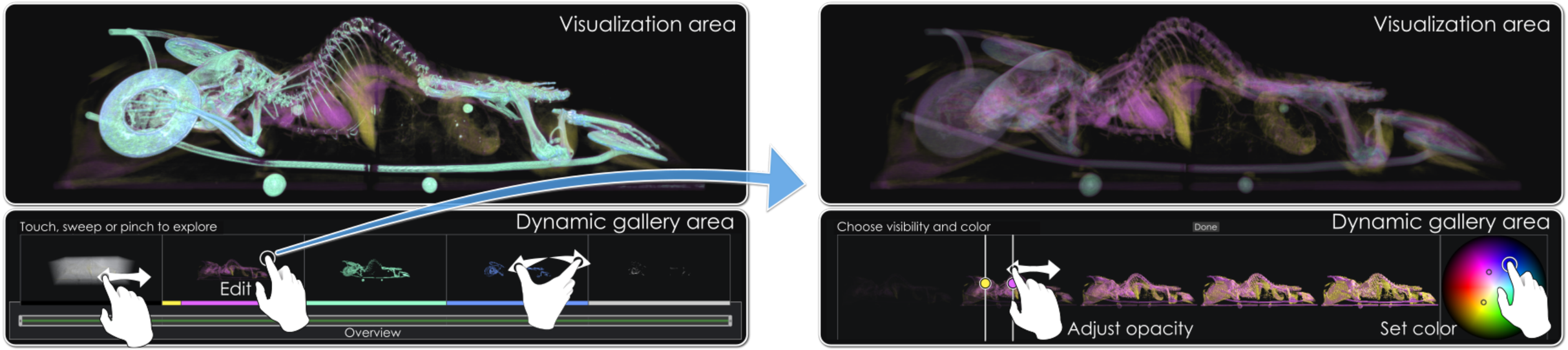
Hybrid Tactile/Tangible Interaction for 3D Data Exploration

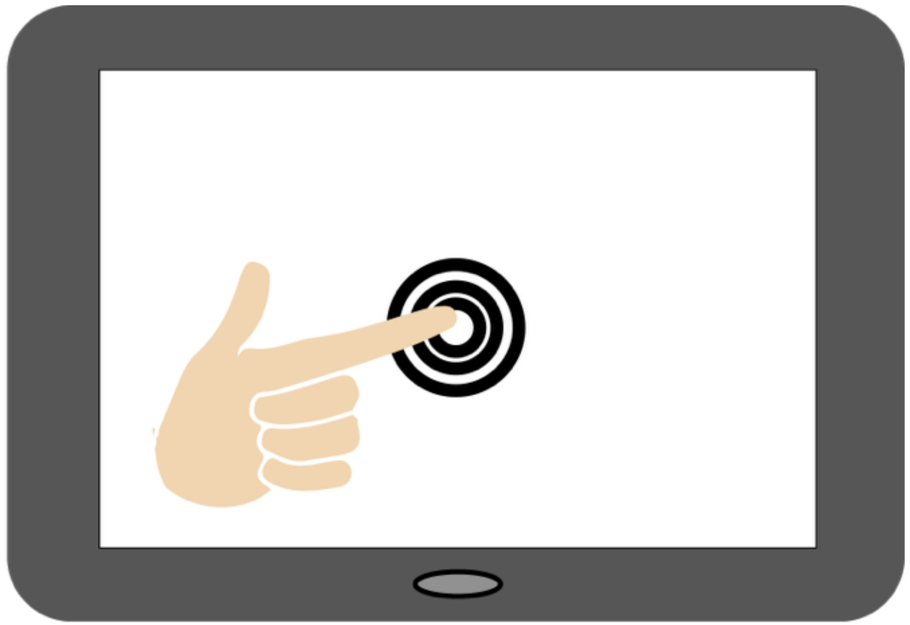
Lonni Besançon, Paul Issartel, Mehdi Ammi, Tobias Isenberg

Problem



Jönsson et al. (2016)

Problem



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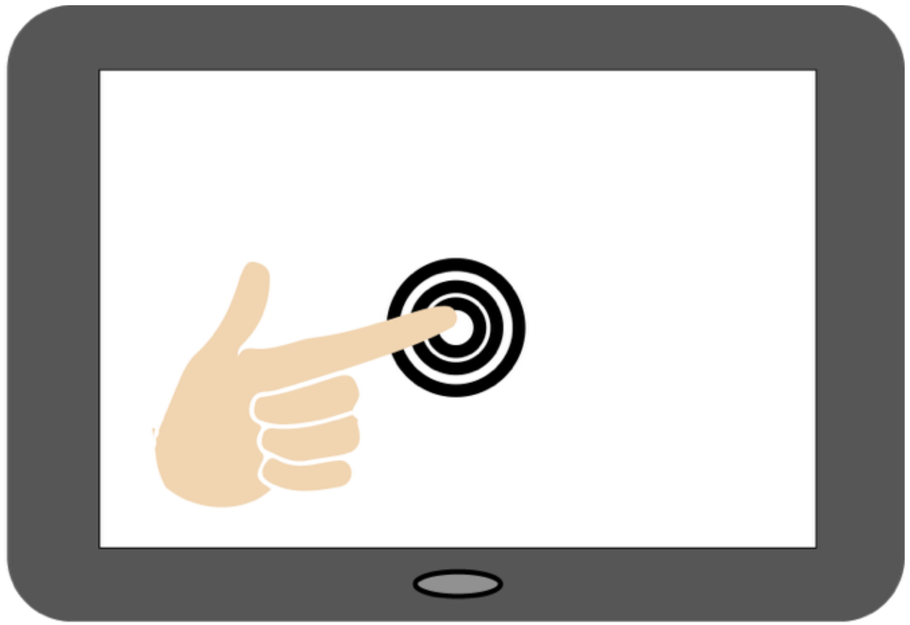
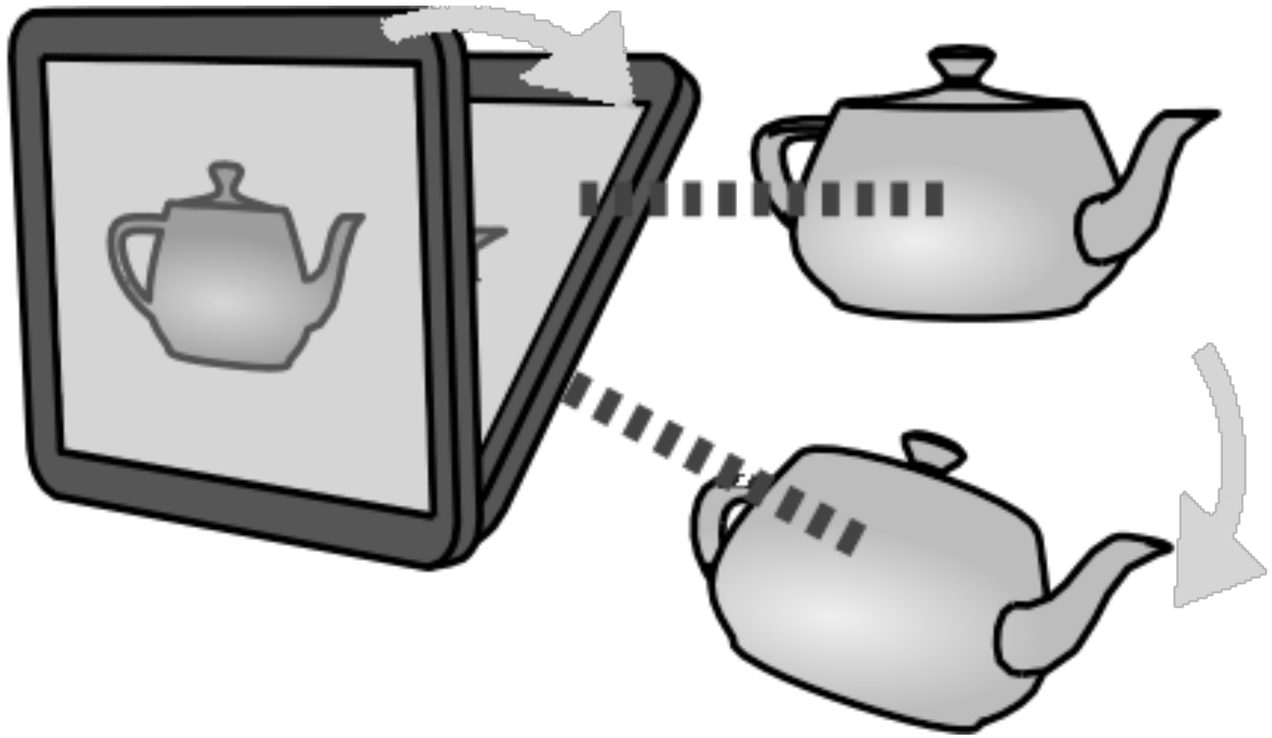
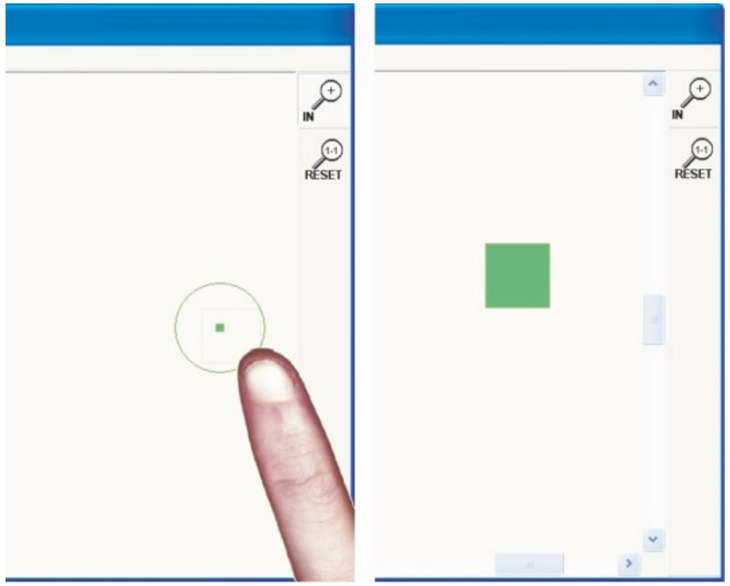




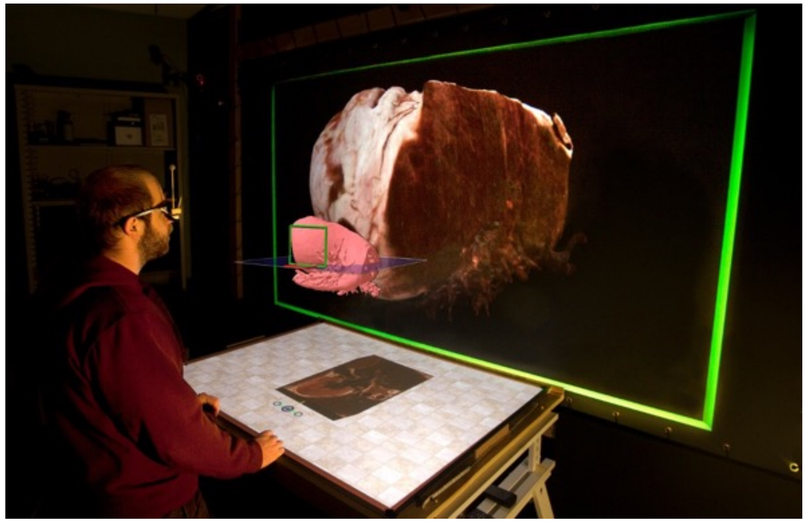
Tactile interaction

Yu et al. (2010)

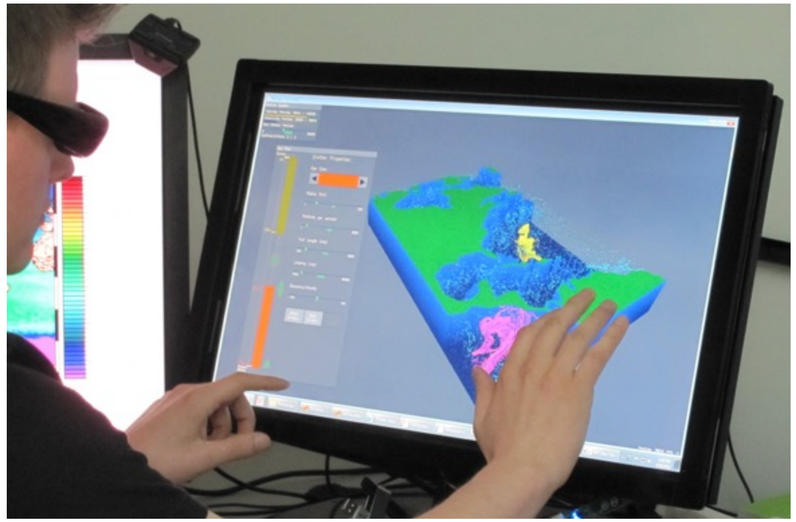


Albinson & Zhai. (2003)

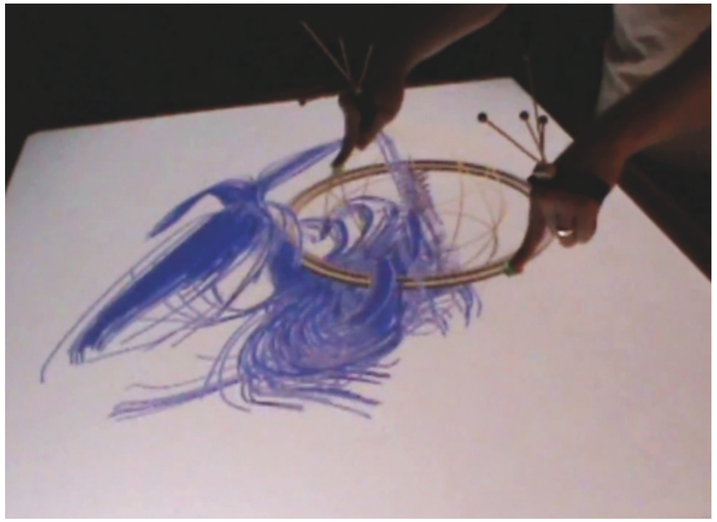
Tactile interaction



Coffey et al. (2012)

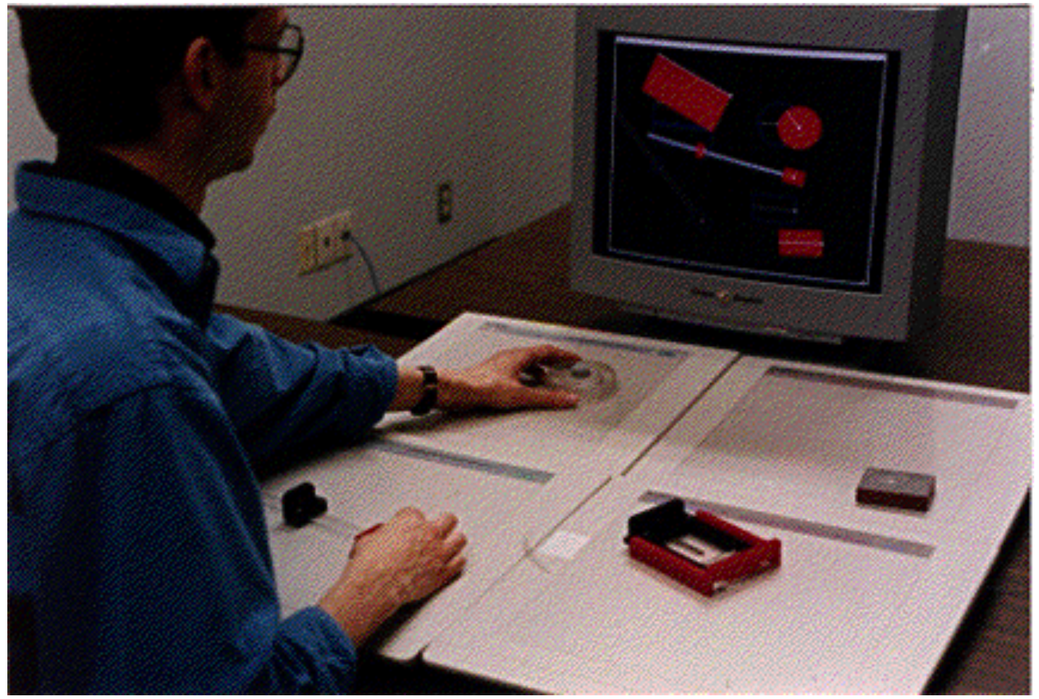


Butkiewicz & Ware (2012)



Jackson et al. (2012)

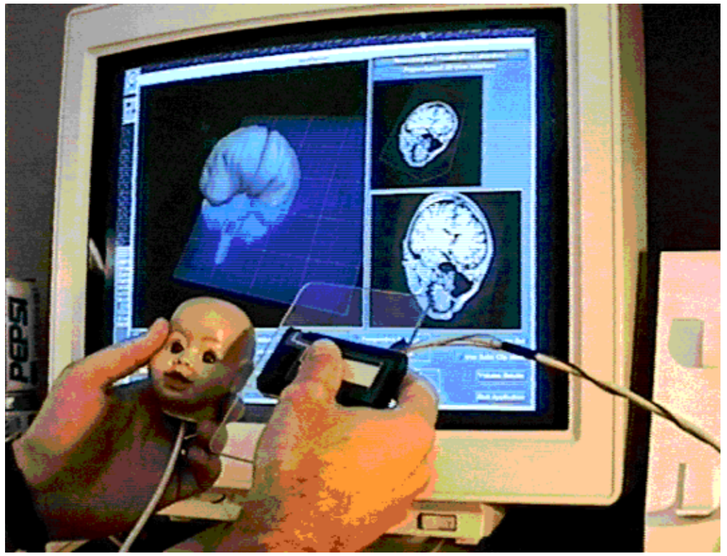
Tangible Interaction



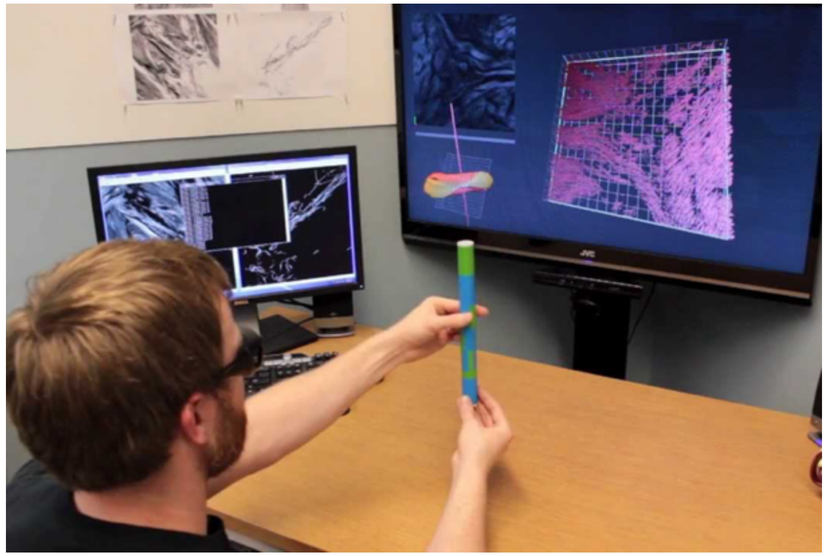
Fitzmaurice & Buxton (1997)

Besançon et al. (2015)

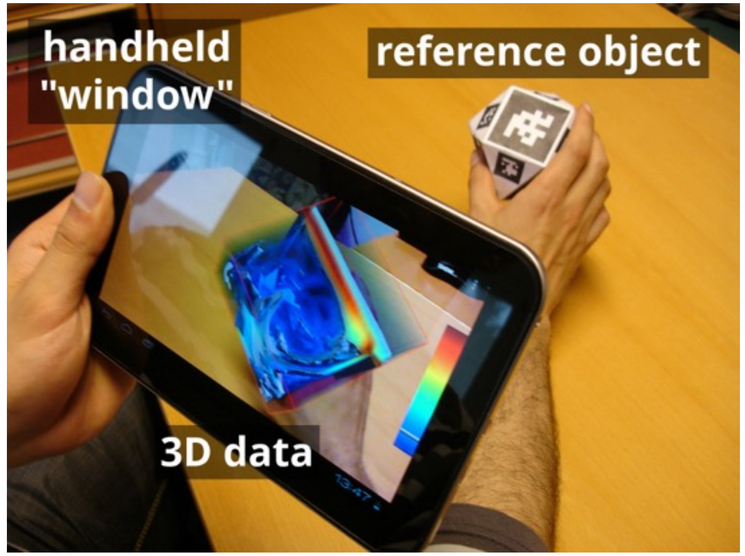
Tangible Interaction



Hinckley et al. (1994)



Jackson et al. (2013)

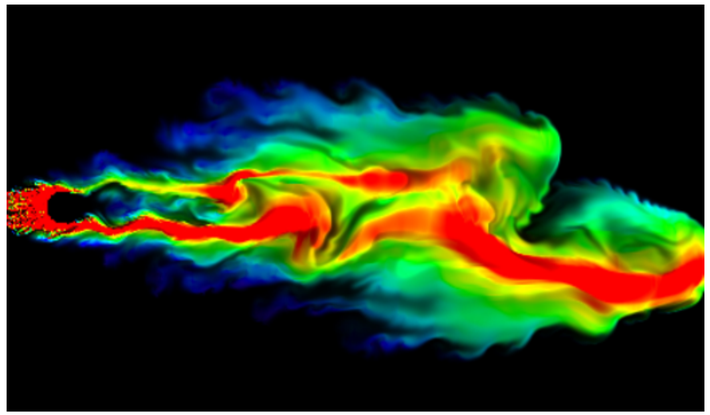


Issartel et al. (2014)

Problem

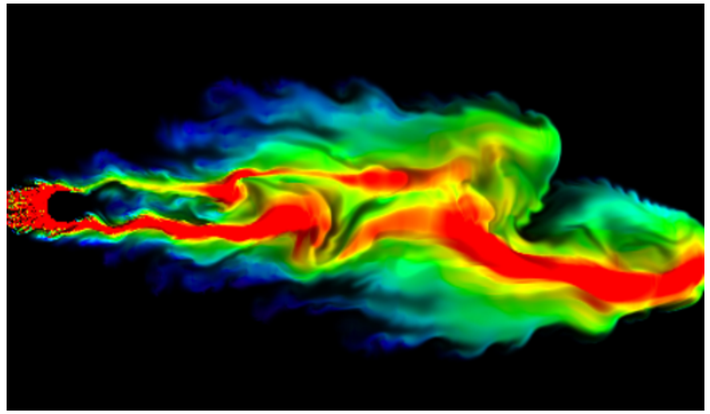
How can tactile and tangible interaction be combined to support 3D data exploration?

