VRDC

Panel: Lessons from IEEE Virtual Reality

Doug Bowman, PhD
Professor. Virginia Tech, USA
Anthony Steed, PhD
Professor. University College London, UK
Evan Suma, PhD
Research Assistant Professor. University of Southern California
Pablo Figueroa, PhD
Associate Professor. Universidad de los Andes, Colombia

What is IEEE VR?

- Most prestigious VR academic conference
- A community interested in systems, applications, devices, interaction techniques, human factors, and other VR related topics
- It gave birth to ISMAR, SUI, 3DUI, SEARIS, ...

Rationale

- Establish a dialog
  - We´ll have a similar panel at IEEE VR´16
- Show interesting research ideas
- Listen research needs
- Foster an IEEE VR – GDC Community

Examples

Virtual perambulator: a novel interface device for locomotion in virtual environment. VRAIS 1996
http://dx.doi.org.ezproxy.uniandes.edu.co:8080/10.1109/VRAIS.1996.490511

display case item 5

Contributors: Mark Bolas, J. Logan Olson, David M. Krum, Evan A. Suma
Sponsor: Institute for Creative Technologies, Army Research Lab

Figure 3. Hoop frame

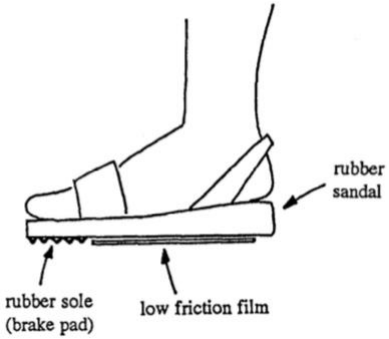


Figure 4. Simplified sliding device

Community

- Mixed Reality Research and Development Group

- mirriad@googlegroups.com
- Search for mirriad at google groups!

Highlights

- Interaction Techniques
- Self Representation, Latency
- Locomotion, Redirected Walking
- Software Architectures for VR
- More Ideas
- Final Remarks

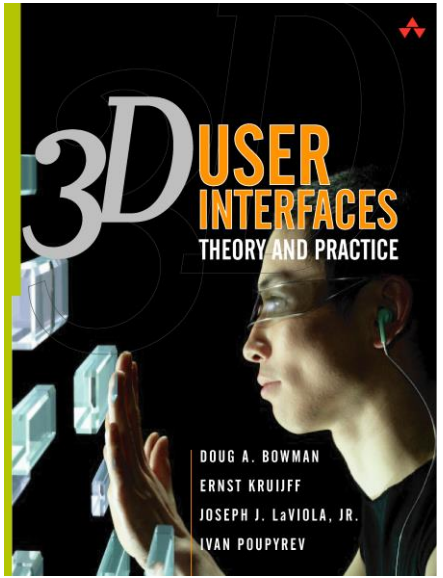
VRDC

Doug Bowman
Professor

Virginia Tech,
USA

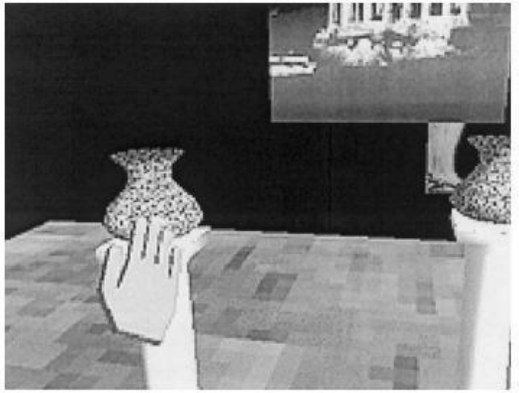
Universal 3D interaction tasks

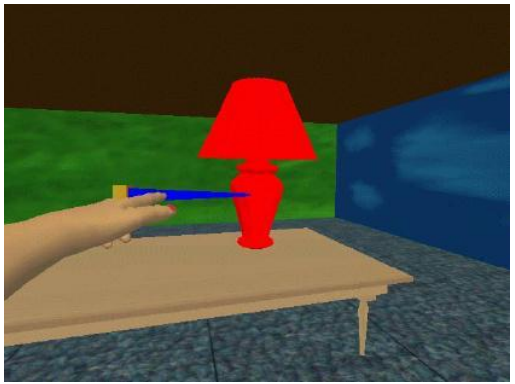
- Selection
- Manipulation
- Navigation
- System control



