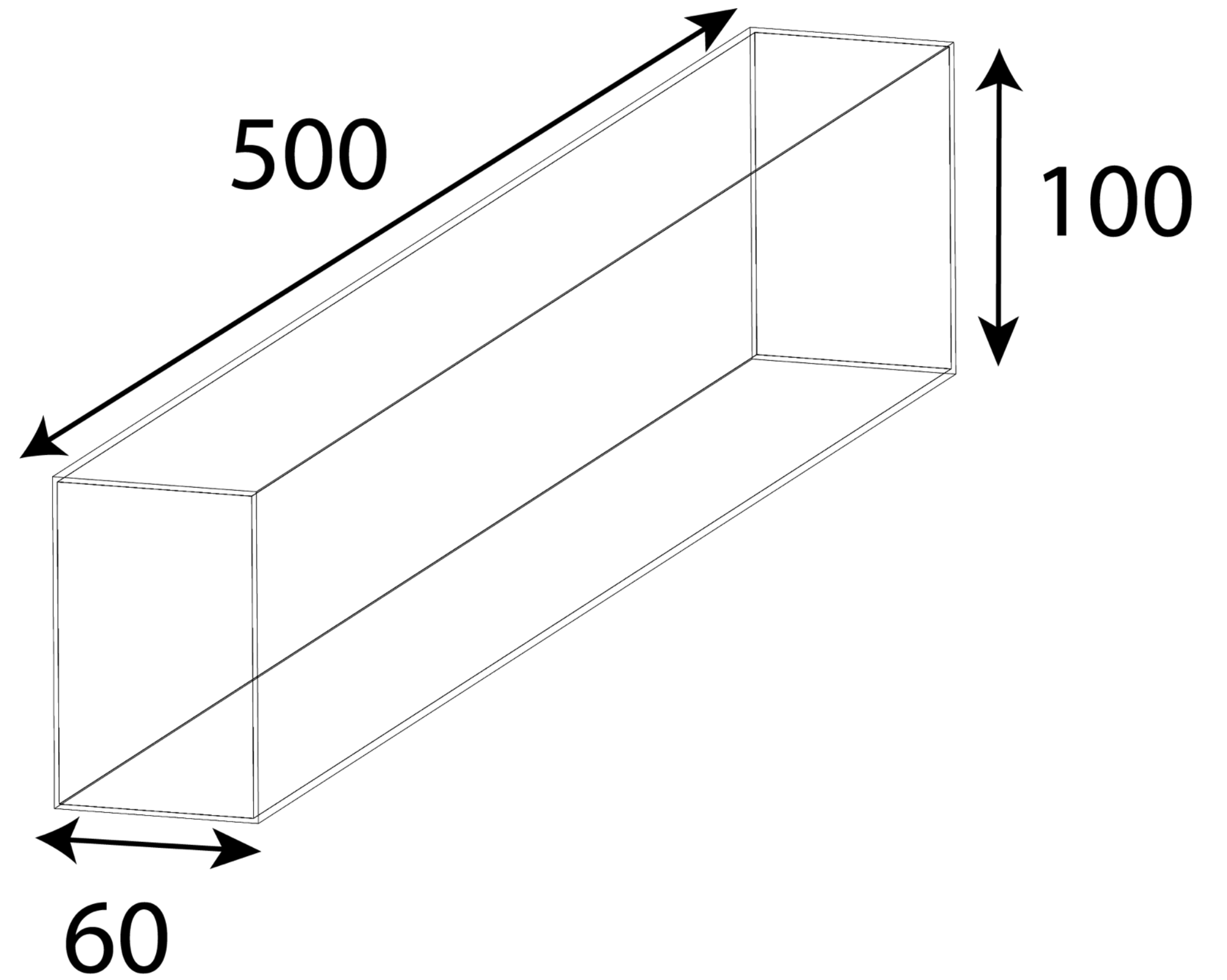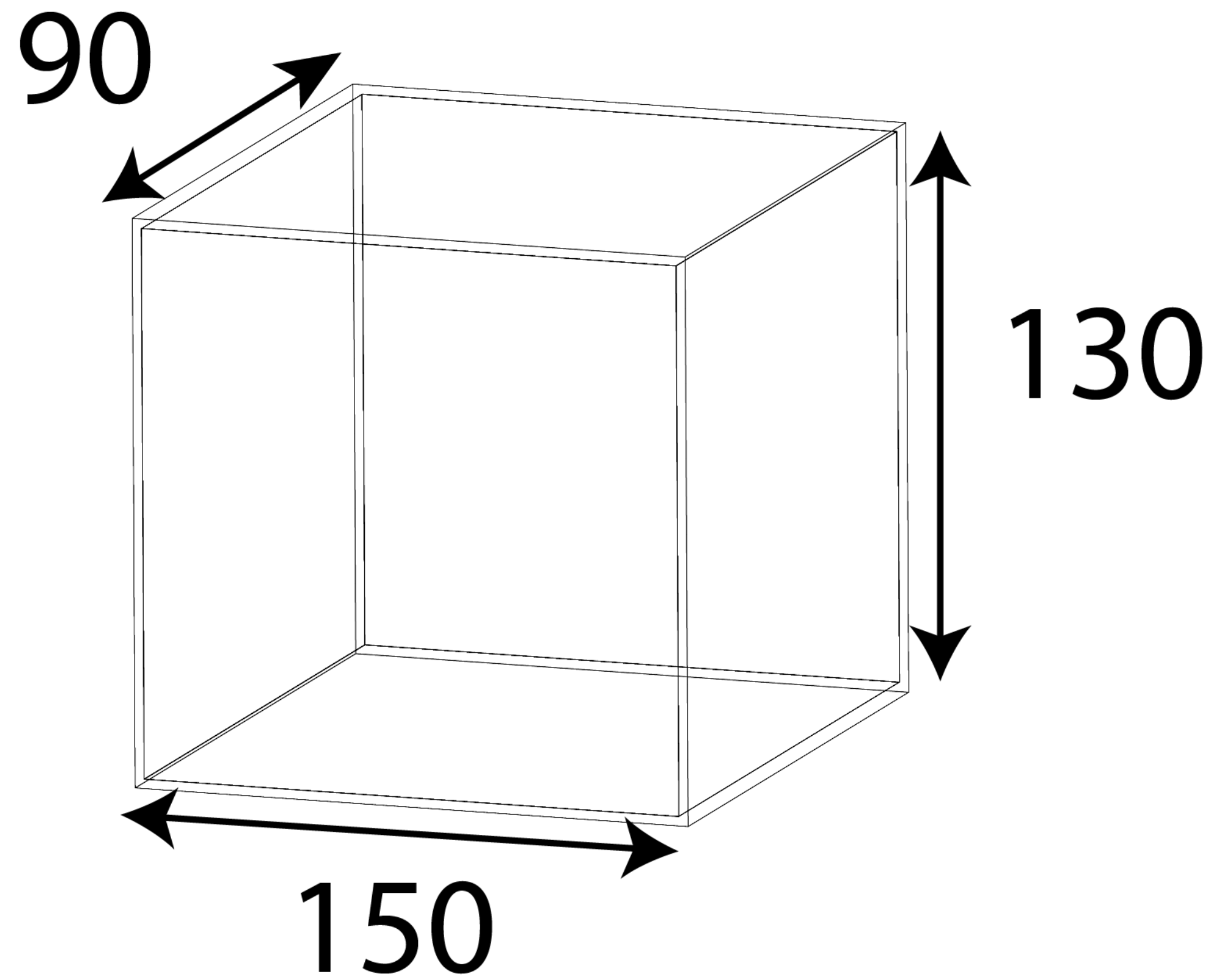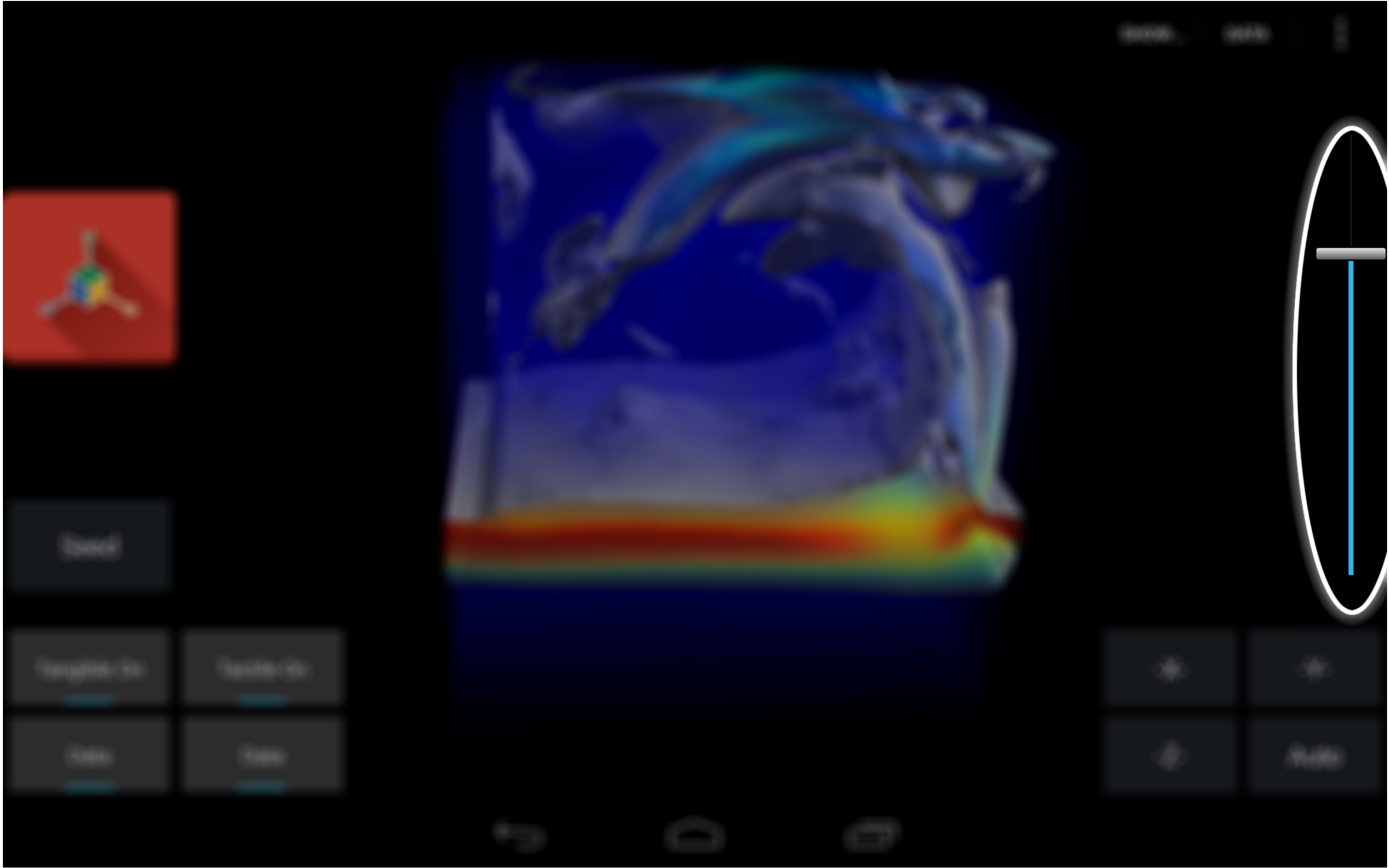