Contributions

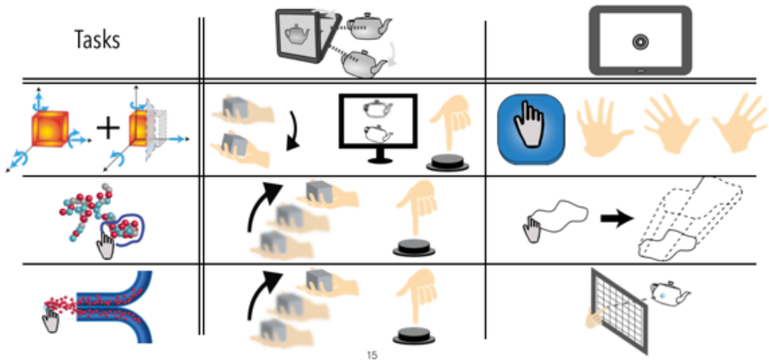


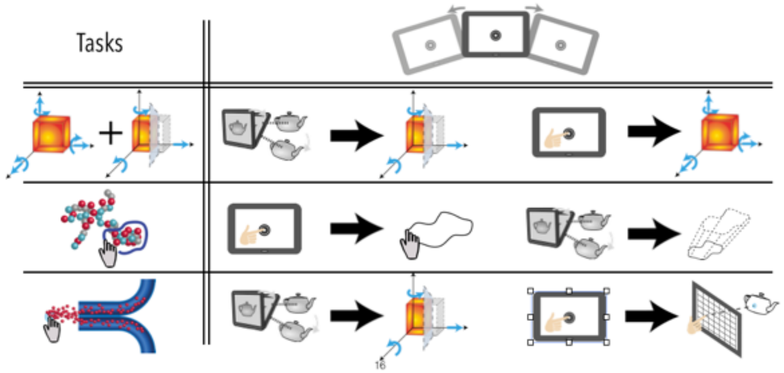
Tsigkari et al. (2012)

Contributions



Tsigkari et al. (2012)





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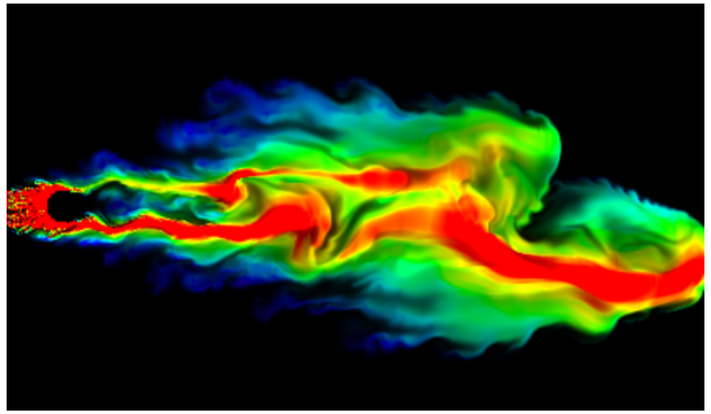
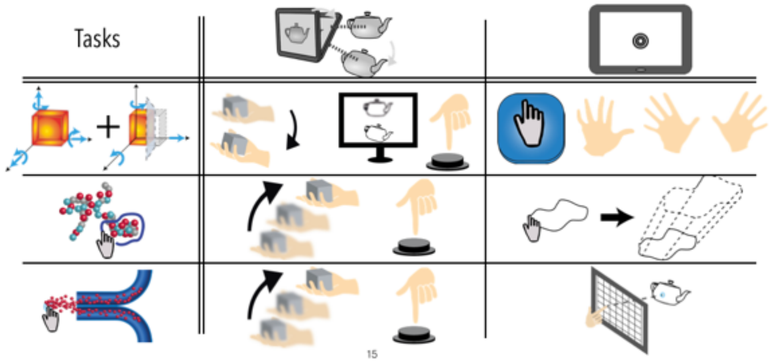
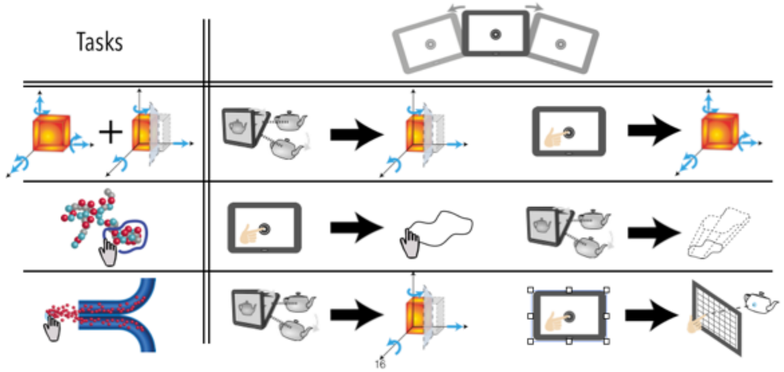
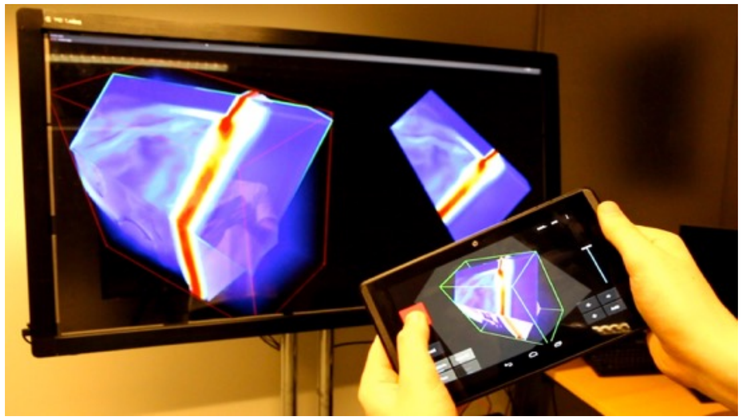


Tsigkari et al. (2012)



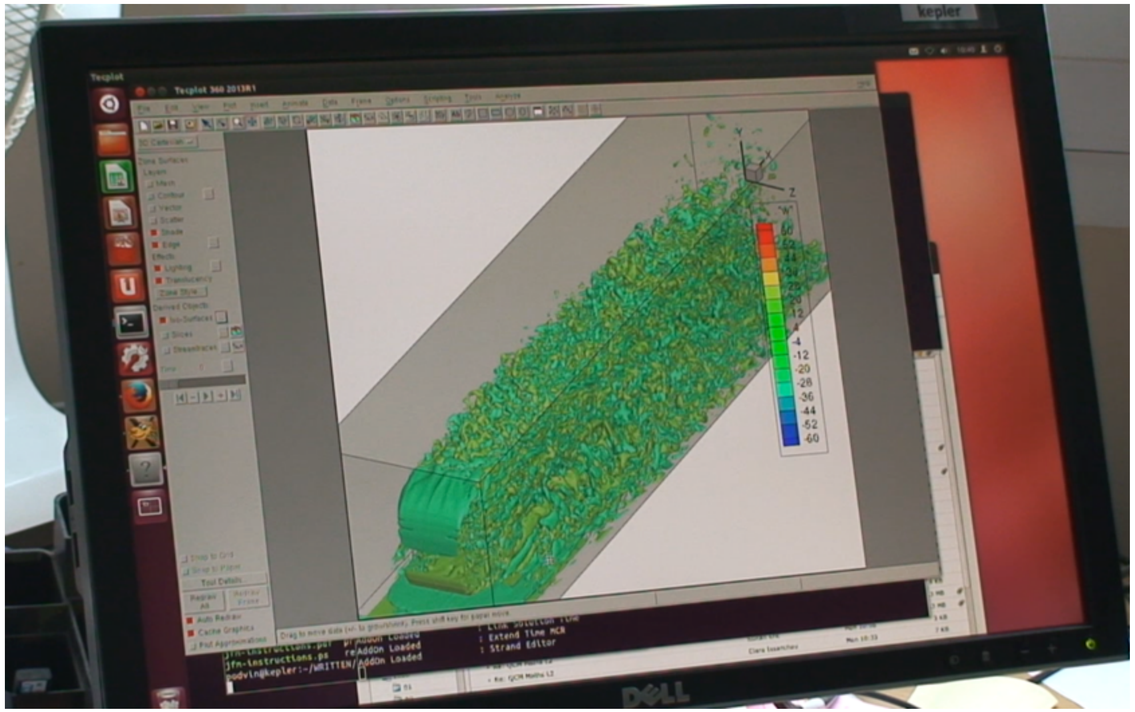




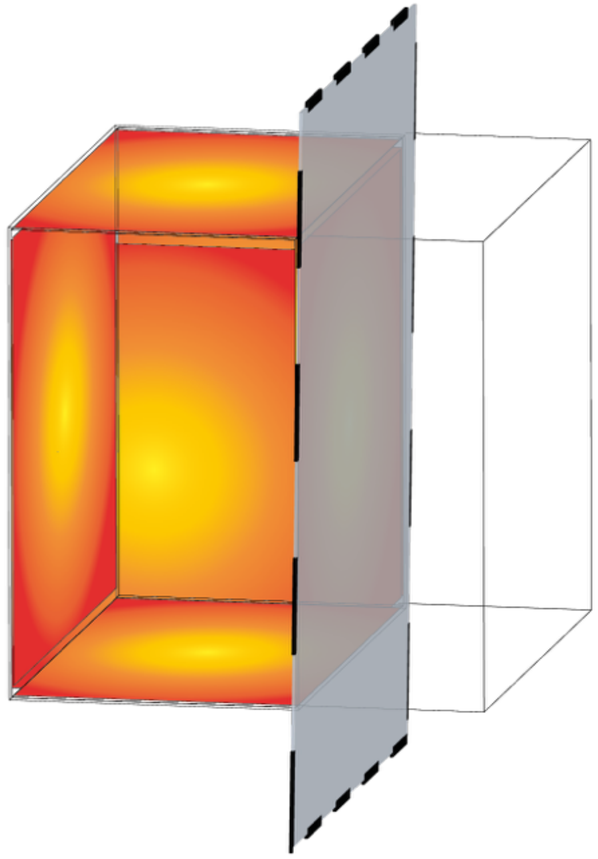
Contribution #1:
Understanding the needs of fluid dynamic experts

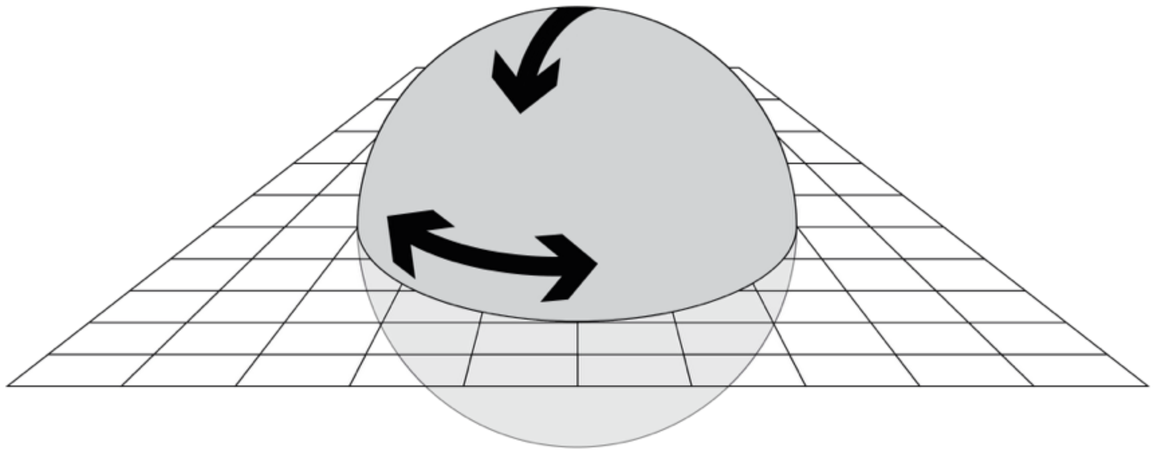
Preliminary study: understanding experts needs

- Field study with experts
- Five fluid dynamic researchers
- Observations and video-recordings
- Semi-structured interviews



Preliminary study results





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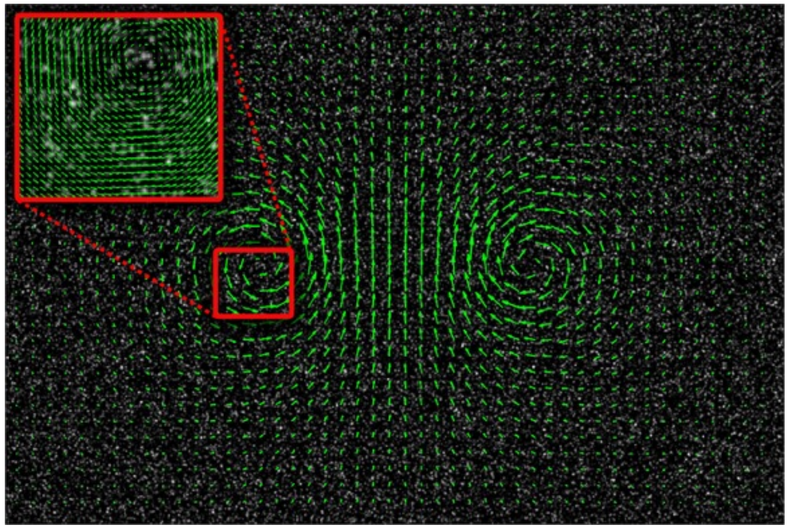

PIVlab multipass ©Willa

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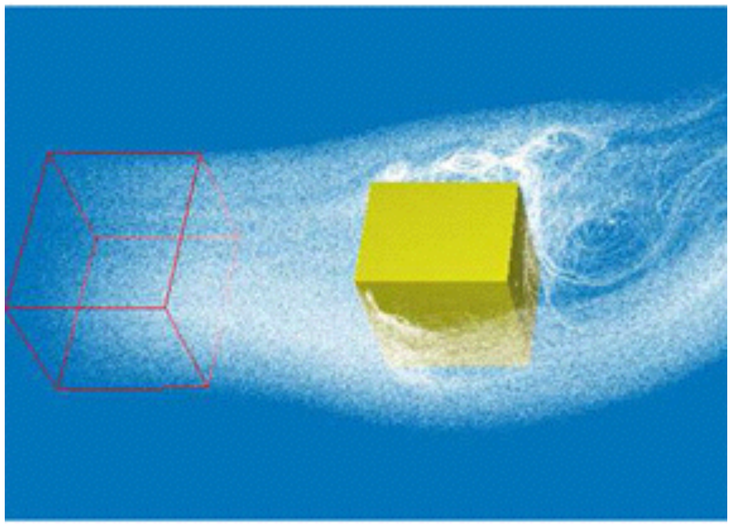
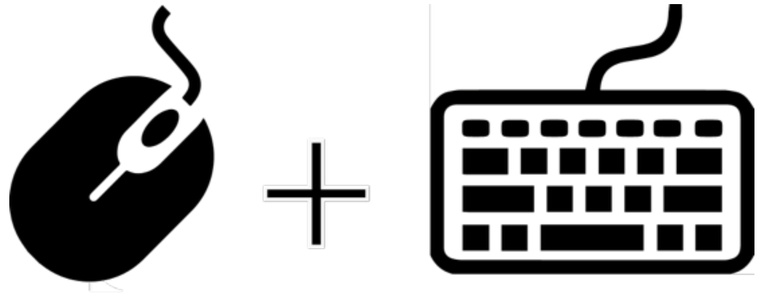
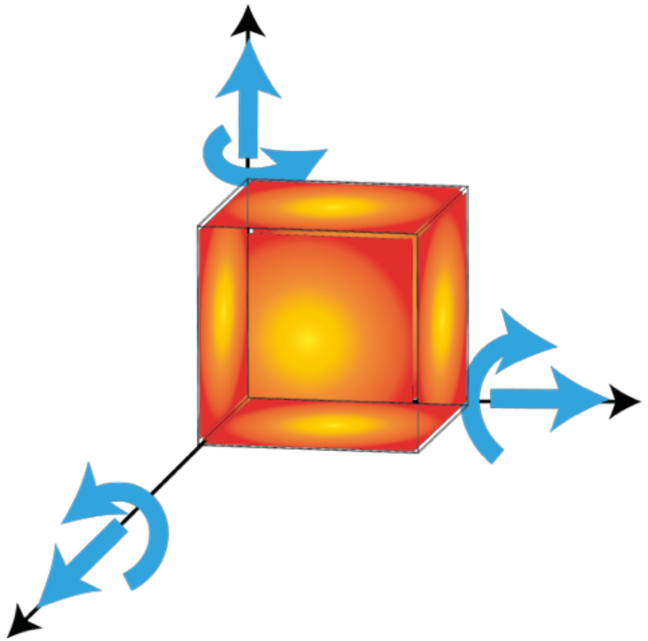


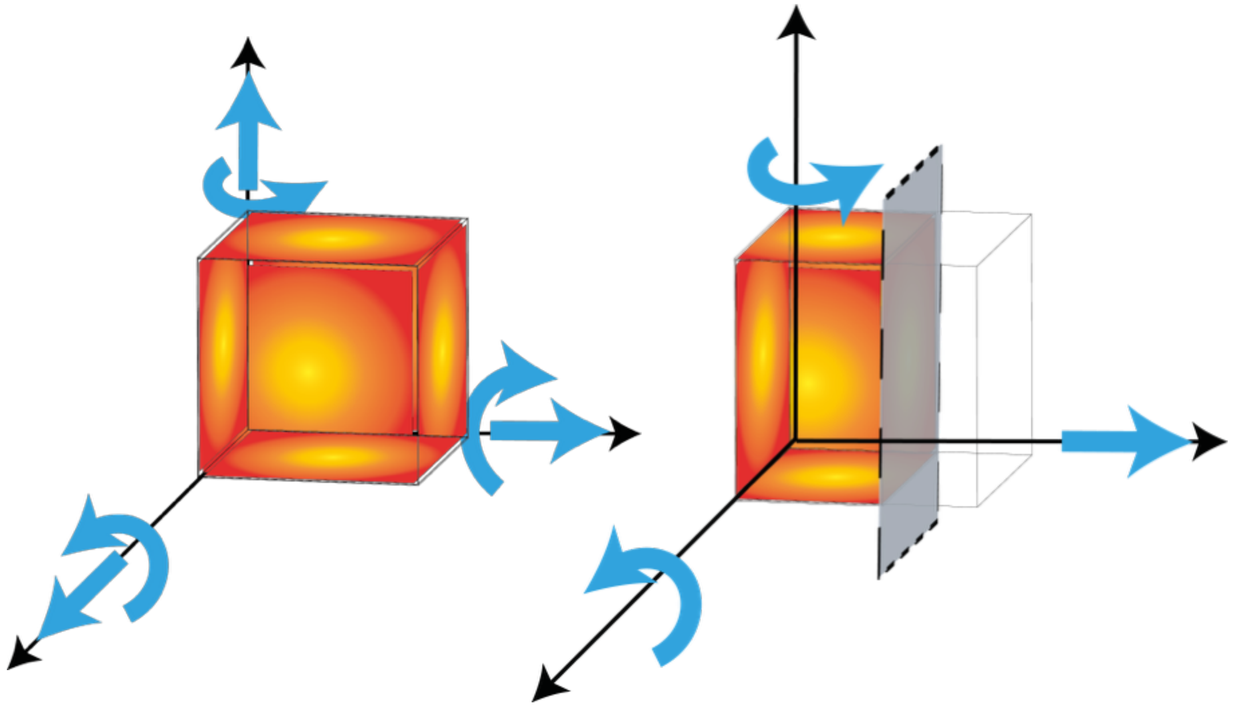
Kruger et al. (2005)



Interaction Tasks in Spatial 3D data



Interaction Tasks in Spatial 3D data



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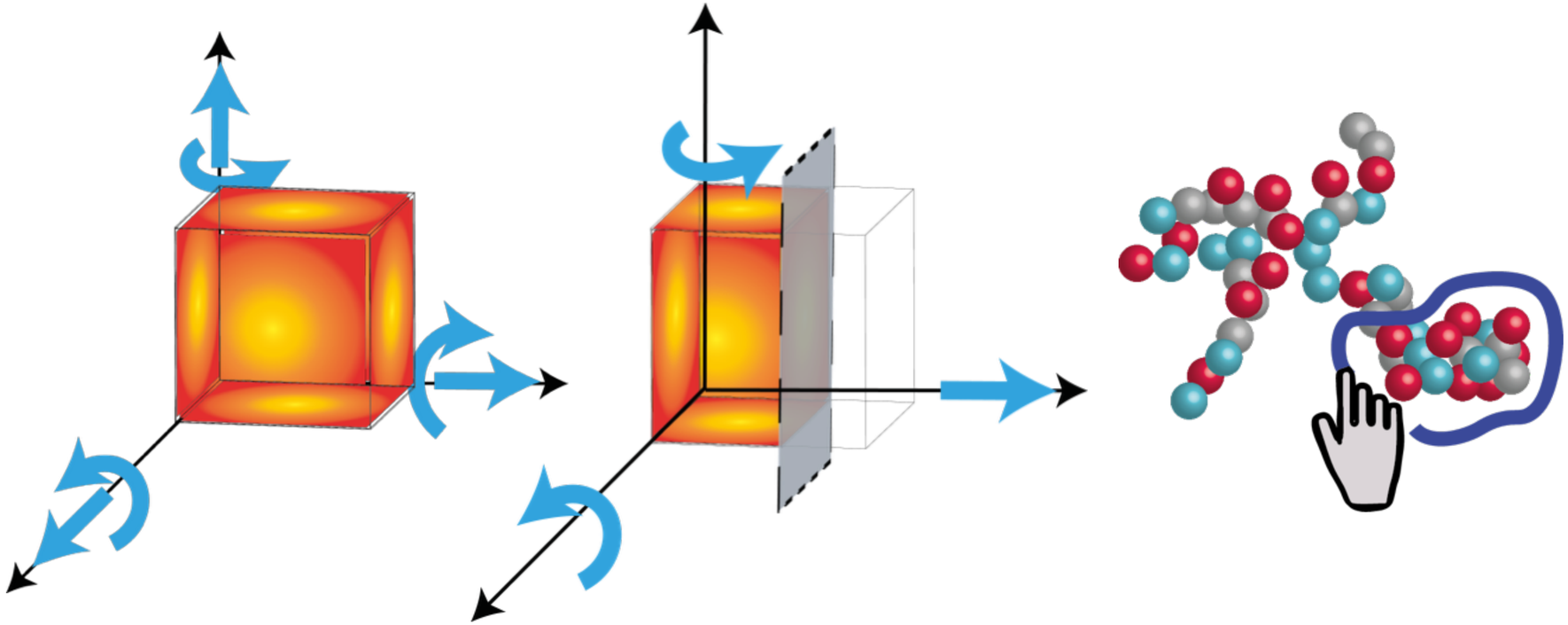
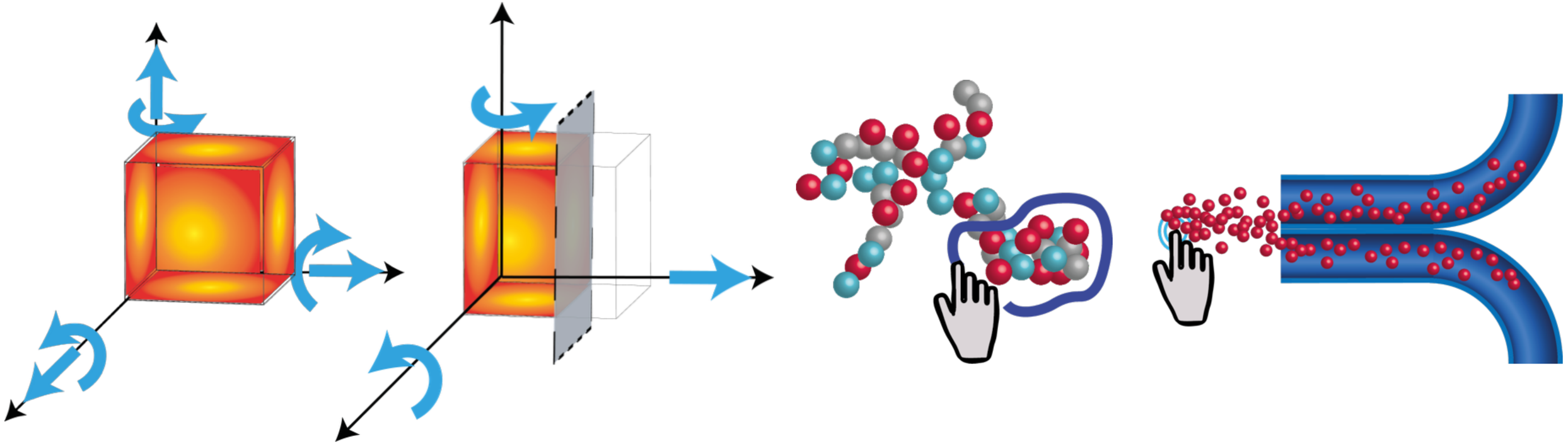
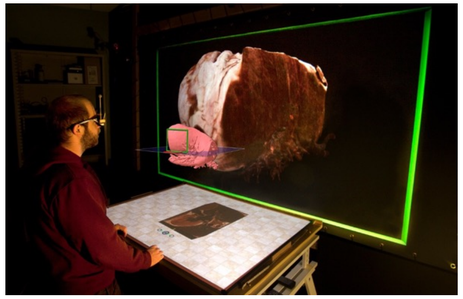