3D selection

- Pick one or more objects from a set
- Real-world metaphors:
  - Touching/grasping
  - Pointing
- "Natural" techniques:
  - Simple virtual hand
  - Ray-casting





3D selection: hard cases

Technique	Distant targets	Small targets	Targets in cluttered regions	Moving targets
Simple virtual hand	✘	✔/✘	✔/✘	✔/✘
Ray-casting	✔	✘	✘	✘

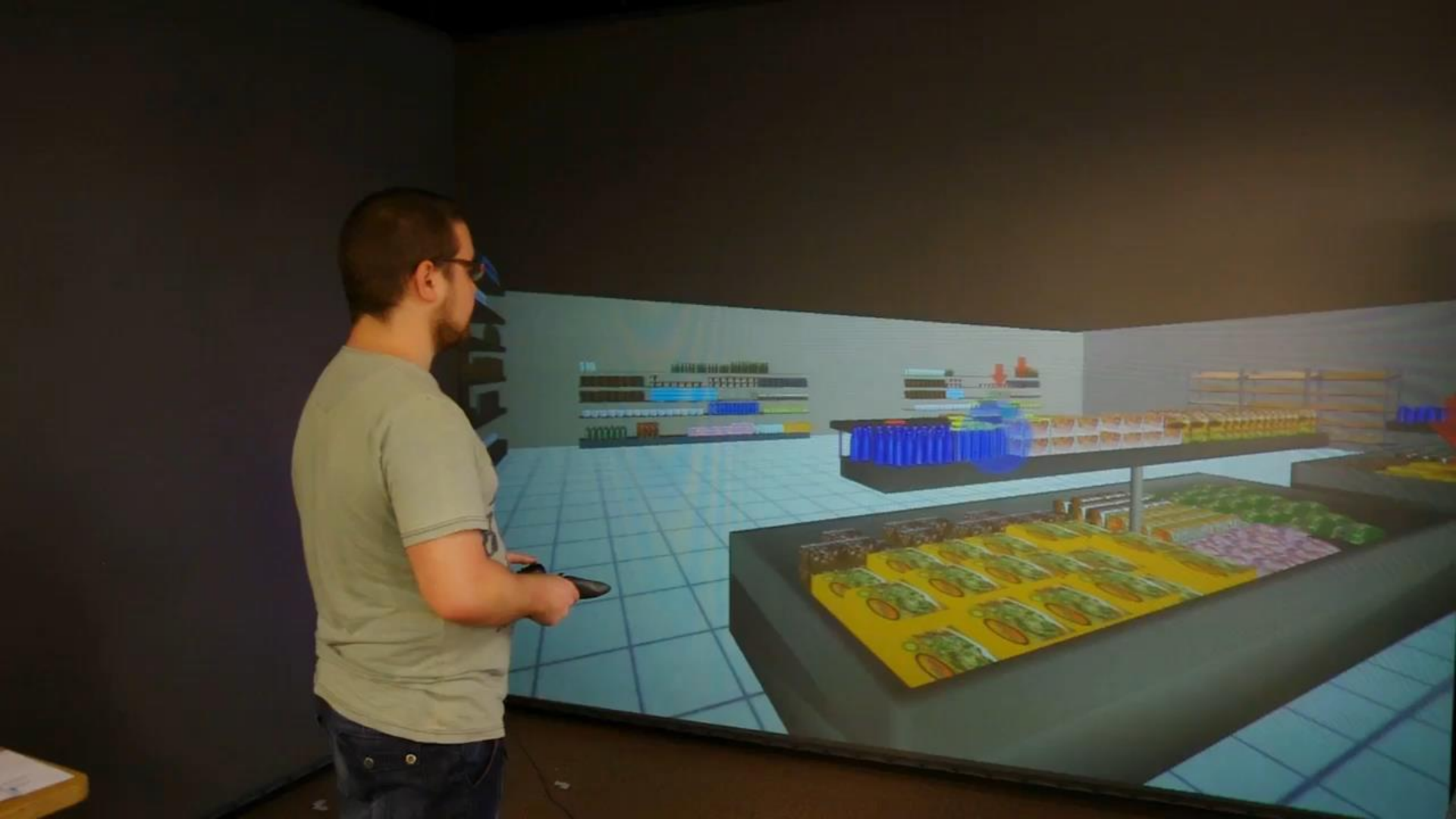