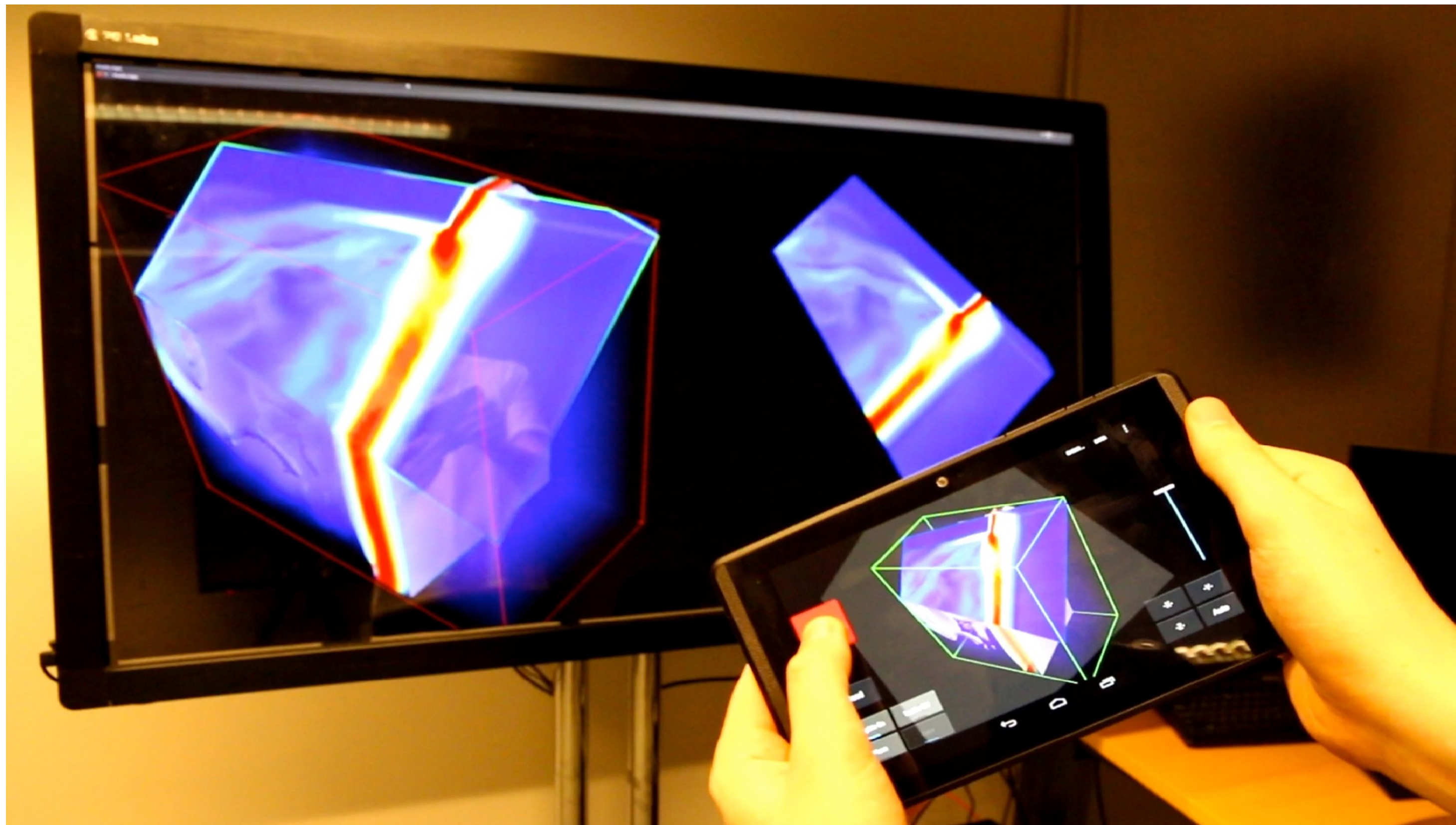- Hybrid interaction possible with off-the-shelves hardware

- Complex tasks easily achieved with a hybrid tactile/tangible input

- Hybrid seed point placement is more flexible

- Hybrid interaction is largely preferred

Interactive 3D Data Exploration Using Hybrid Tactile/Tangible Input

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http://tiny.cc/hybridinteraction