Interaction Tasks in Spatial 3D data

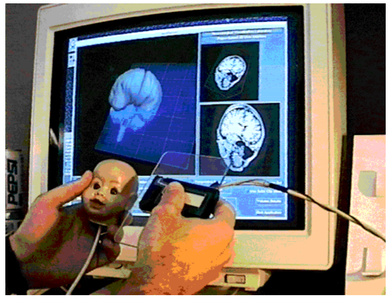


Contribution #2:
Design space exploration

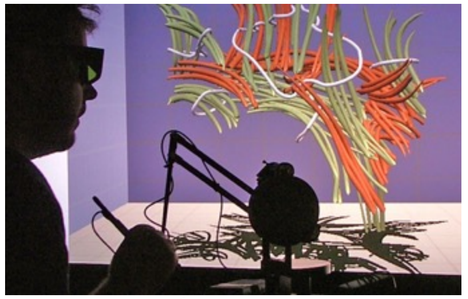
Examples



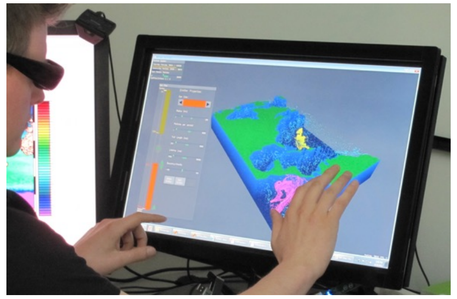
Coffey et al. (2012)



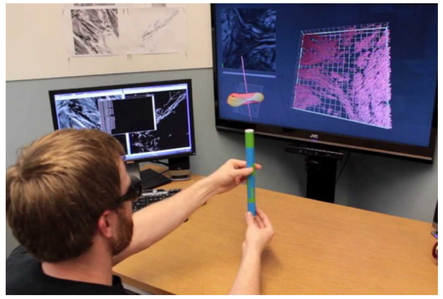
Hinckley et al. (1994)



Keefe (2010)

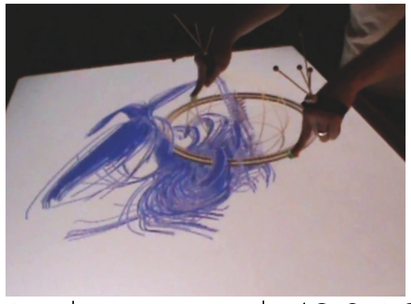


Butkiewicz & Ware (2012)

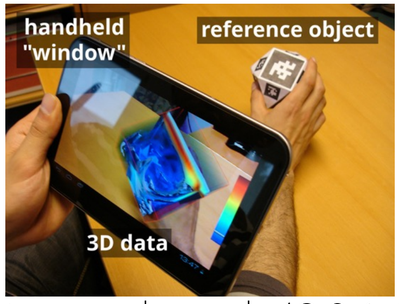


Jackson et al. (2013)

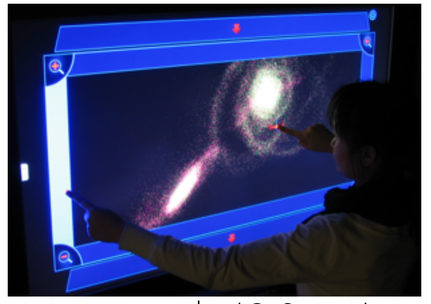
Schkolne et al. (2012)



Jackson et al. (2012)



Issartel et al. (2014)



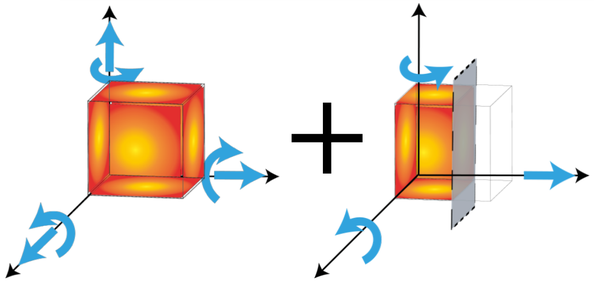
Yu et al. (2014)

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

Tasks		

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

Tasks



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

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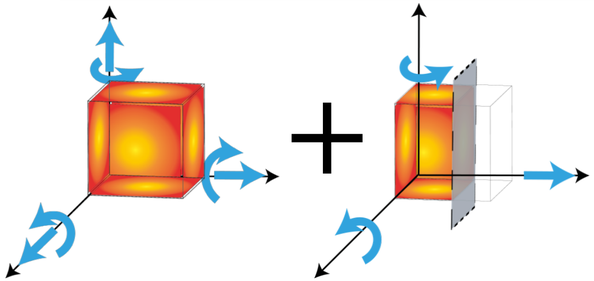		
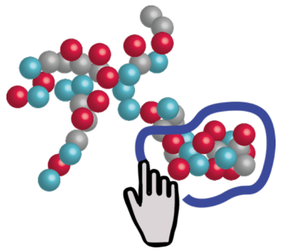		

Design Space Exploration: tactile-only and tangible-only settings

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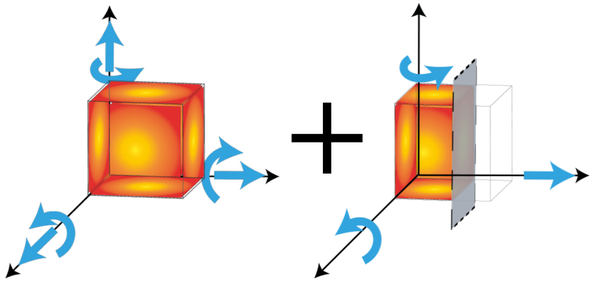
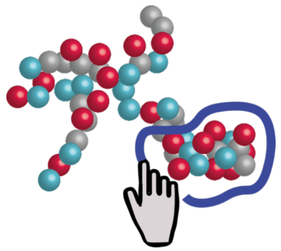
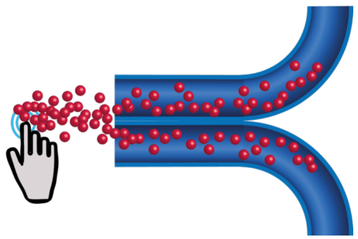
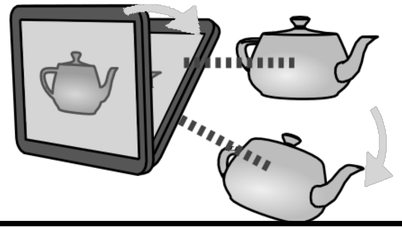
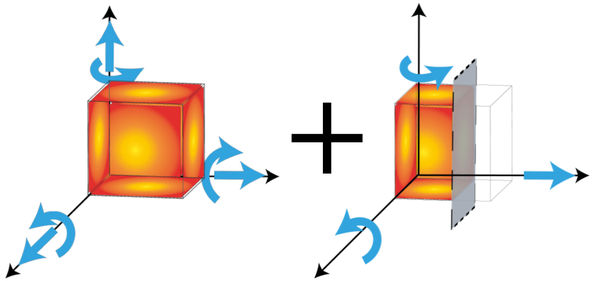
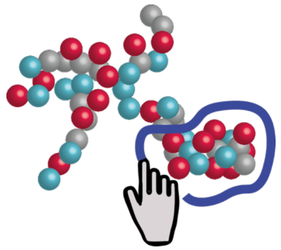
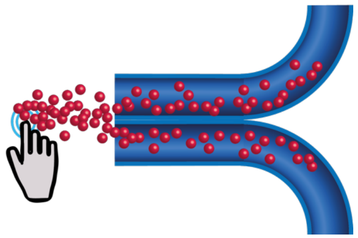
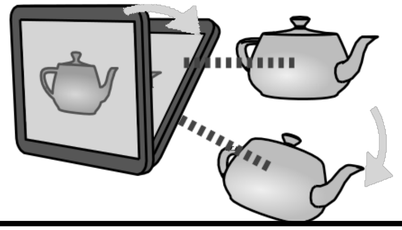
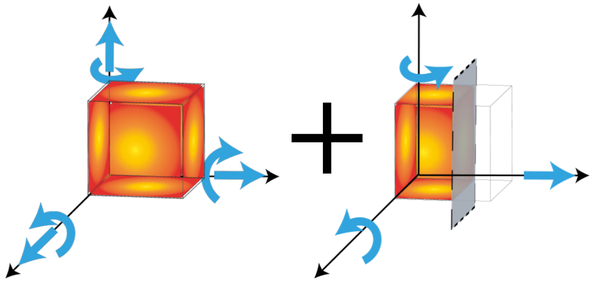
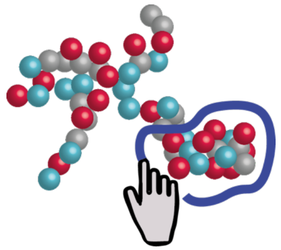
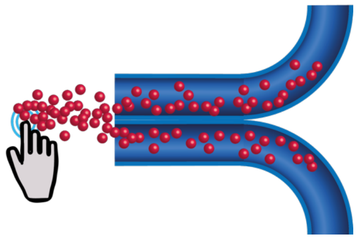
		
		
		

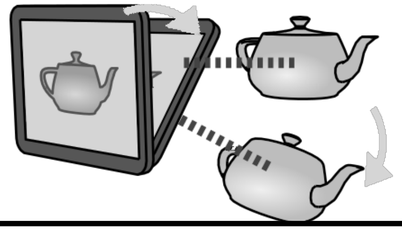
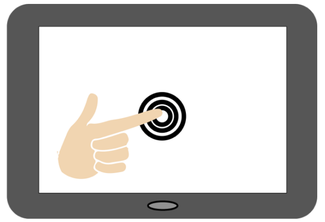
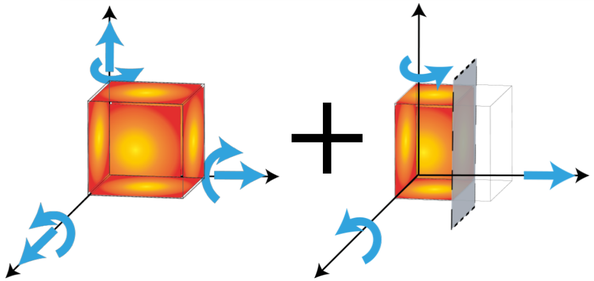
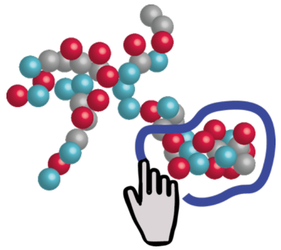
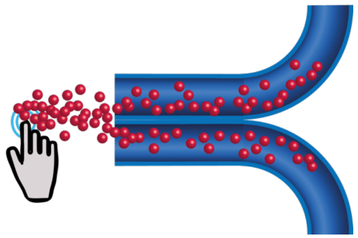
Design Space Exploration: tactile-only and tangible-only settings

Tasks		
		
		
		

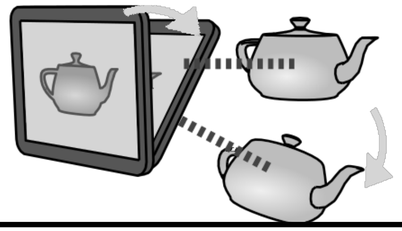
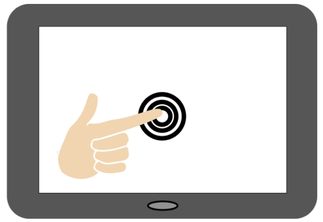
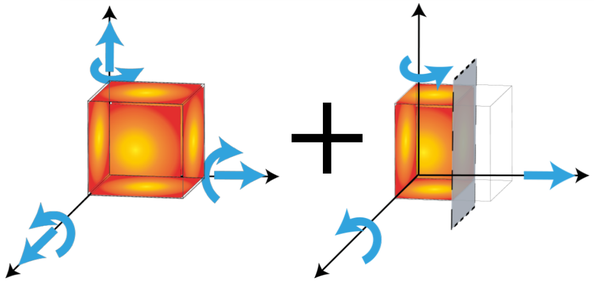
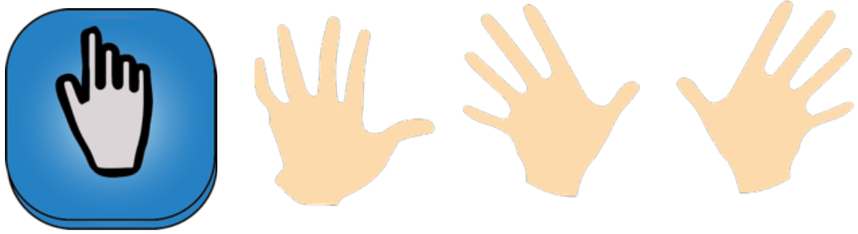
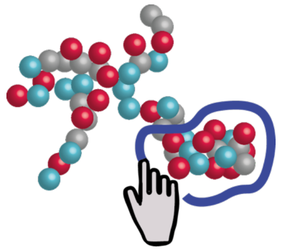
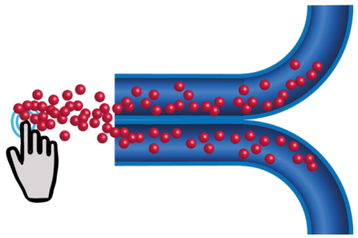
Design Space Exploration: tactile-only and tangible-only settings

Tasks		
		
		
		

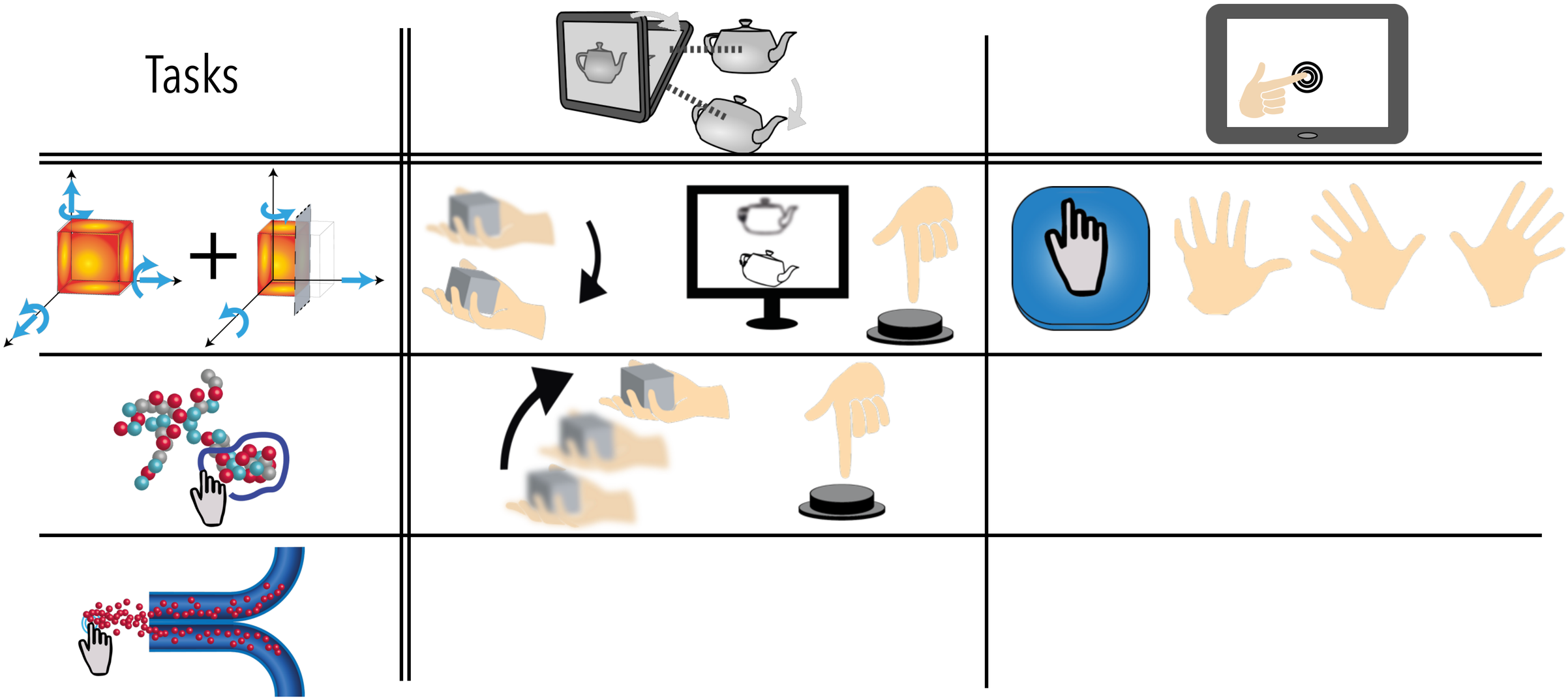
Design Space Exploration: tactile-only and tangible-only settings

Tasks		
		
		
		

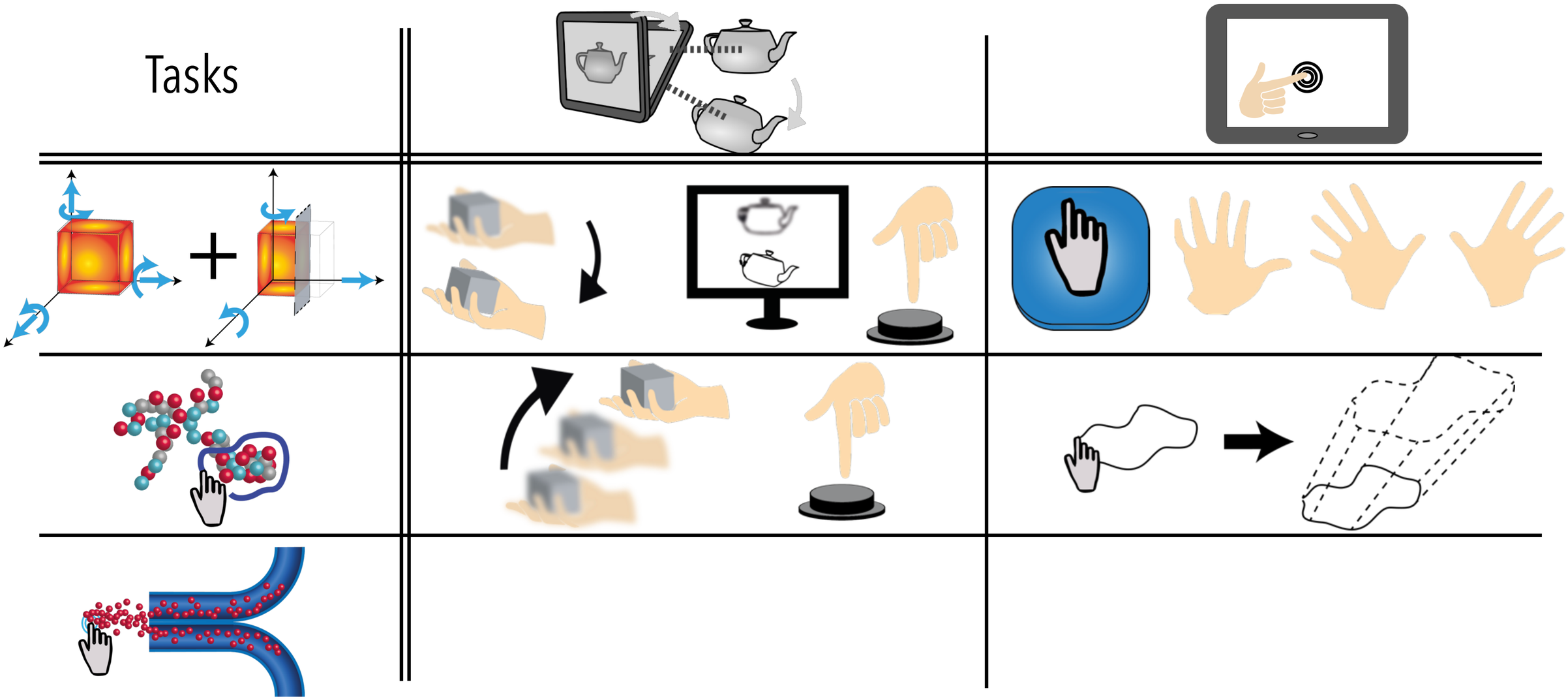
Design Space Exploration: tactile-only and tangible-only settings

Tasks		
		
		
		

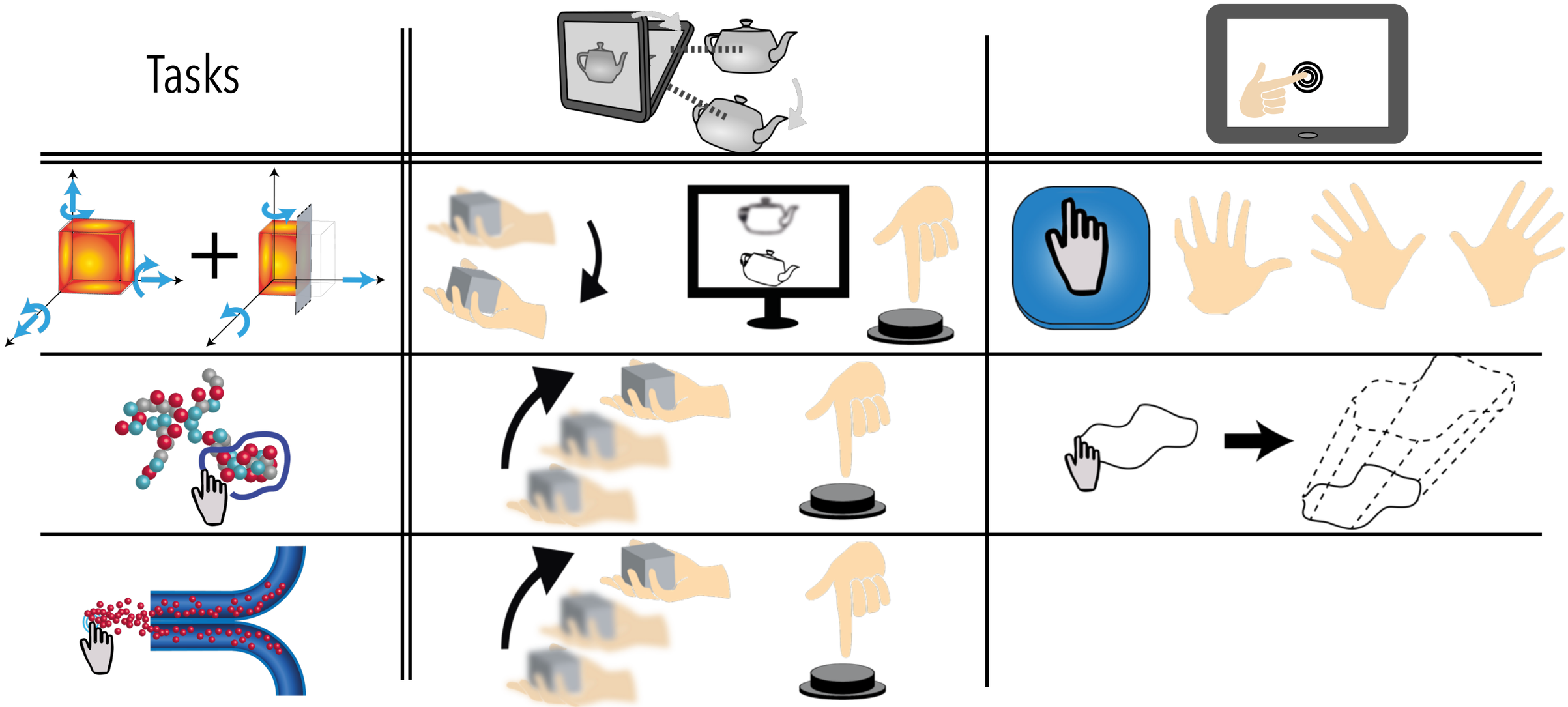
Design Space Exploration: tactile-only and tangible-only settings