3D selection: failures of naturalism

- Technology: tracking jitter, precision, latency
- Human: hand jitter
- Environment: distance, occlusion

- Natural techniques only semi-natural
- Even fully natural techniques not optimal

3D selection: Double Bubble

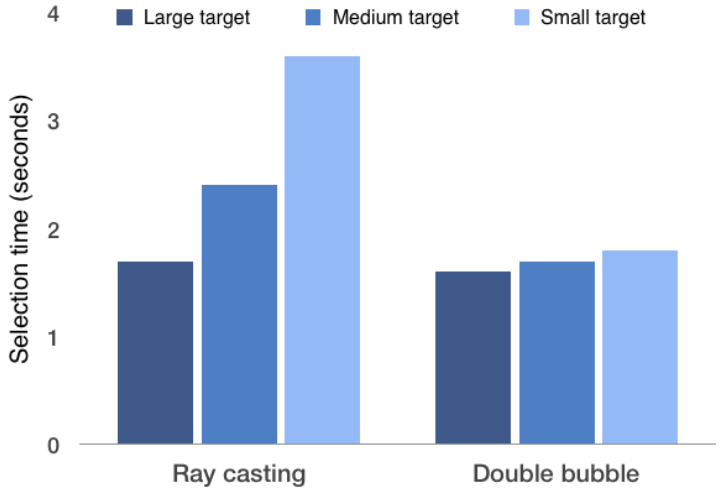
- Extend ray-casting
- Dynamic volume cursor
- Progressive refinement

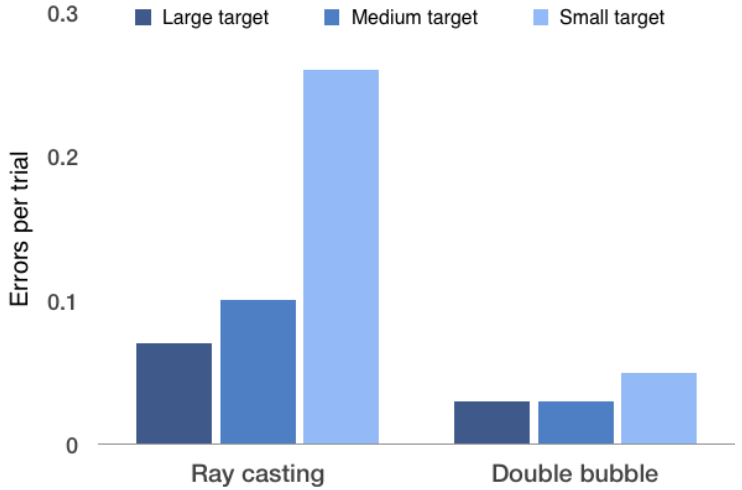


3D selection: hard cases

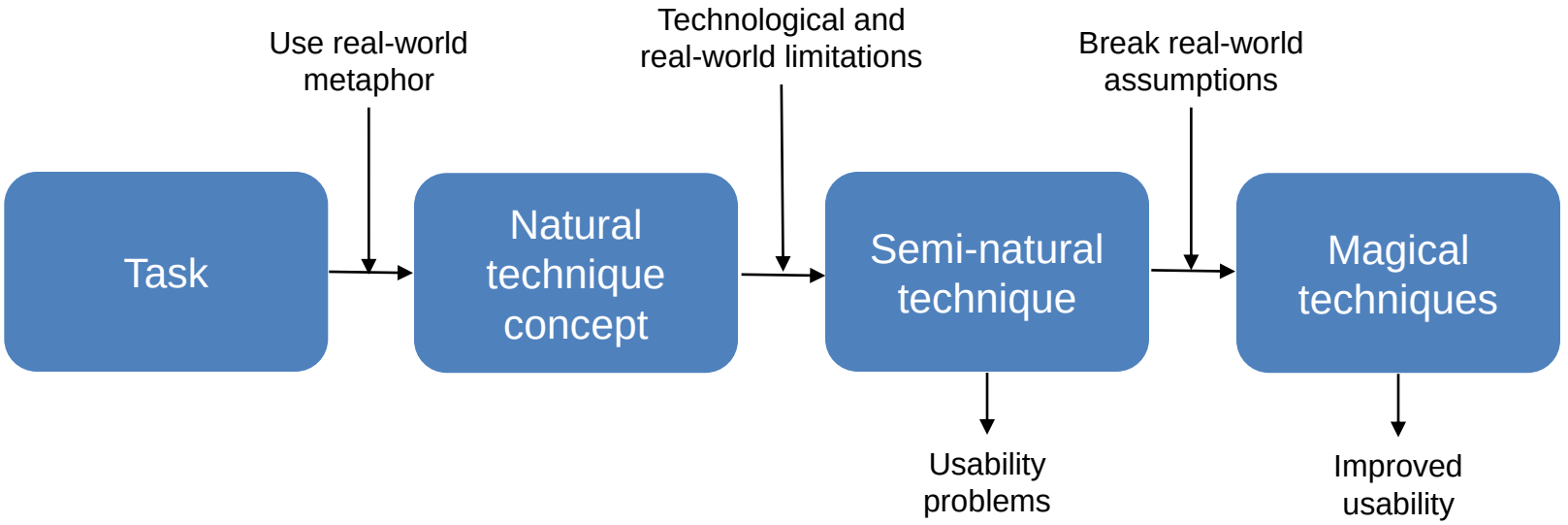
Technique	Distant targets	Small targets	Targets in cluttered regions	Moving targets
Simple virtual hand	✘	✔/✘	✔/✘	✔/✘
Ray-casting	✔	✘	✘	✘
Double Bubble	✔	✔	✔	✔