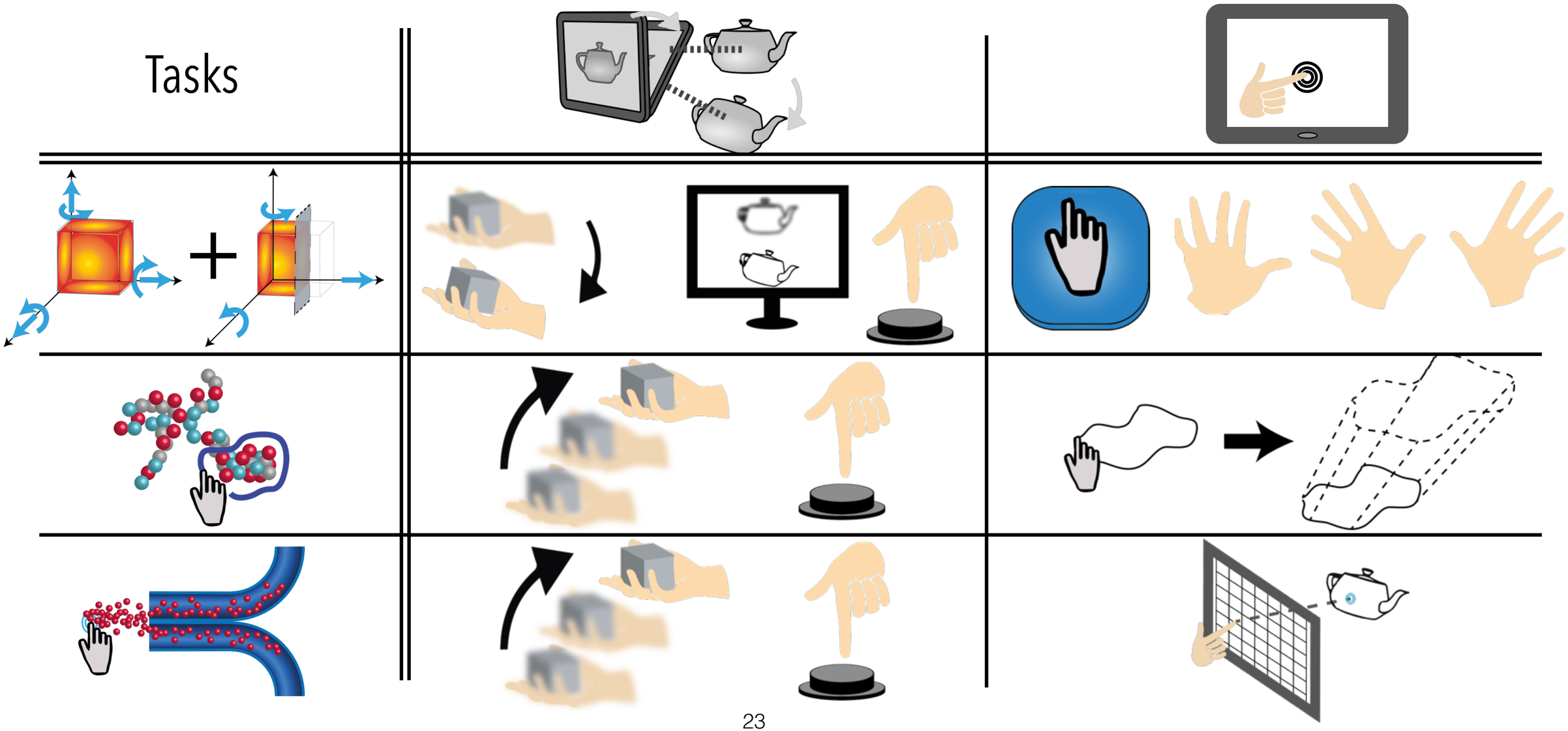
Design Space Exploration: tactile-only and tangible-only settings



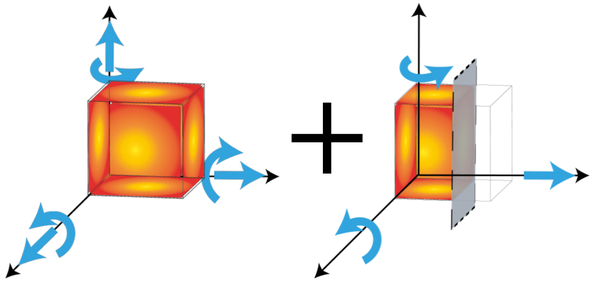
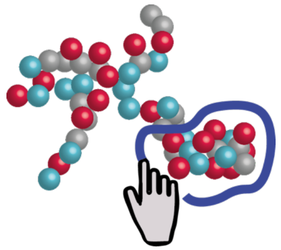
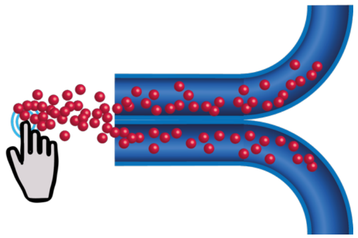
Design Space Exploration: tactile-only and tangible-only settings



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

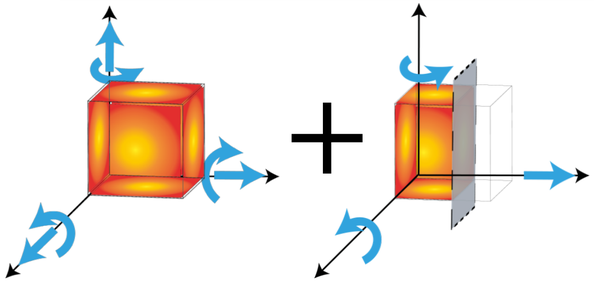


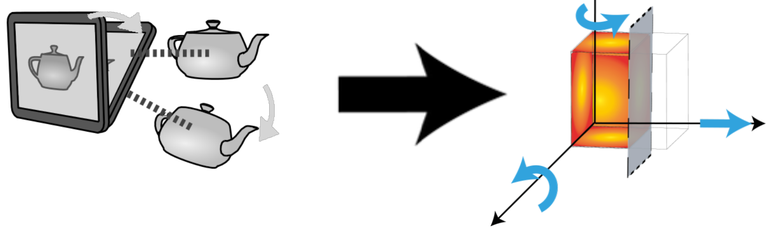
Design Space Exploration: Hybrid interaction

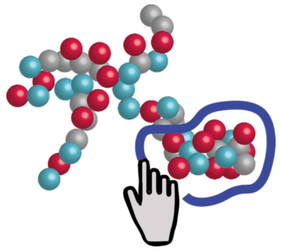
Tasks	
	
	
	

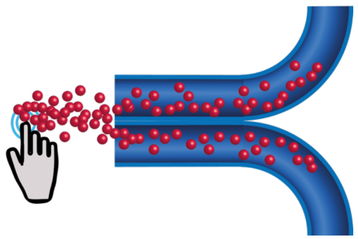
Design Space Exploration: Hybrid interaction

Tasks



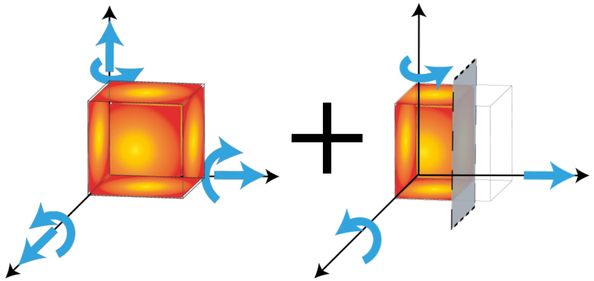


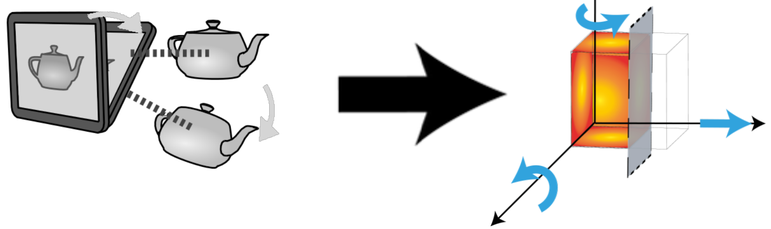


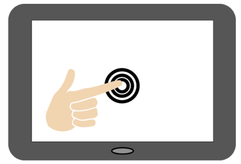


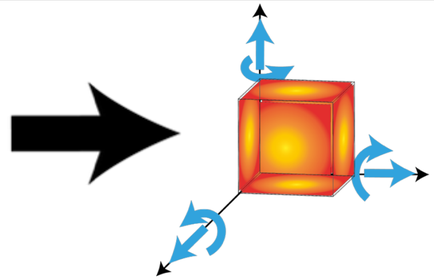
Design Space Exploration: Hybrid interaction

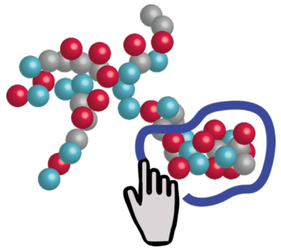
Tasks

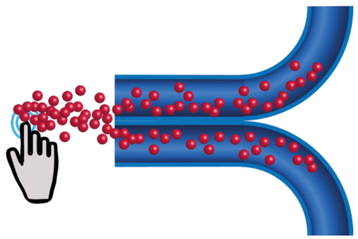




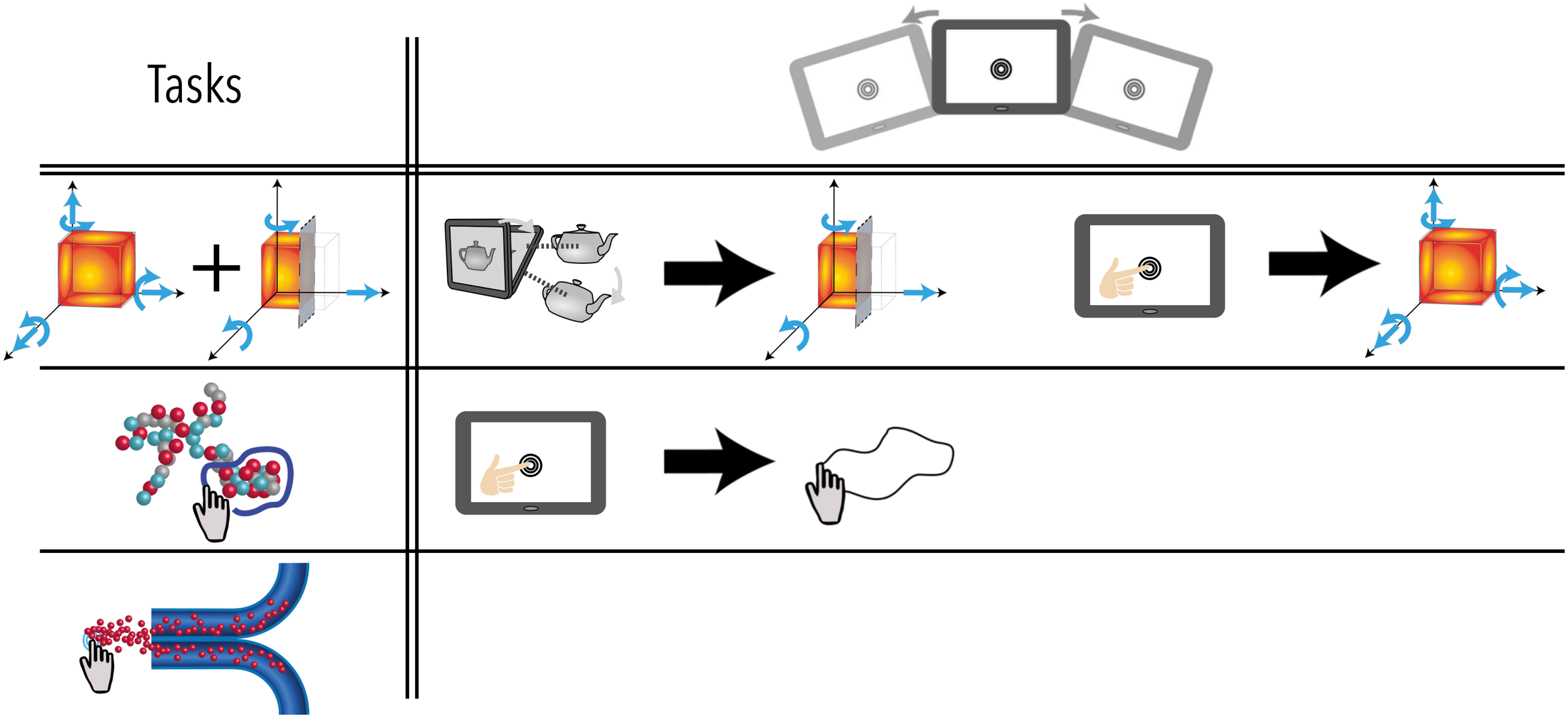




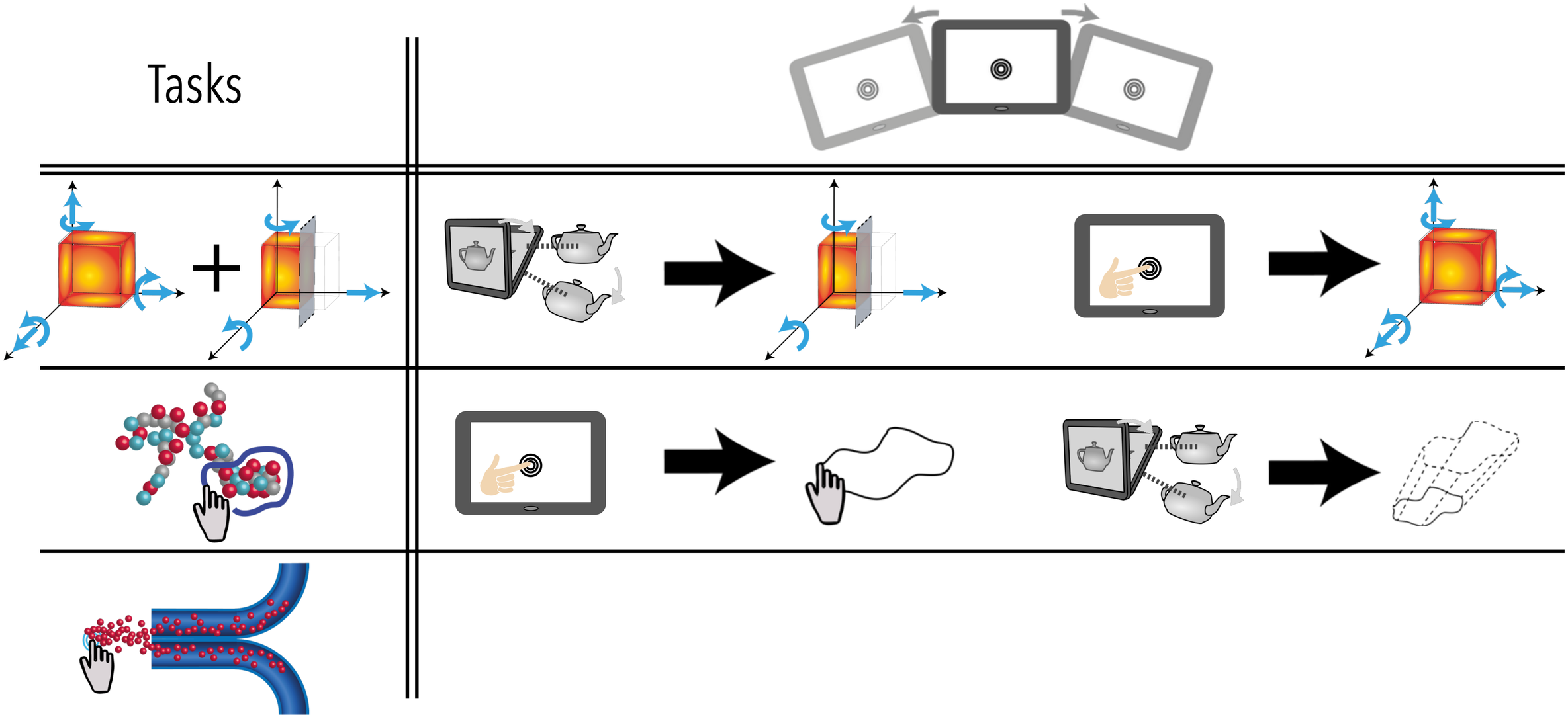




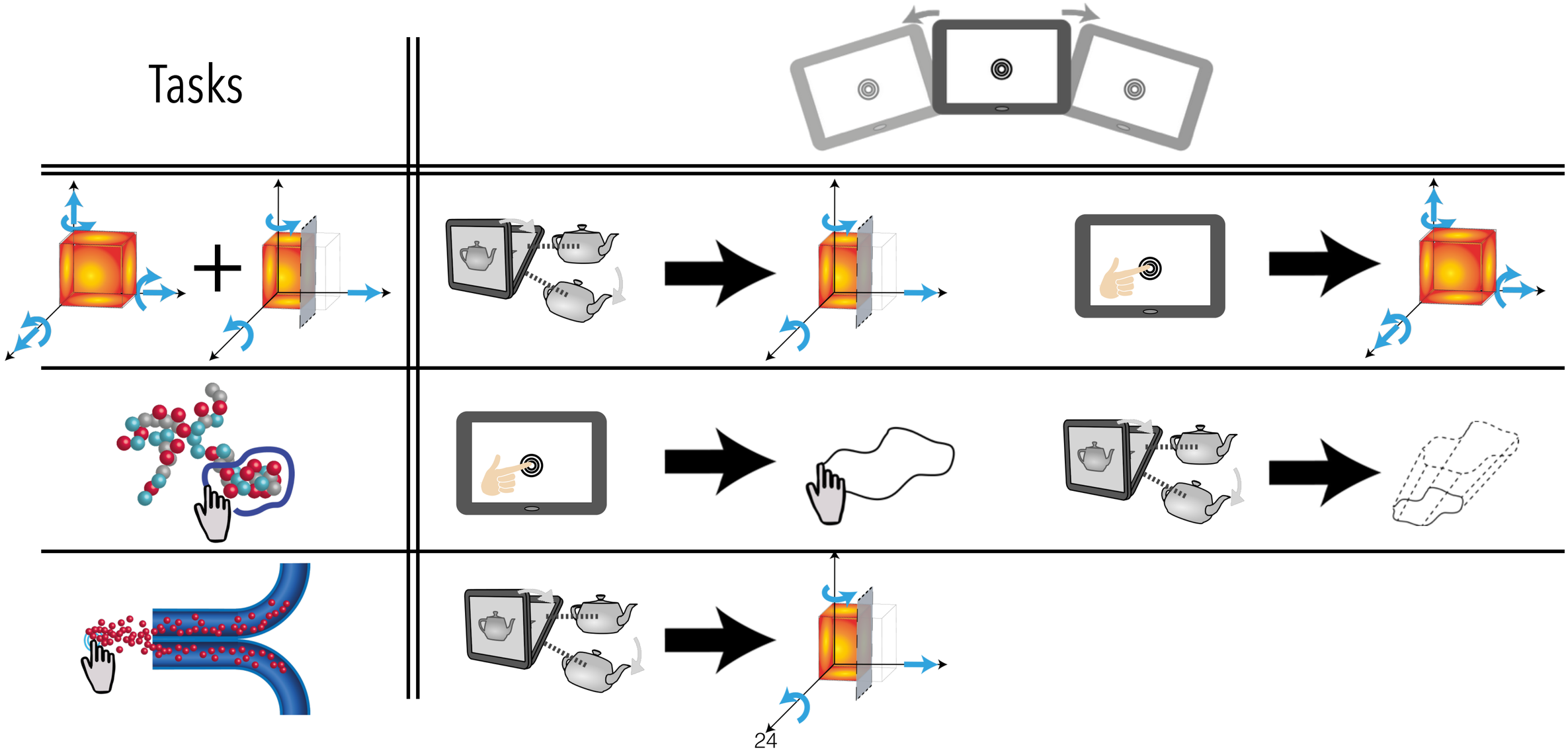
Design Space Exploration: Hybrid interaction



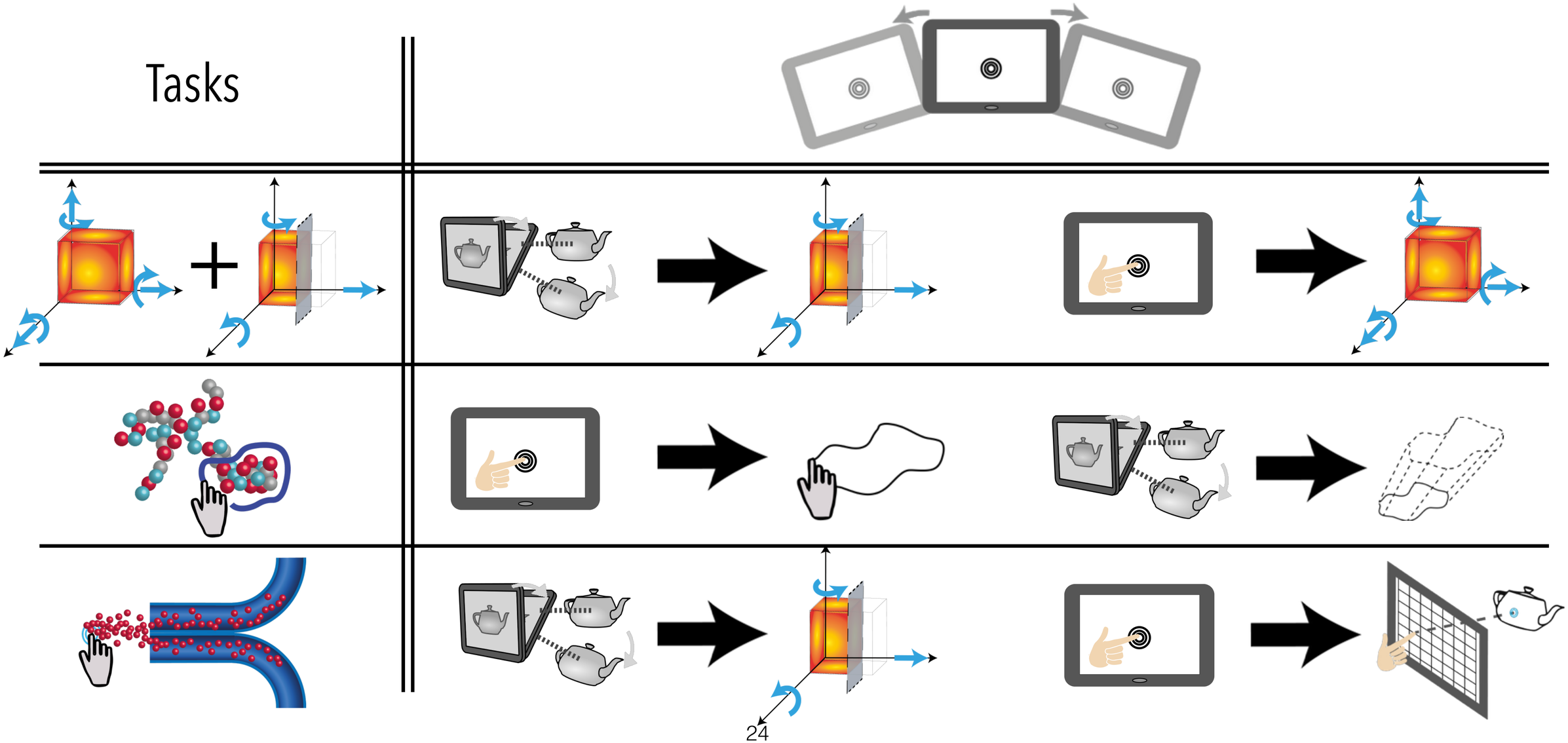
Design Space Exploration: Hybrid interaction