3D selection: findings





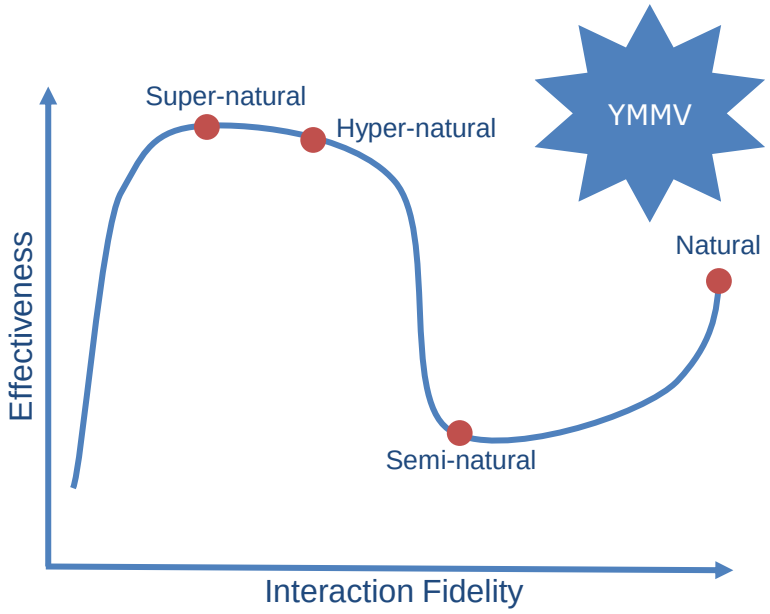
Innovation in 3D interaction



Task	Natural metaphor	Semi-natural techniques	Usability issues	Magical techniques
Selection	Touching, pointing	Simple virtual hand, ray-casting	Small, distant, moving objects in cluttered envs.	Double Bubble, Hook, SQUAD, Aperture
Manipulation	Grasp and move	Simple virtual hand	Manipulation at a distance, precision	Go-Go, PRISM, Scaled HOMER
Navigation	Walking	Walking-in-place, treadmills	Unnatural force feedback, lack of inertial cues, large environments	Teleportation, grabbing the air, WIM
System control	GUI menus	Floating 3D menus	Occlusion, lack of surface constraints, menu placement	Pen-and-tablet menus, rapMenu

3D interaction: final thoughts

- Naturalism vs. magic
  - Hyper-natural
  - Super-natural
- Precision interaction with imprecise tools
  - Progressive refinement
  - Dynamic C/D gain
  - Virtual friction



VRDC

Anthony Steed
Professor

University College London, UK

Main Thoughts

- From a user-interface point of view, what is disruptive about virtual reality?

  "perceptual illusion of nonmediation"

  (Lombard and Ditton)

- You are the agent acting, not primarily moderated by devices you need to learn to use.

Non-Mediation

- You (your senses in your body) are immersed
- What ever you do changes multiple sensory stimuli in predictable ways that you understand implicitly from “prior to VR” experiences
- Two implications among many:
  - How your movements are reproduced is critical
  - What you see is important for sensorimotor-match

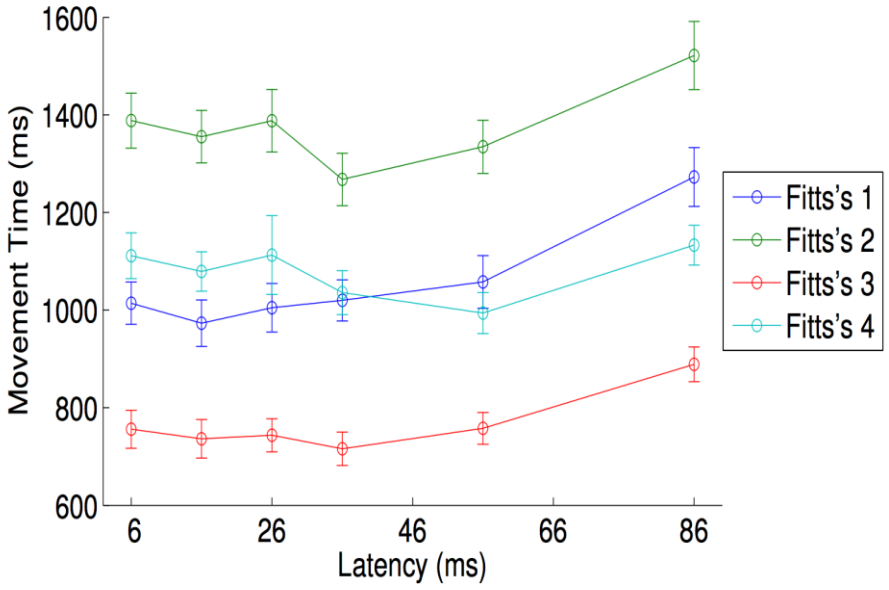
Latency

- Reducing latency is not just important to combat sickness, but because latency is critical for performance of actions
- Latency of 18ms is sometimes claimed to be hard to perceive, but it can still affect performance
- *If you are optimizing 3D interaction you must profile latency or your results may not transfer*

Fitts' Law

- Models human movement on simple pointing tasks
- 100s of academic papers (pick any movement device you like)
- Most VR results from 1990s, 2000s, dealt with latency 30ms-200ms

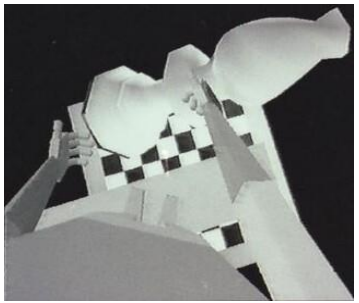
Friston, Karlström, Steed, 2015



- "Performance" peaks around 30ms
- Lower than 30ms is more "natural" but slower (on this task)
- Hypothesis is that the motor system has "latencies"

Impact of the Virtual Body

- Many studies of the impact of an avatar
- Vital for social interaction
- Also vital for presence (for some people)



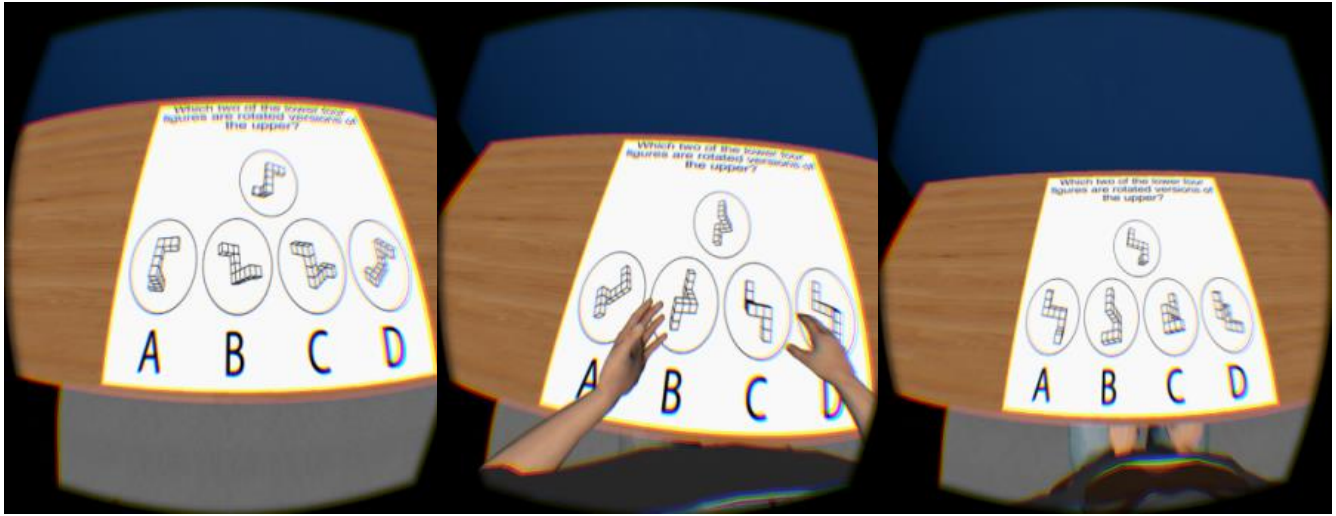
Pit demo at QMUL, circa 1993

Steed, et al., "An 'In the Wild' Experiment … ", IEEE VR 2016

Gesture and the Body

- Gesture is needed to explain to others
- Some people gesture constantly
- Researchers in linguistics have studied impact of gesture on ability to explain difficult concepts

Steed, Pan, Zisch, Steptoe, IEEE VR2016



No avatar, full avatar, avatar no movement

Impact of Avatar

- Having an avatar significantly improved ability to perform an object memory task
- People who had an avatar gestured a lot more than people without an avatar

Summary

- Latency is critical. Lower latency tends towards more "natural" interfaces, but these might not be the most efficient interfaces in all situations
- Virtual body is very important to some users