Design Space Exploration: Hybrid interaction

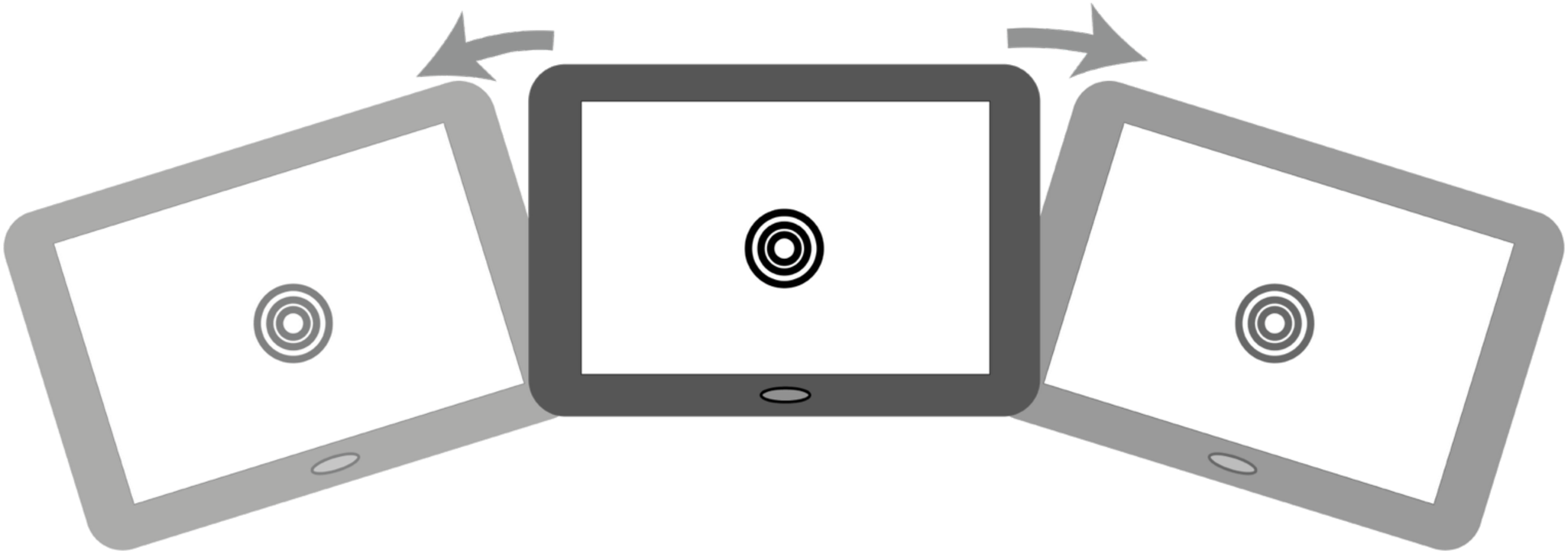


Design Space Exploration: Hybrid interaction



Contribution #3:
Hybrid interaction prototype and user study

Prototype



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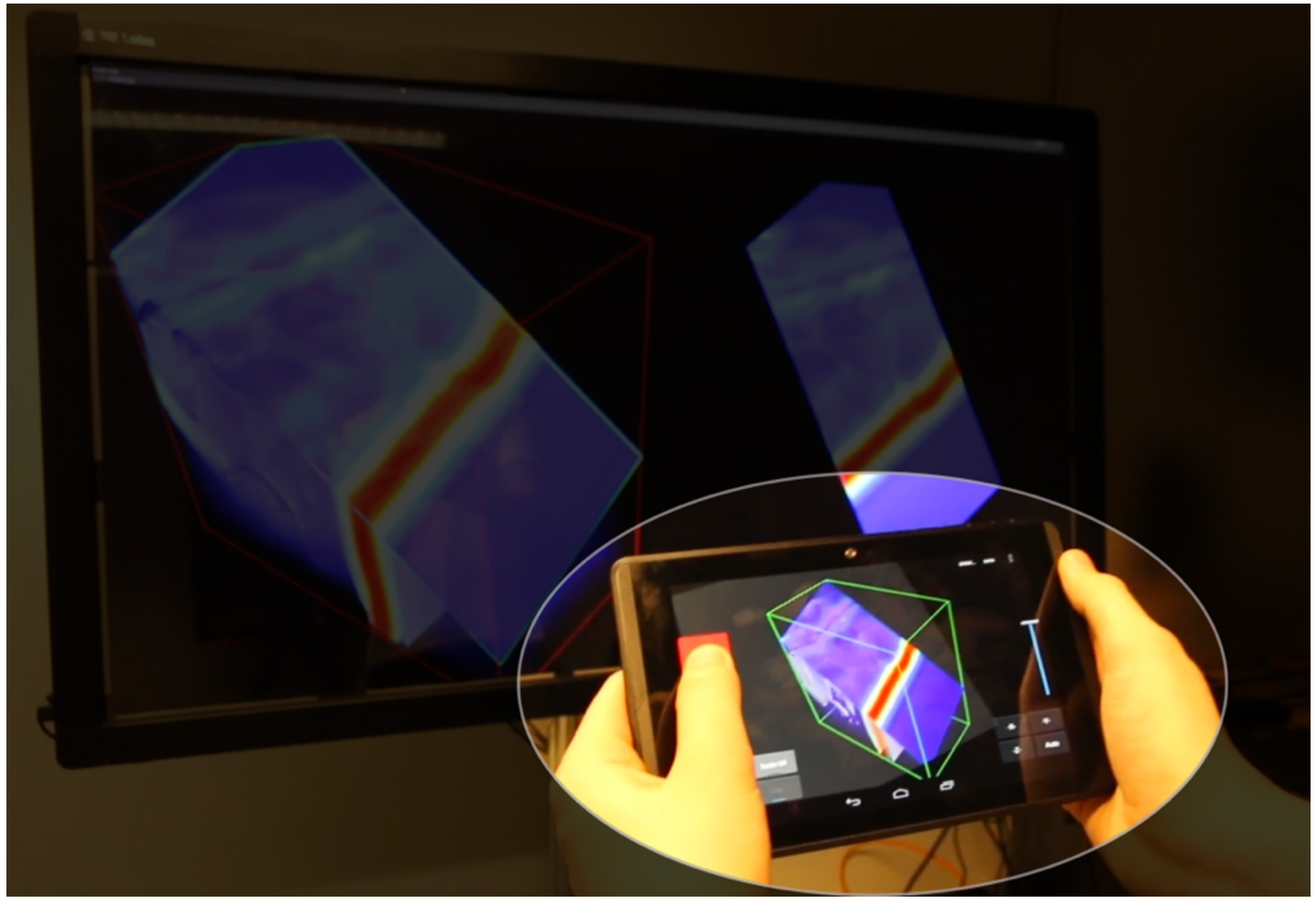

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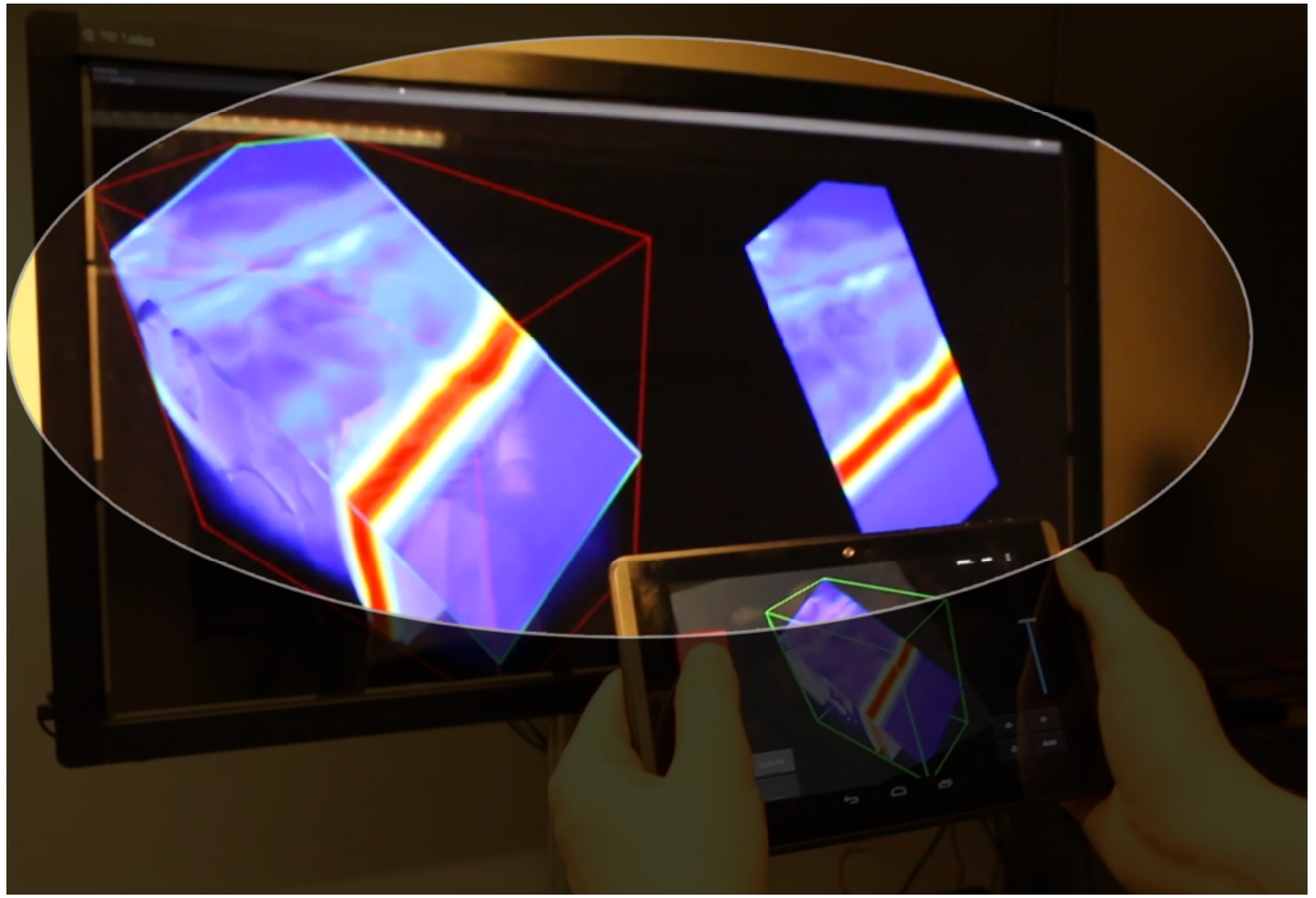

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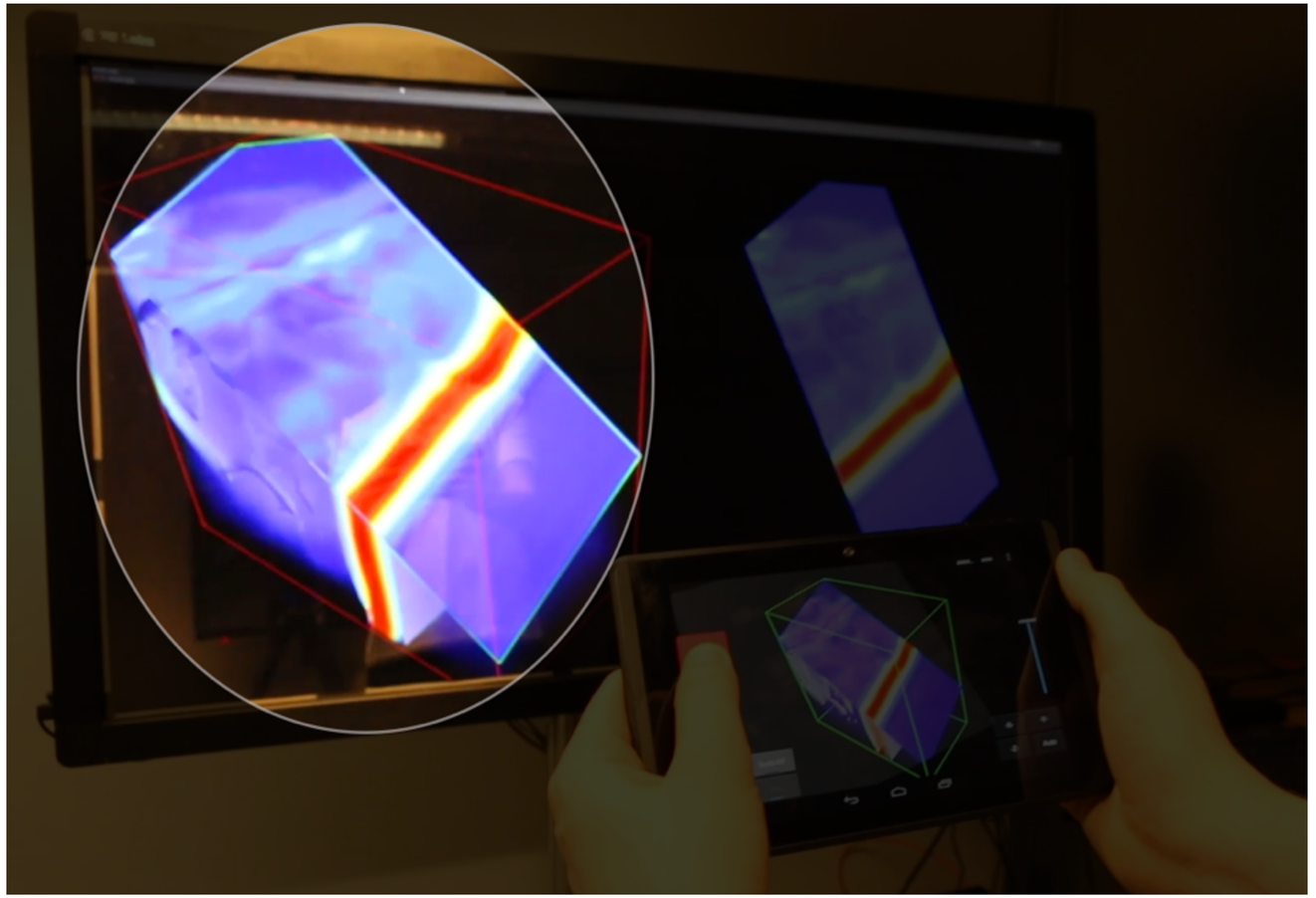

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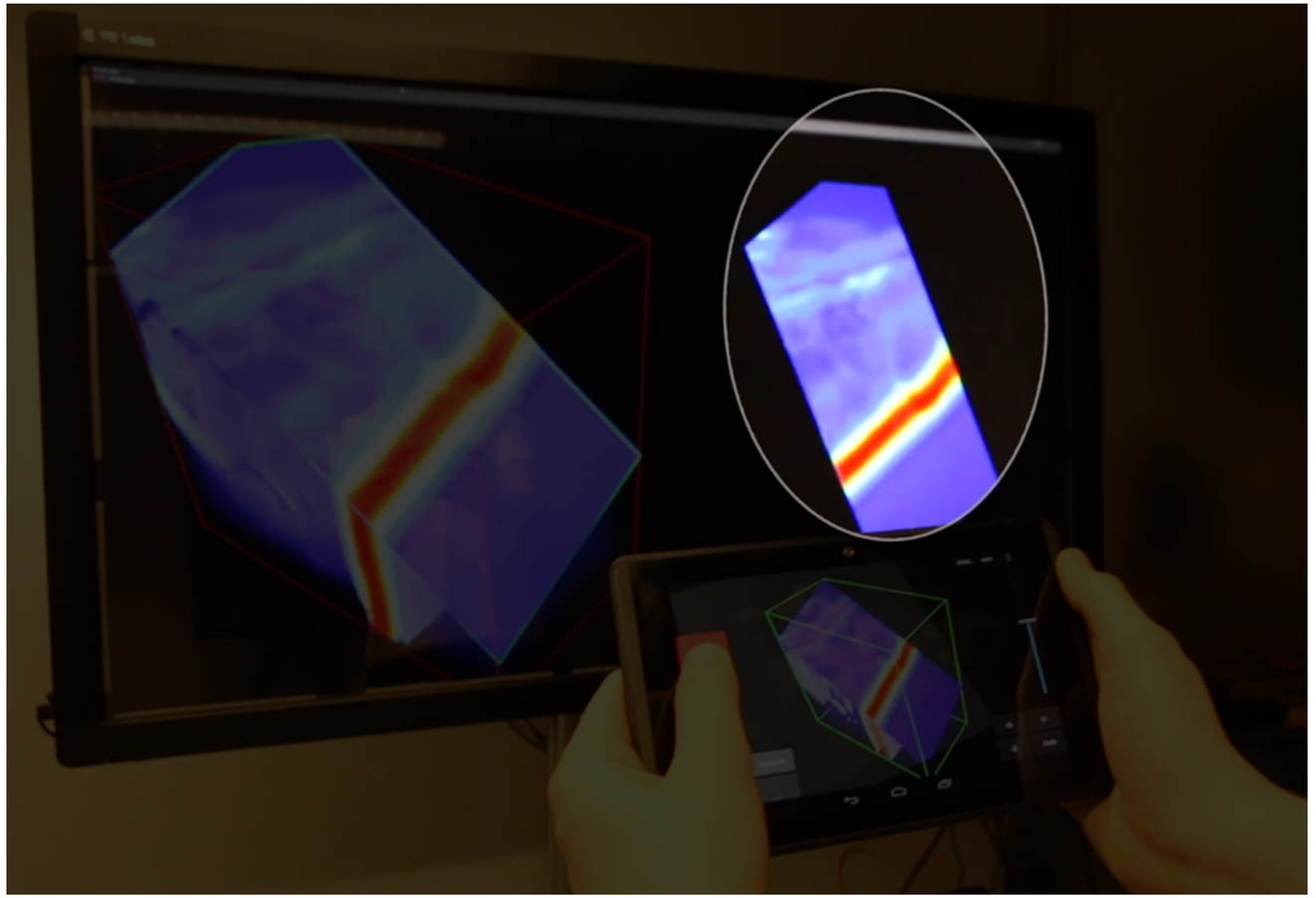
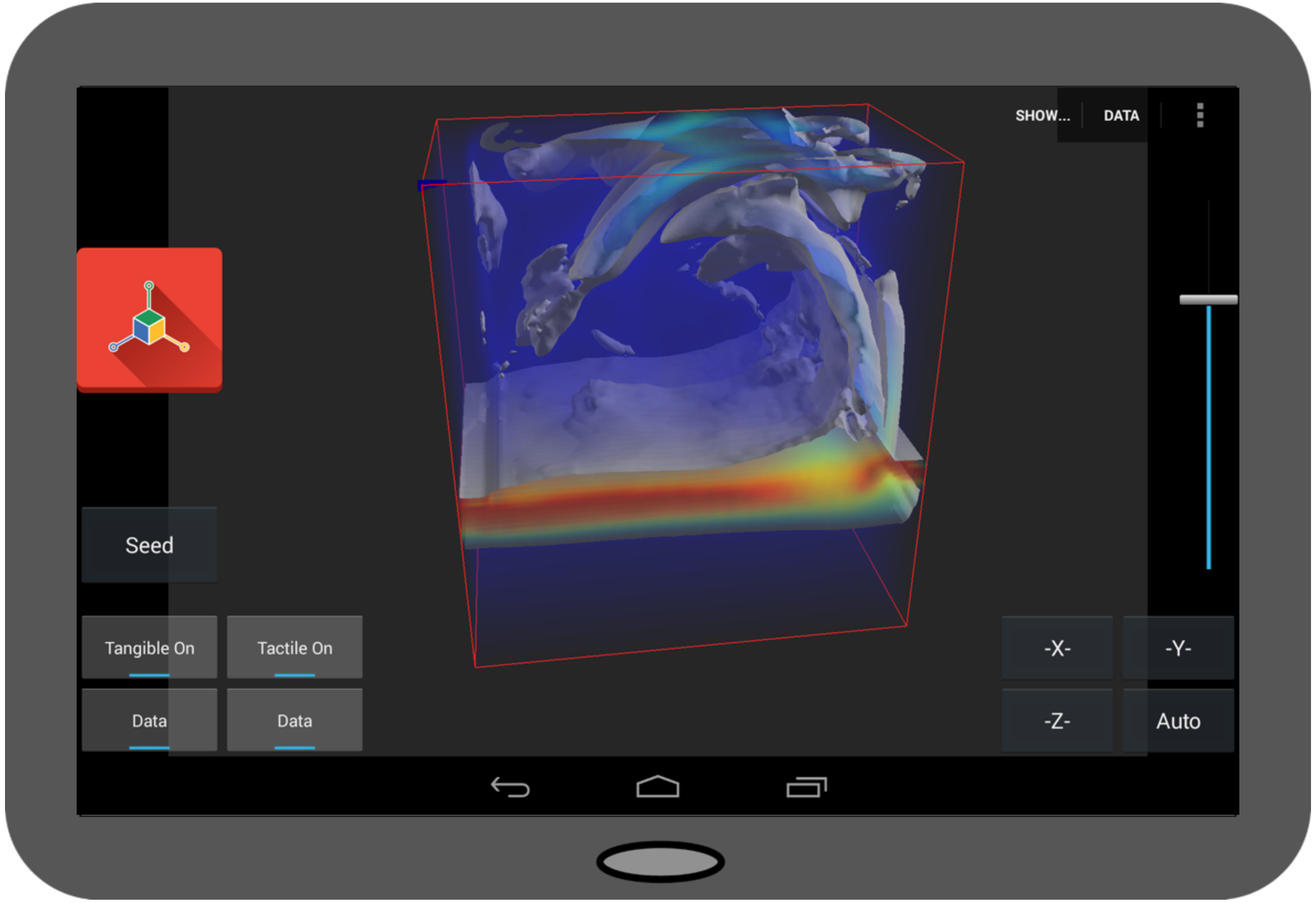
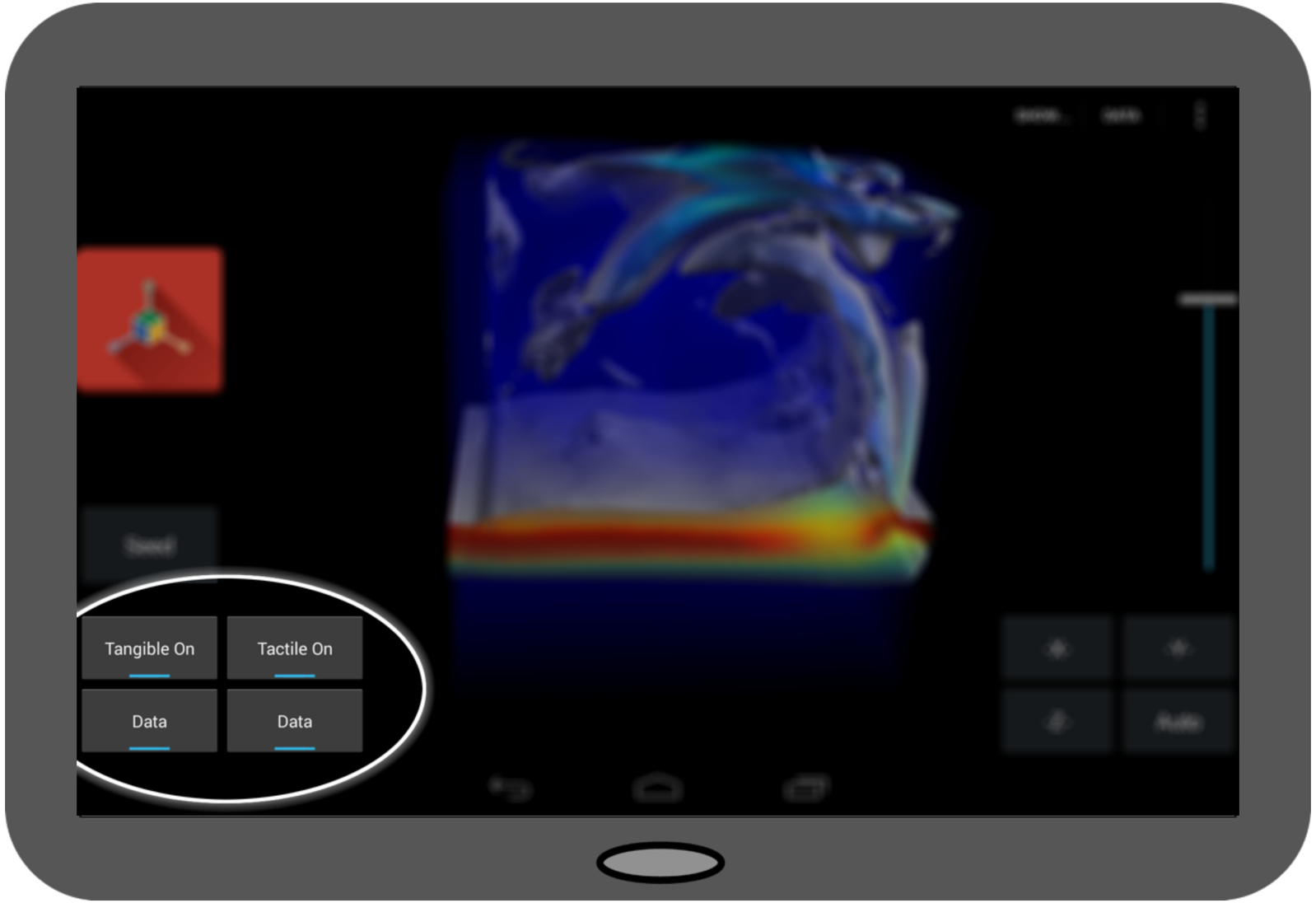