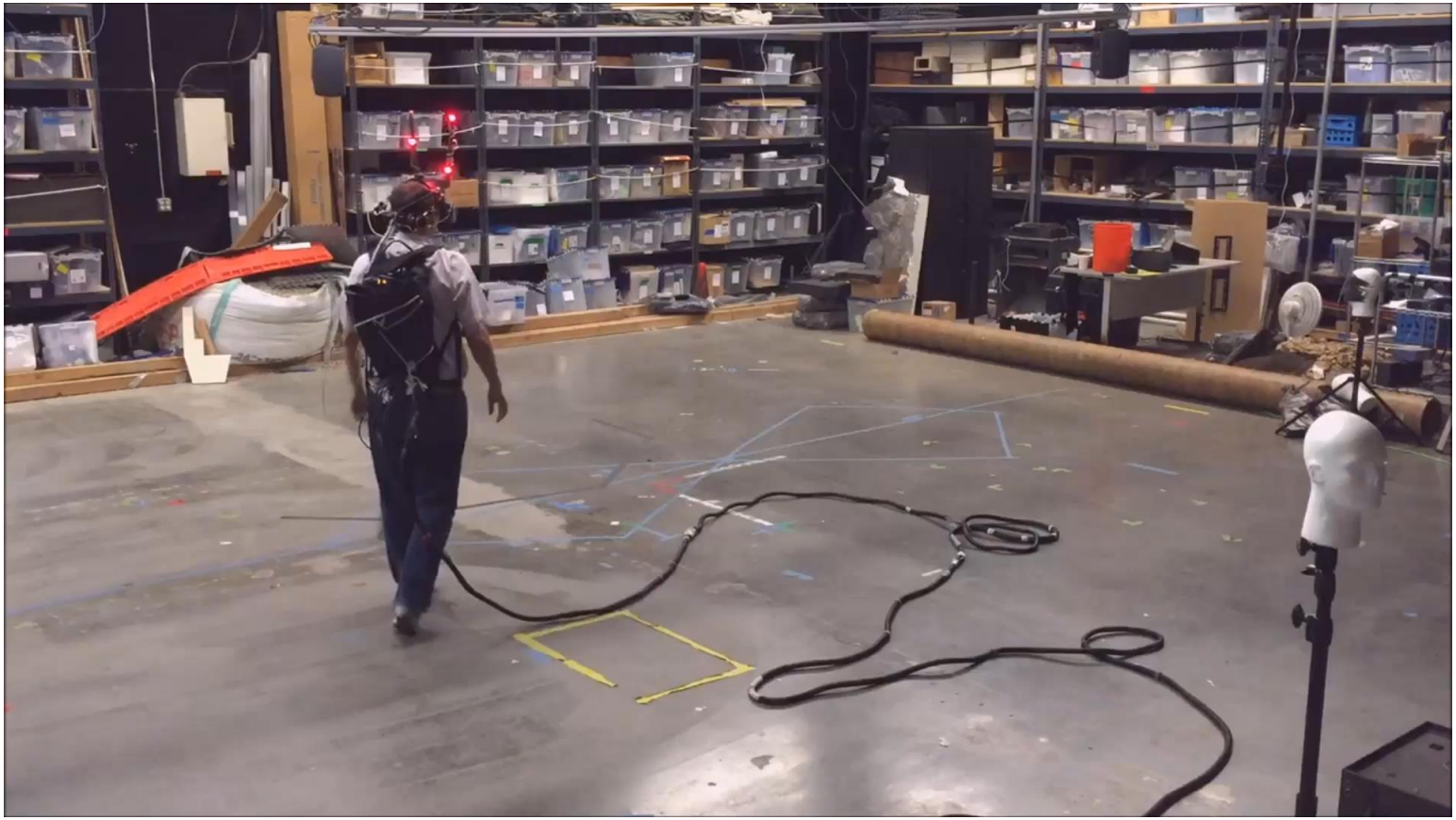
- "Virtual reality" research can be found in a huge range of disciplines because impact and requirements are so broad
- A very diverse research community makes for exciting and interesting research collaborations