User Interface



User Interface



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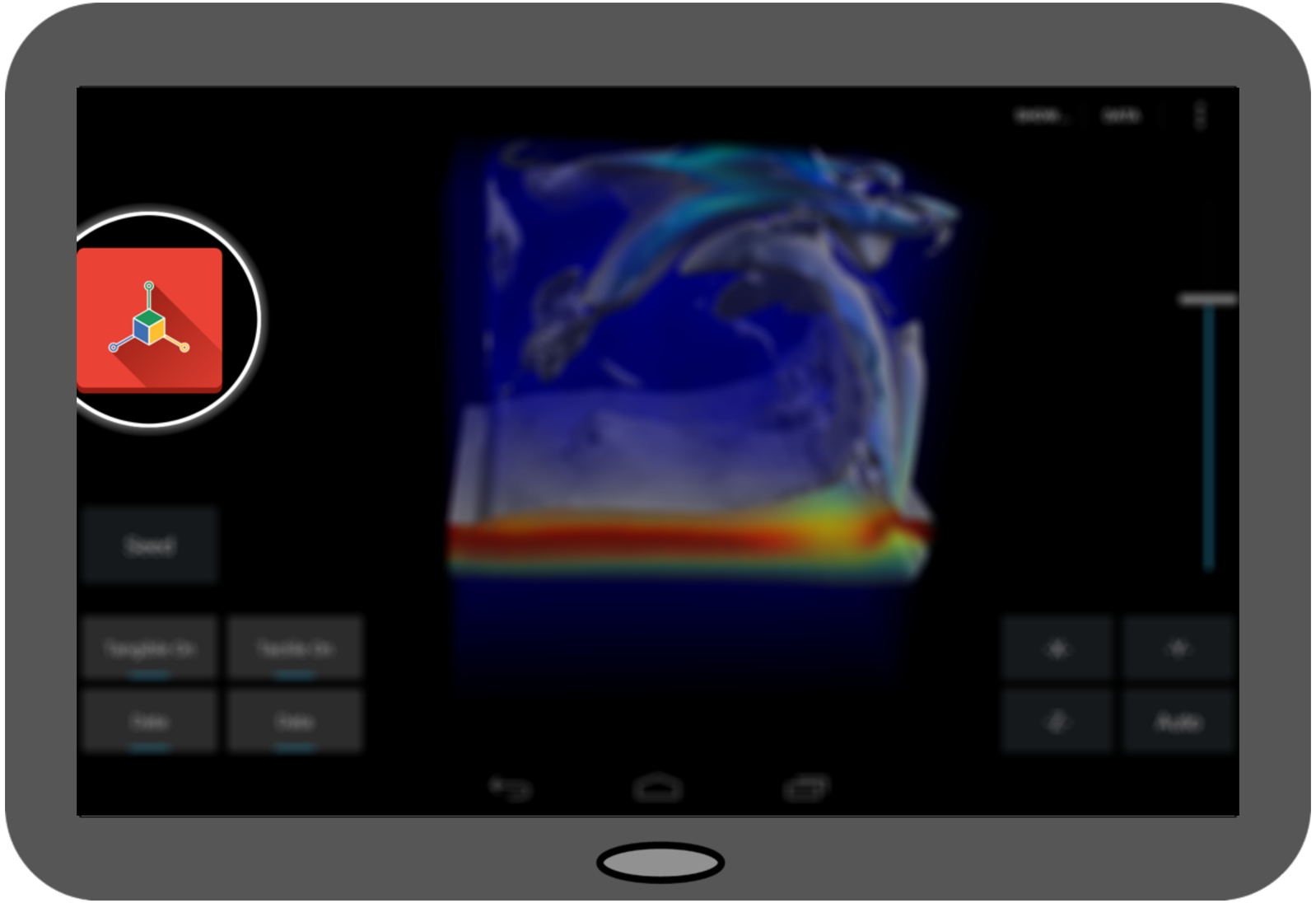

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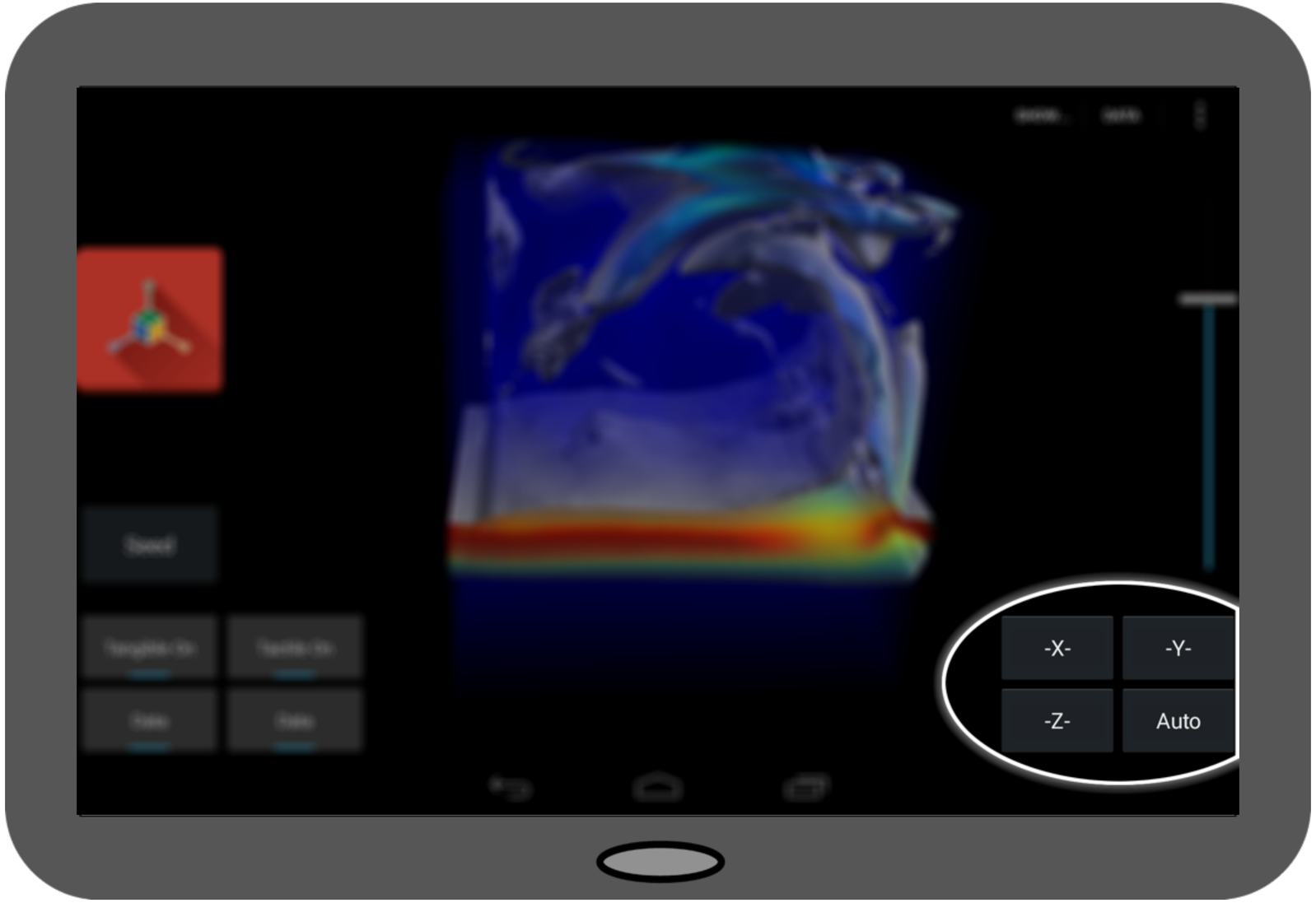

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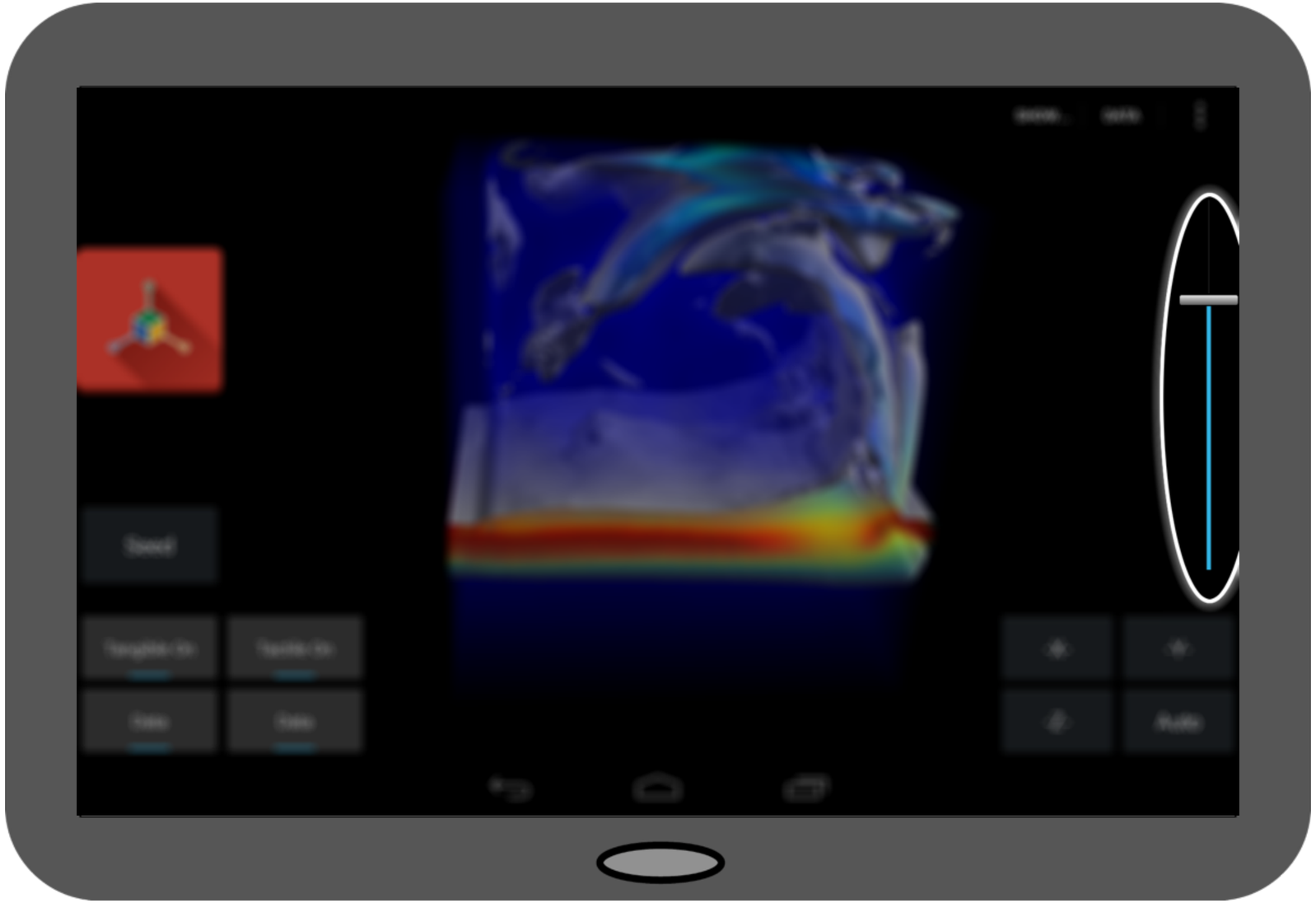

3D data space navigation

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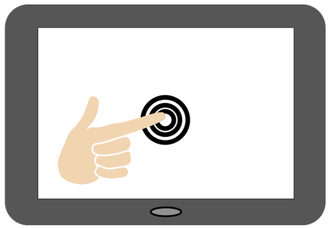

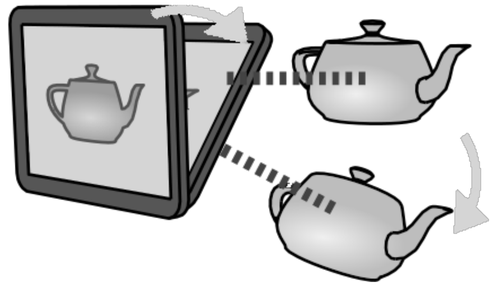

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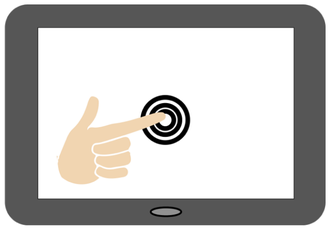

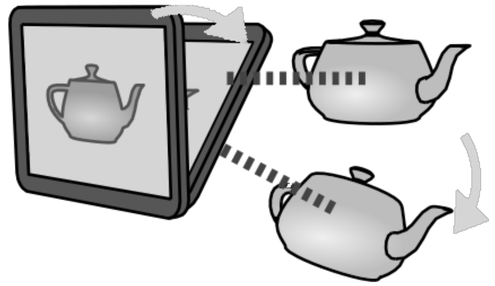

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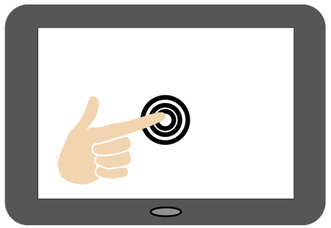
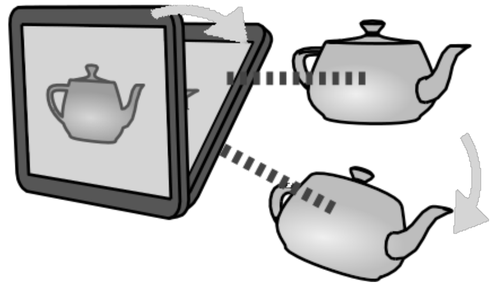
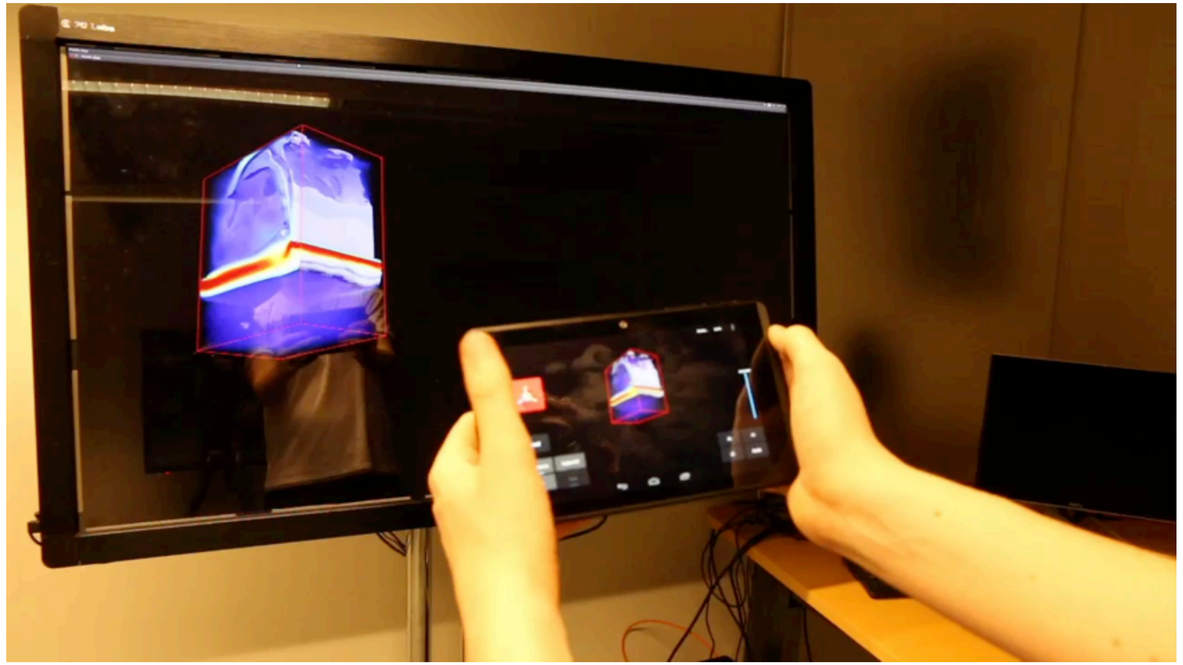
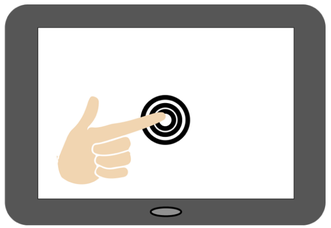
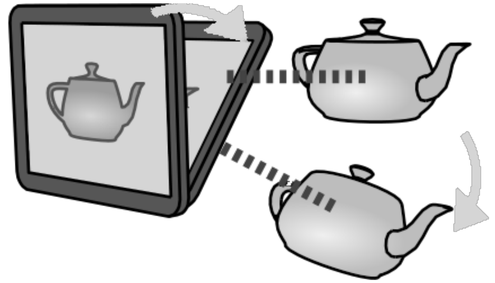






3D cutting plane manipulations





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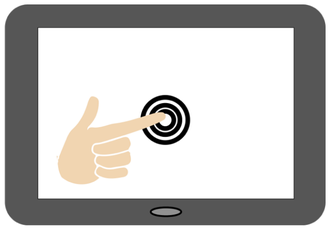
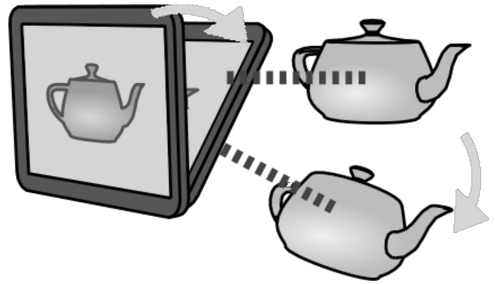
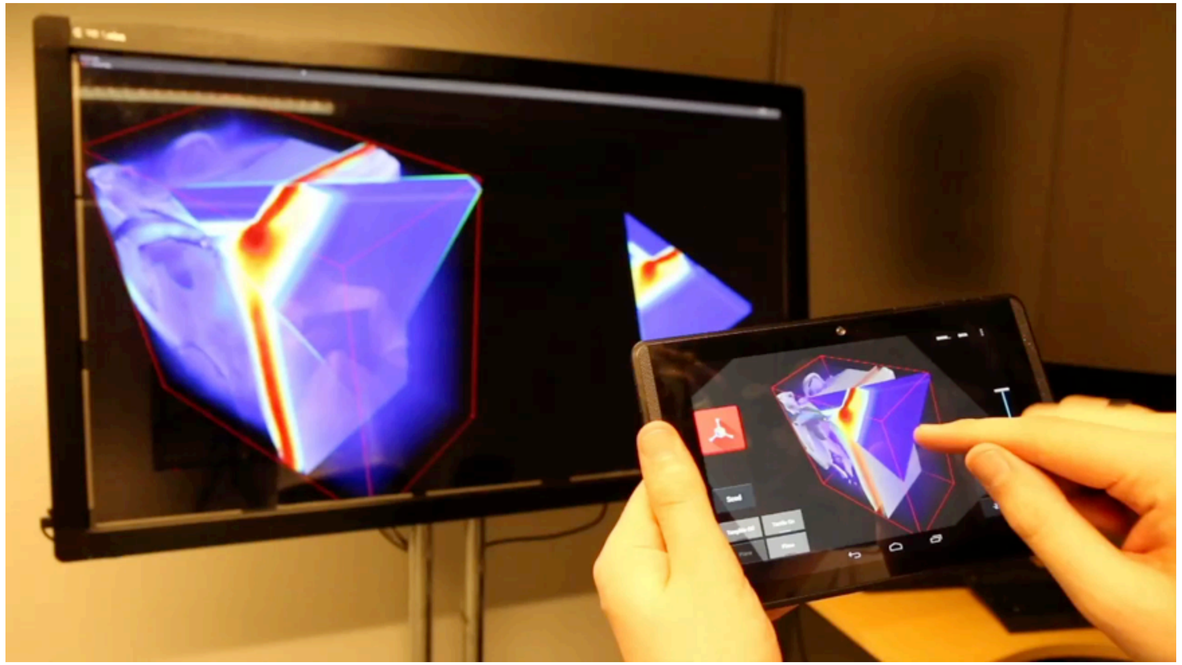
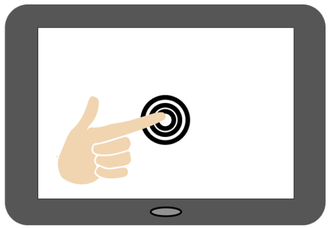
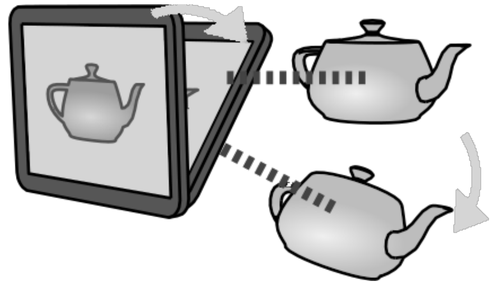


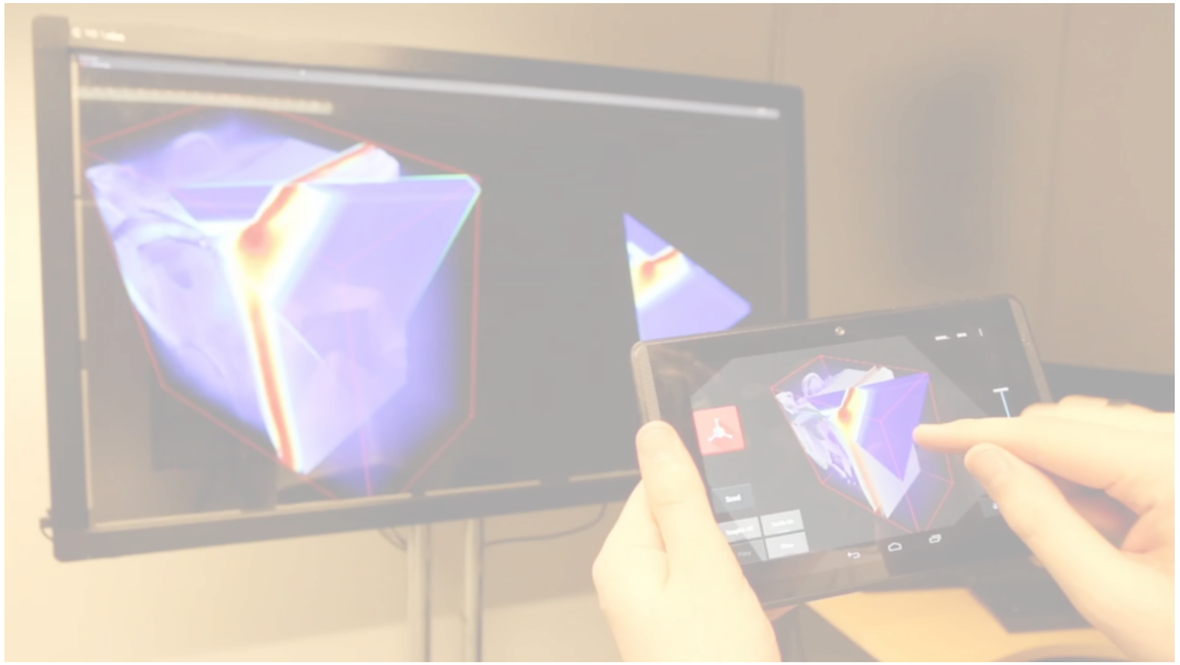


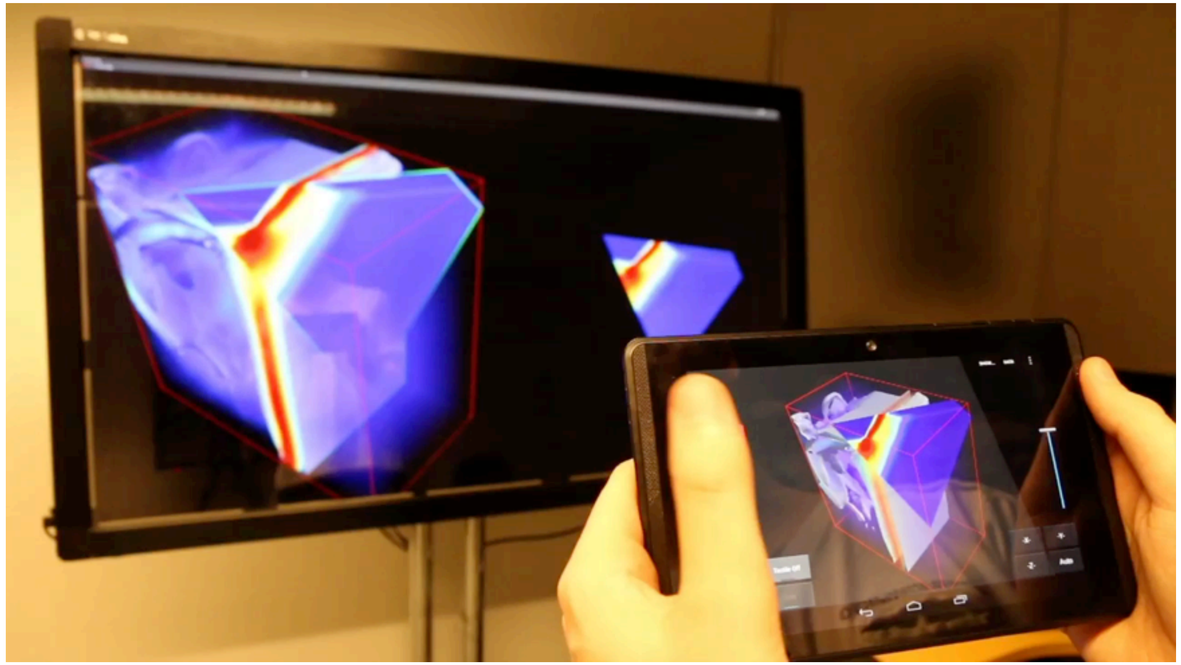


3D cutting plane manipulations

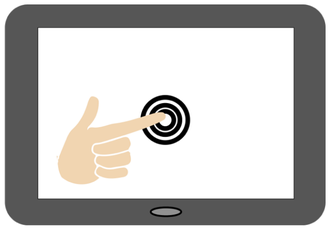


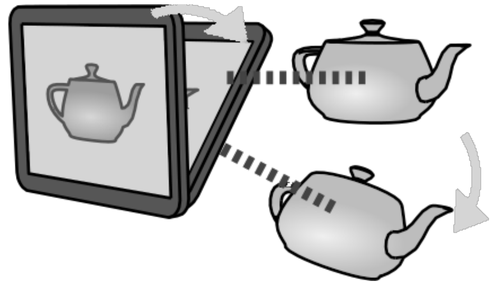




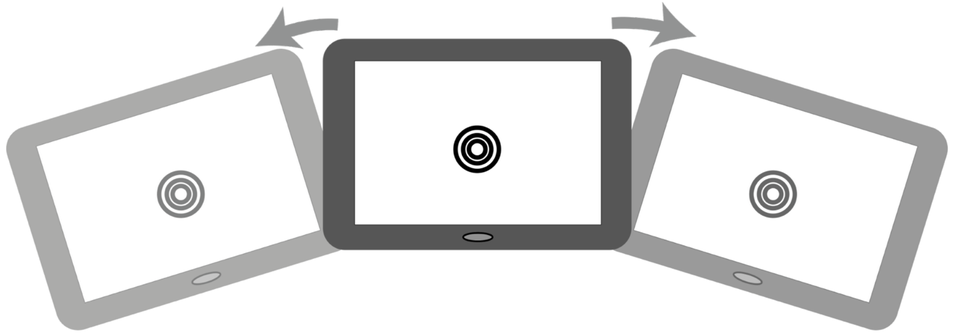


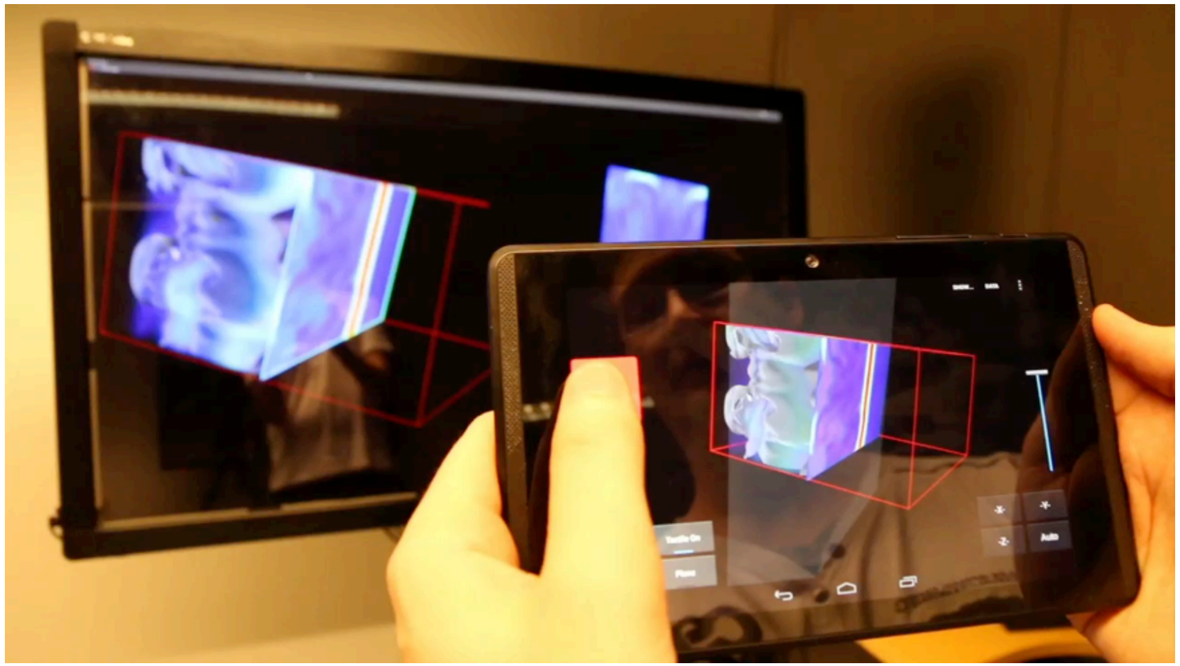
Hybrid Tactile/Tangible manipulations



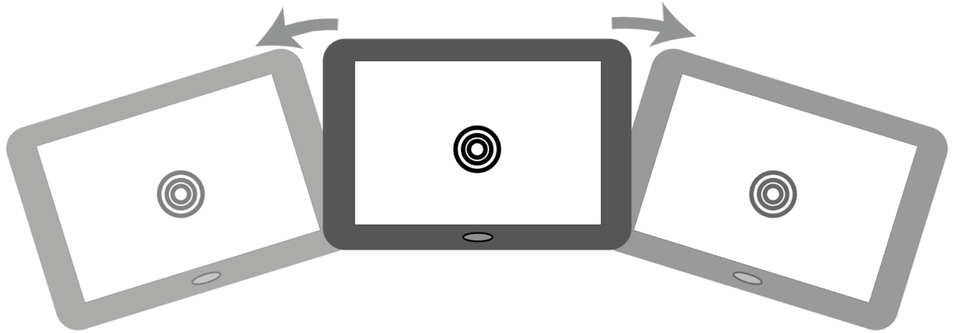


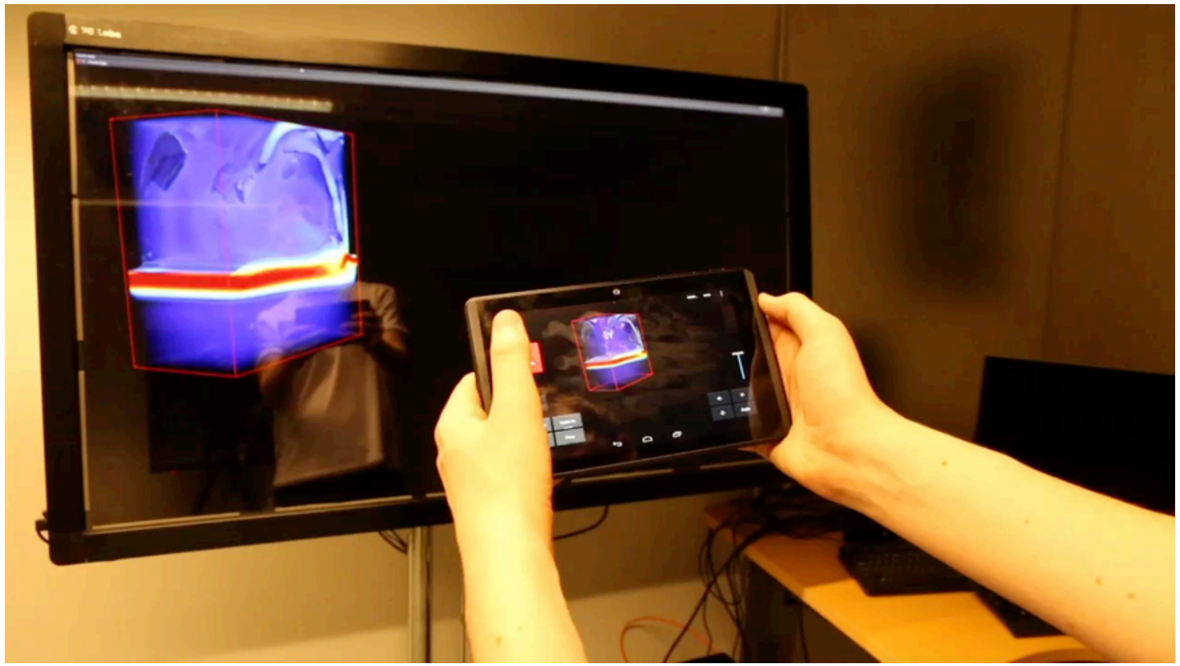
Hybrid Tactile/Tangible manipulations



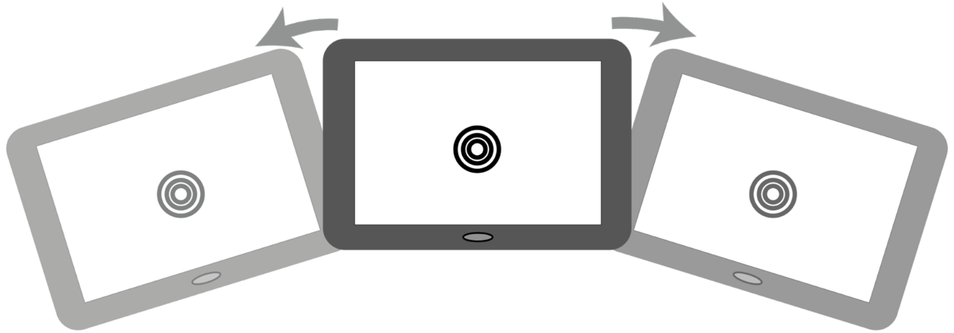


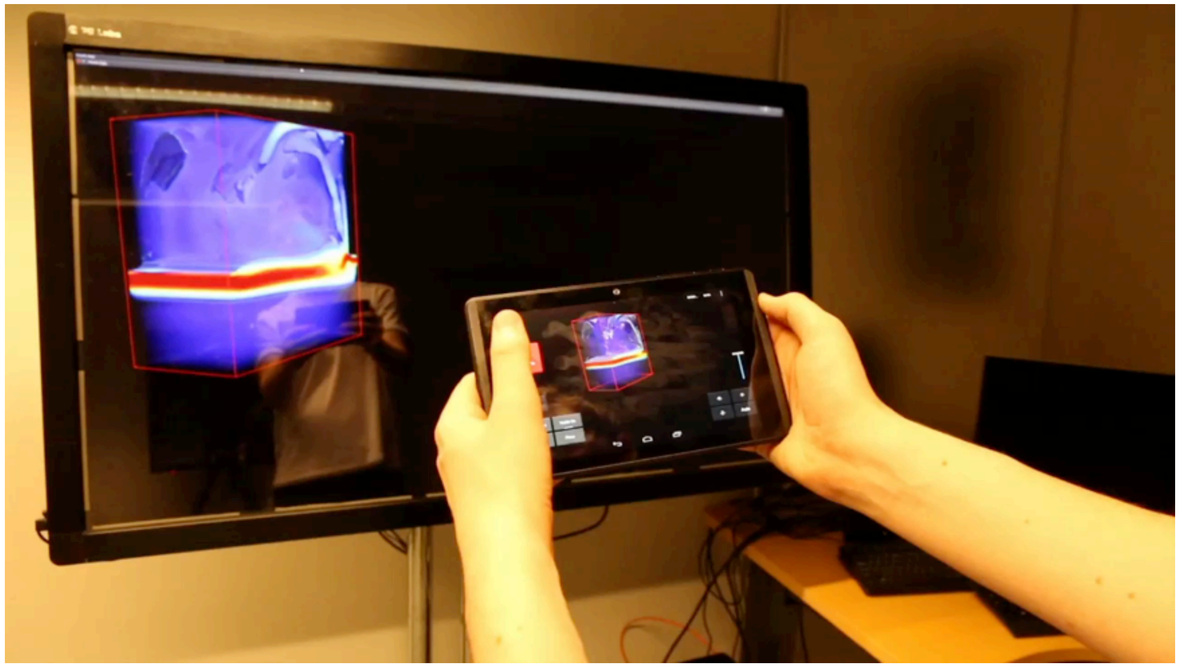
Gain-factor manipulations



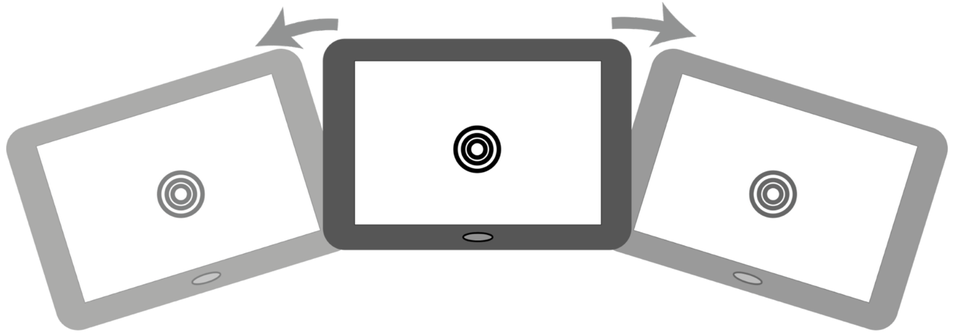


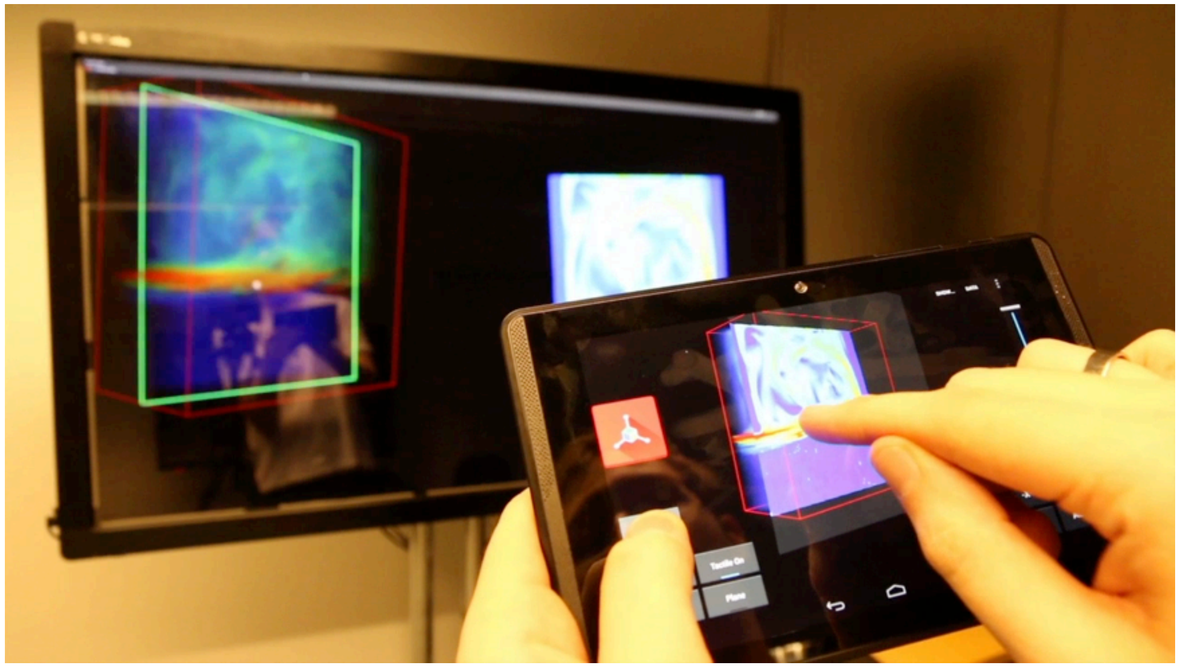
Gain-factor manipulations





Seeding point Placement





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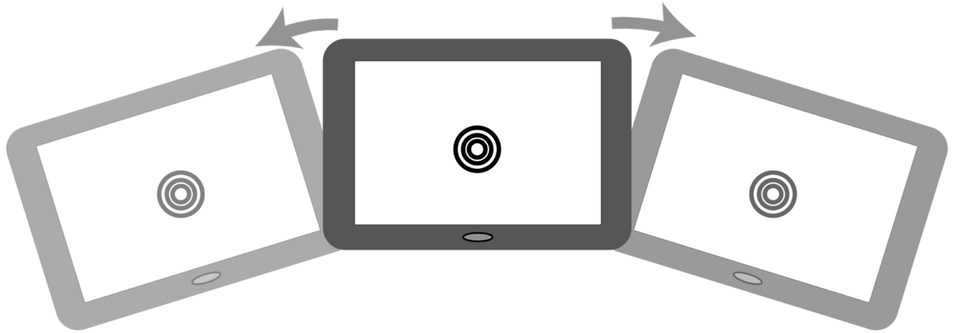
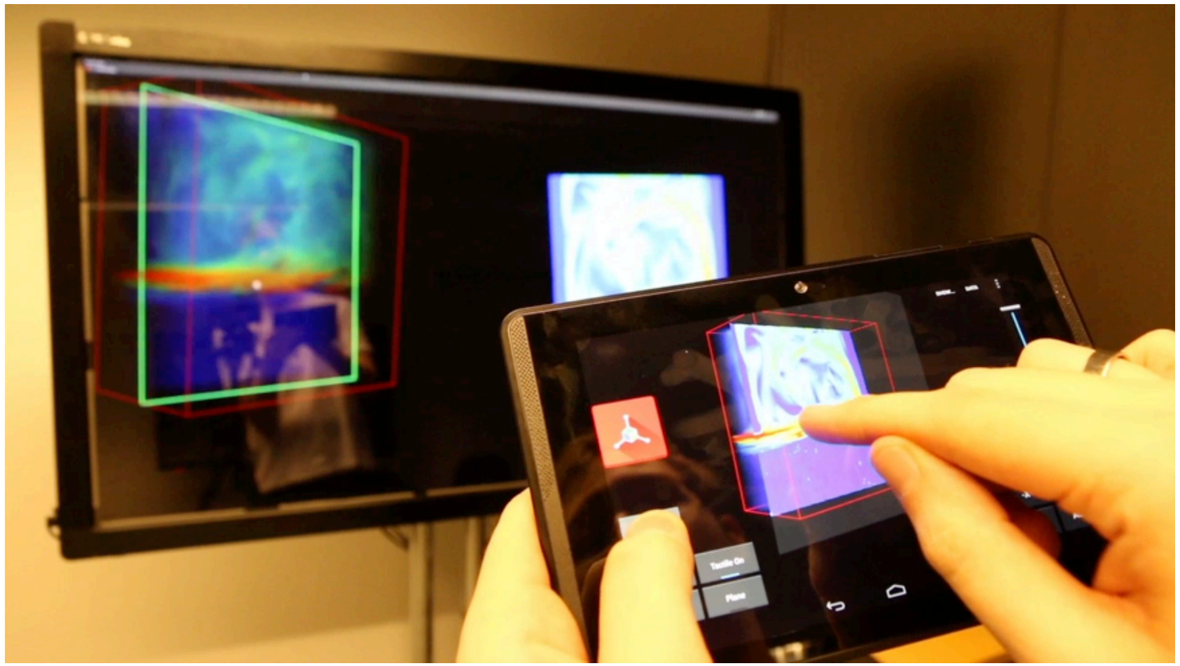
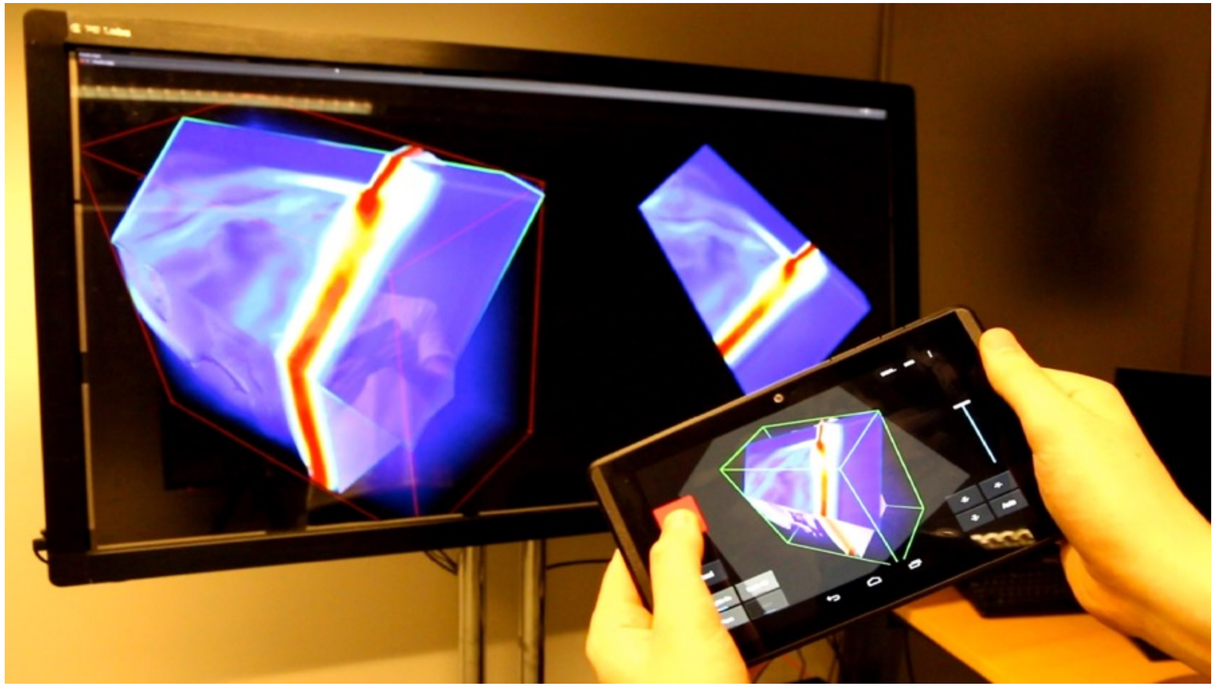


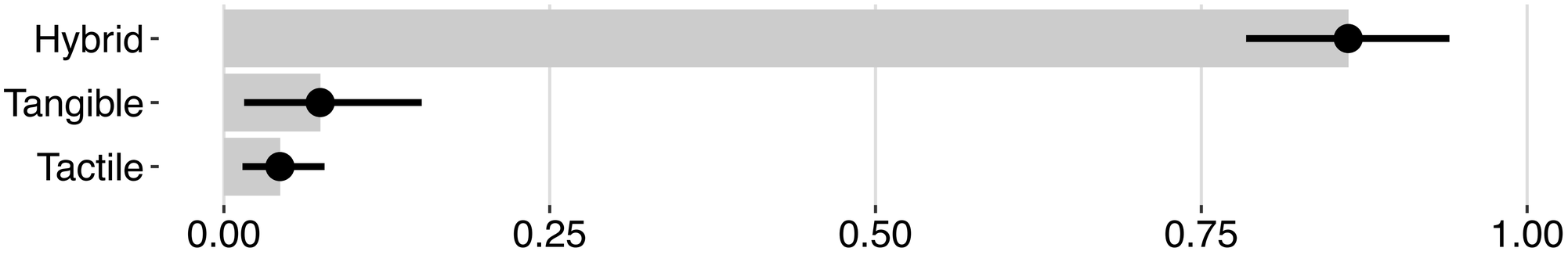


Hybrid Interaction Study

- 7 fluid dynamic researchers (mean 12.8 years of experience)
- Free exploration task with a FTLE dataset
- Questionnaires

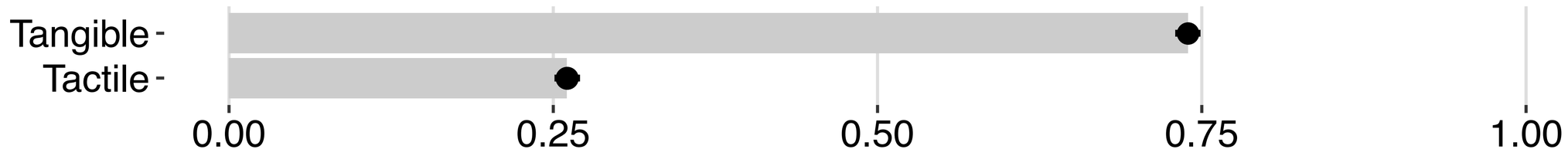


Quantitative Results



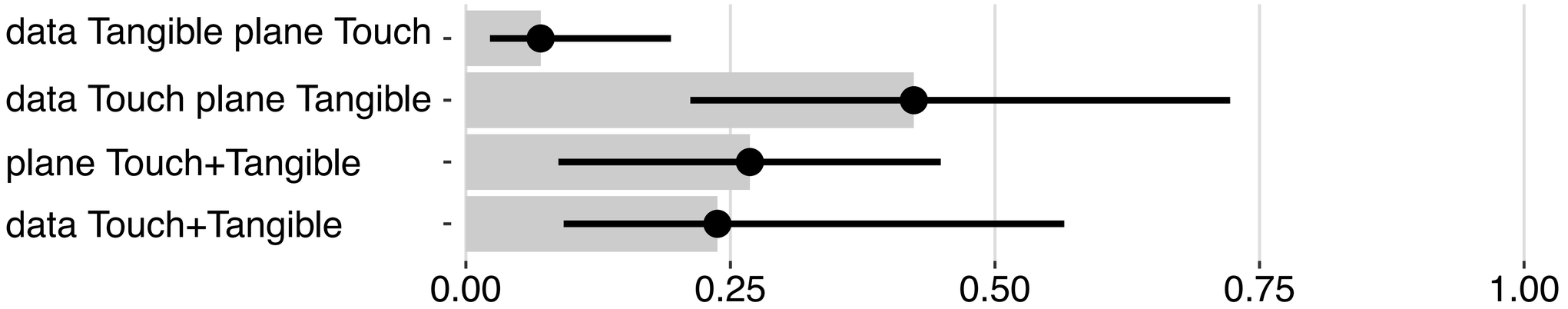
ratio of time spent interacting in the different conditions, error bars 95% CI

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

Qualitative Results

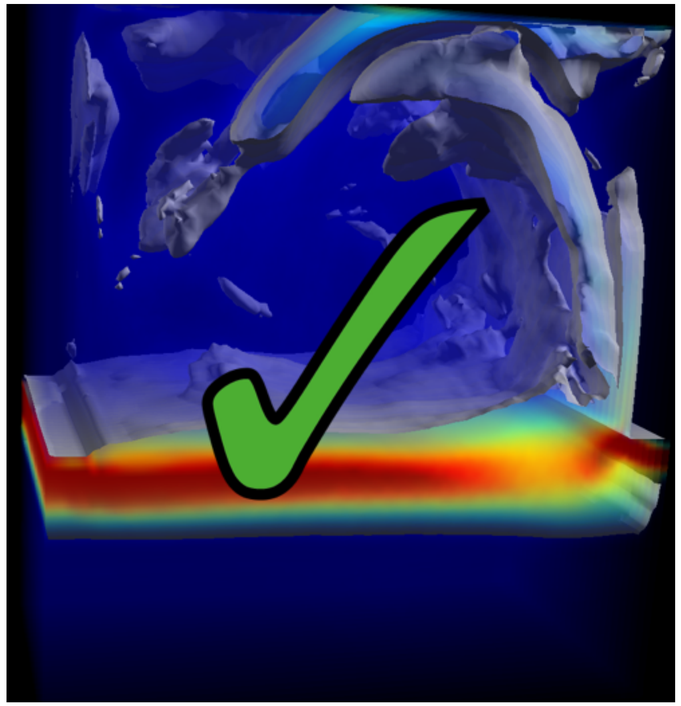
- "The system is a reproduction of what I can do with a PC but with better interaction techniques"
- "Seed point placement is more engaging and flexible"
- "I could achieve rotations or translation difficult to perform with a mouse-only approach"
- "Could be used as an extra visualization tool for primary analysis before getting back to a PC for more in depth analysis that requires scripts"

Qualitative Results

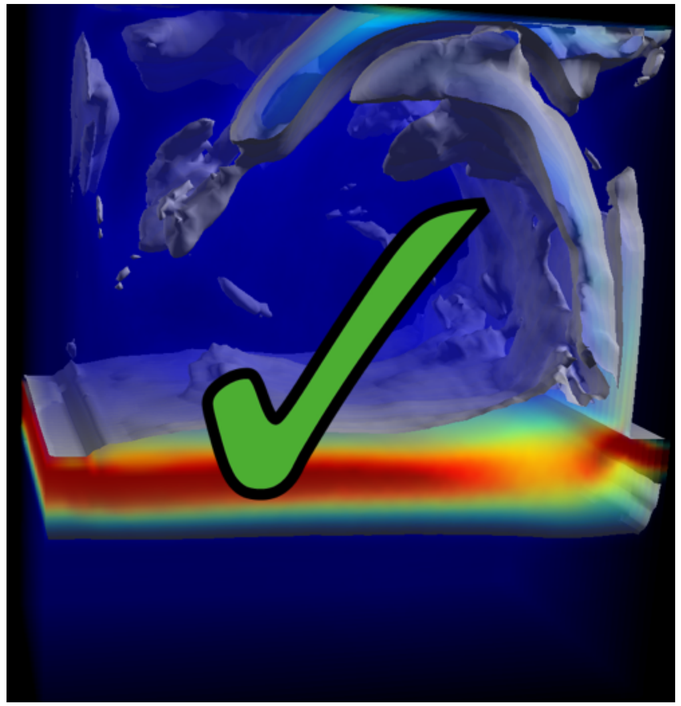
- Only 1 participant did not consider the tool as being fit for practical work yet
- 5 participants would gladly use it if synchronises with their desktop stations

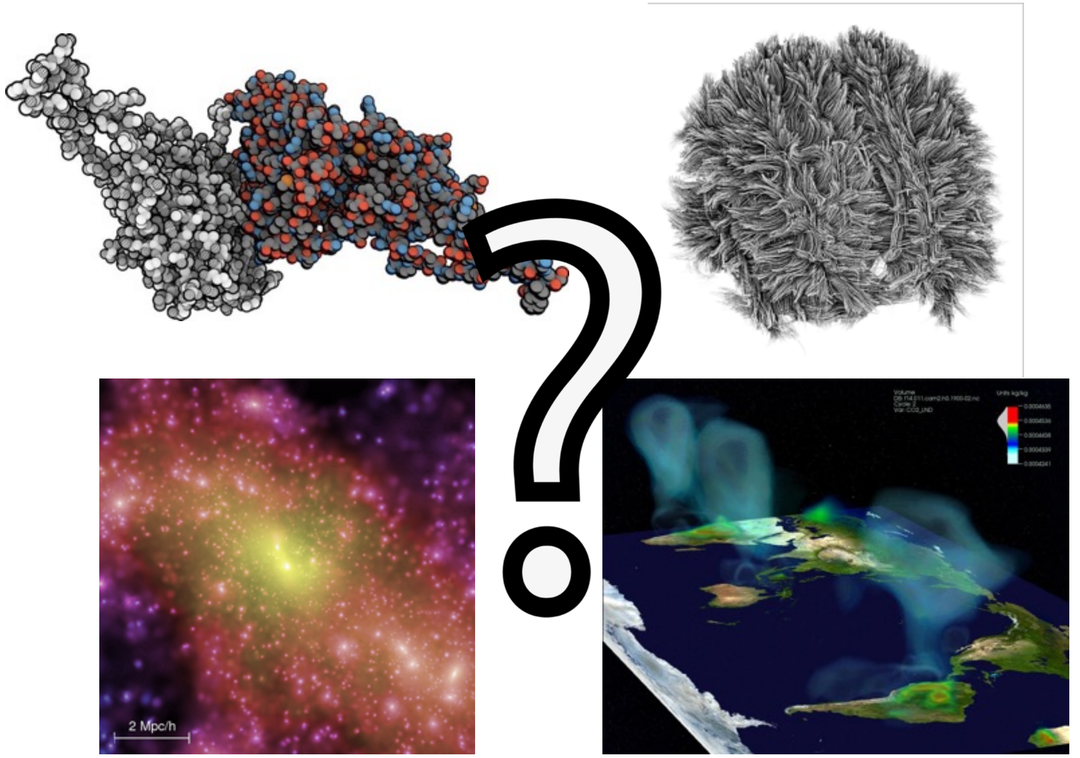
Limitations

Limitations

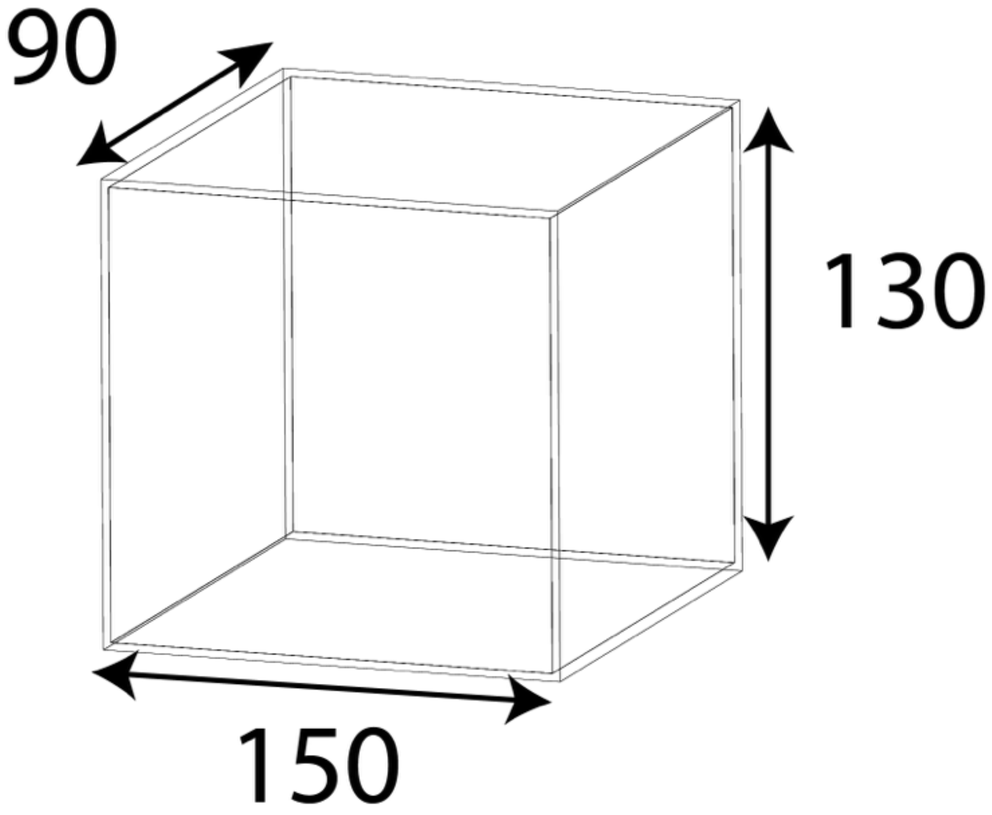


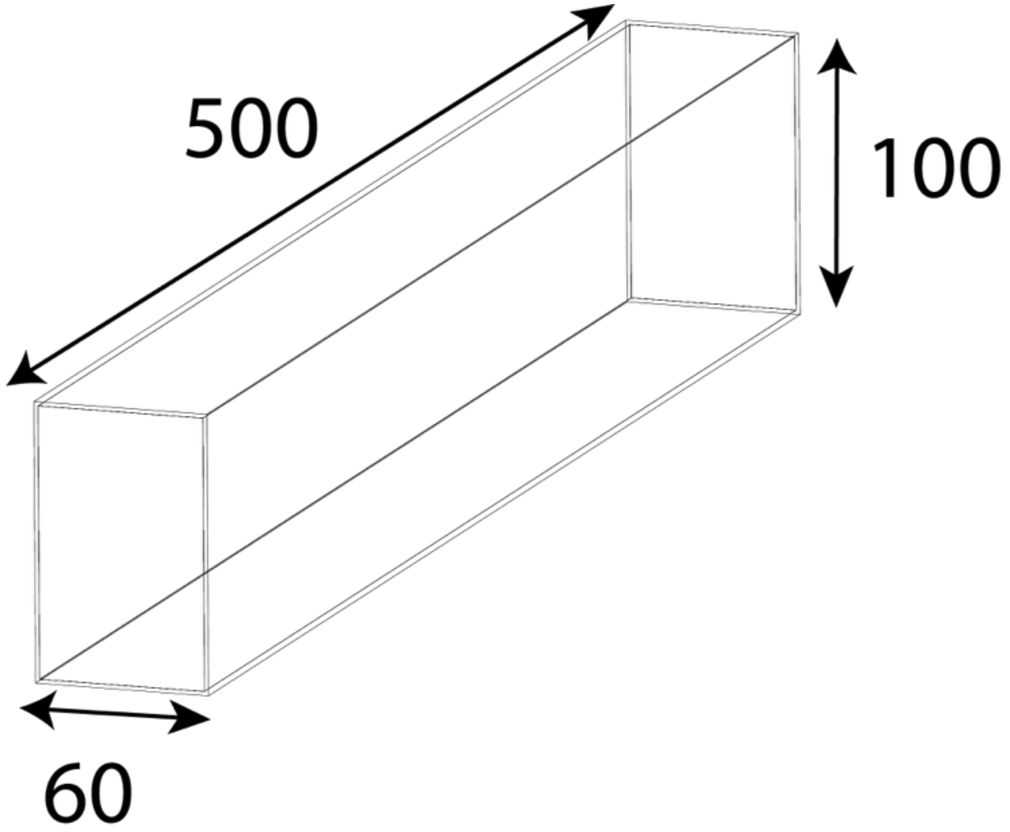
Limitations





Limitations





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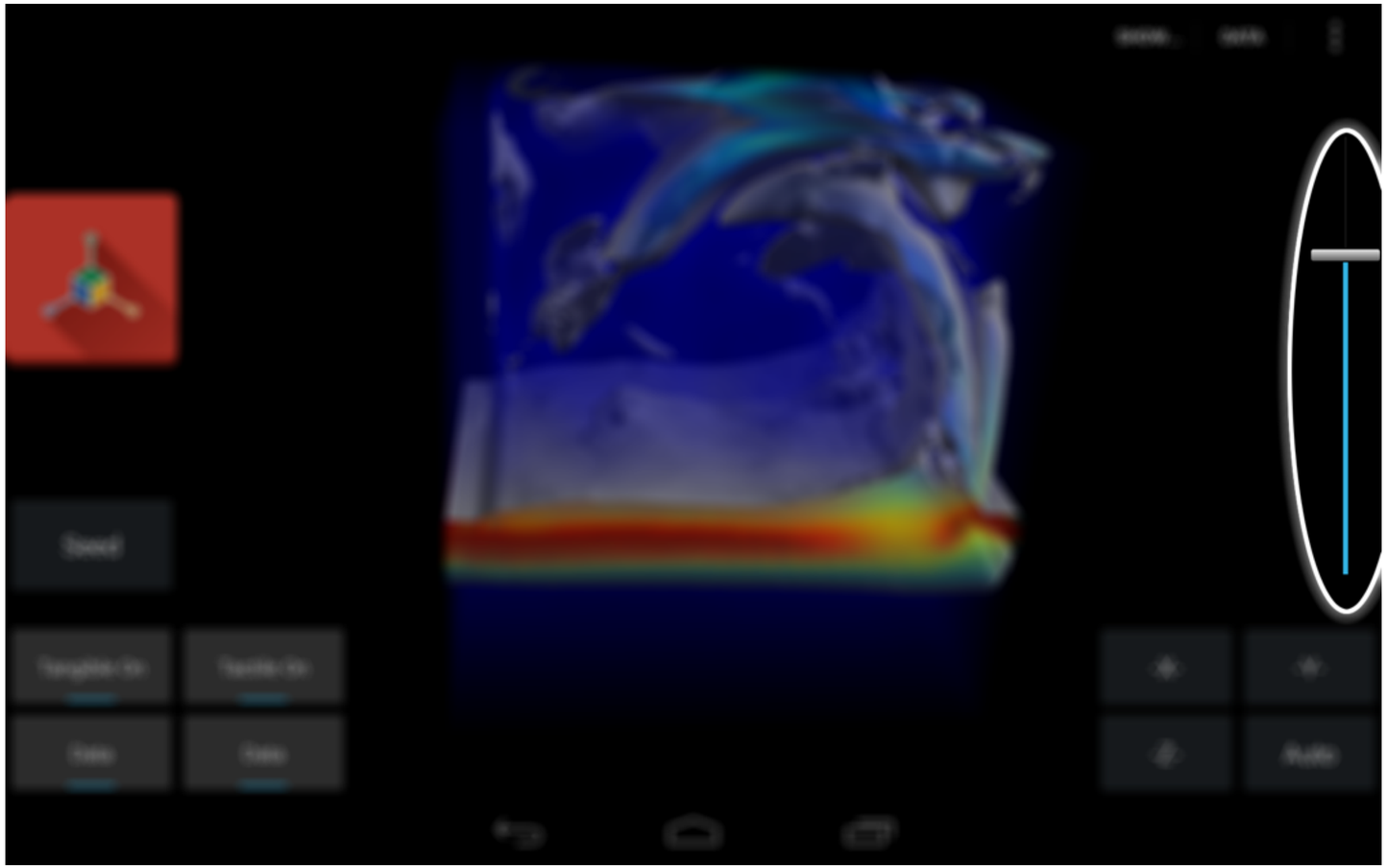

Conclusion

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- Hybrid interaction possible with off-the-shelves hardware

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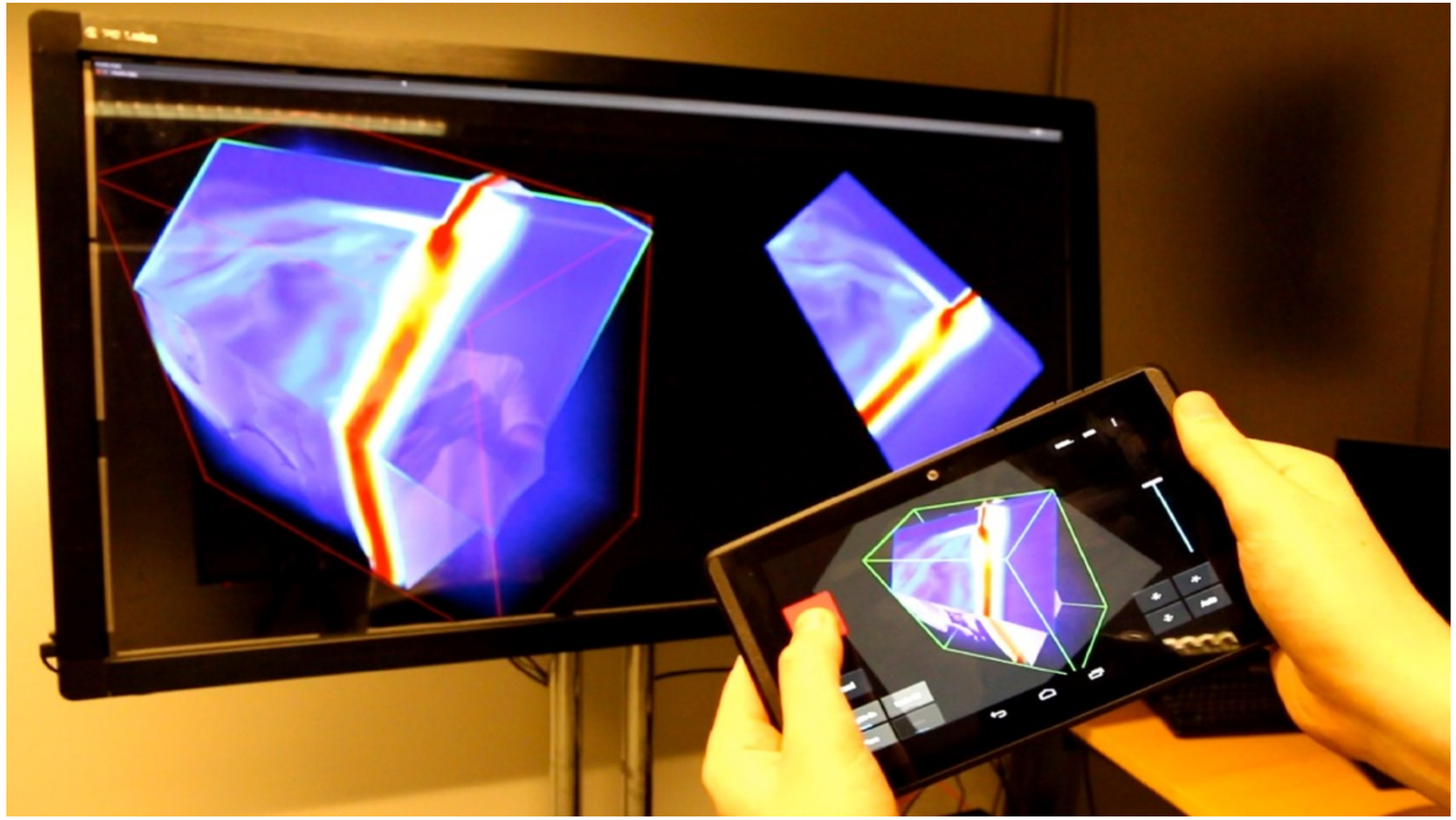
Conclusion

- 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

Hybrid Tactile/Tangible Interaction for 3D Data Exploration

Lonni Besançon, Paul Issartel, Mehdi Ammi, Tobias Isenberg



http://tiny.cc/hybridinteraction