VRDC

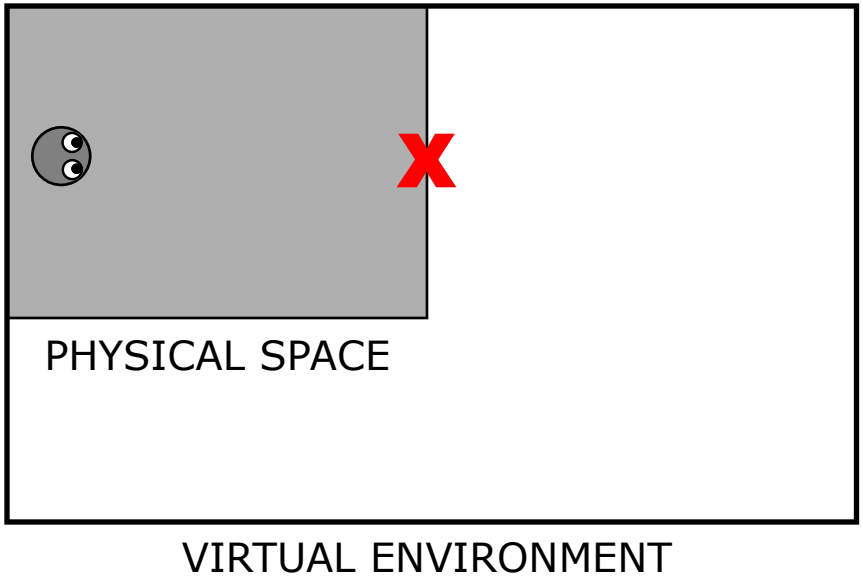
Evan Suma

Research Assistant Professor

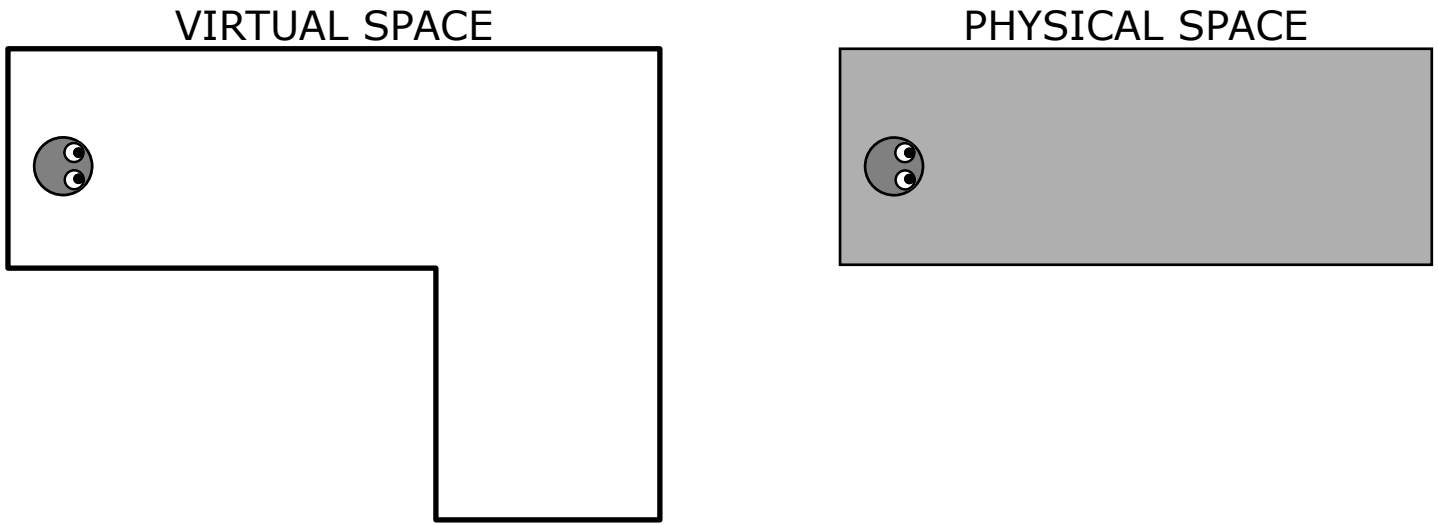
Institute of Creative Technologies (USC), USA



Walking in Virtual Reality

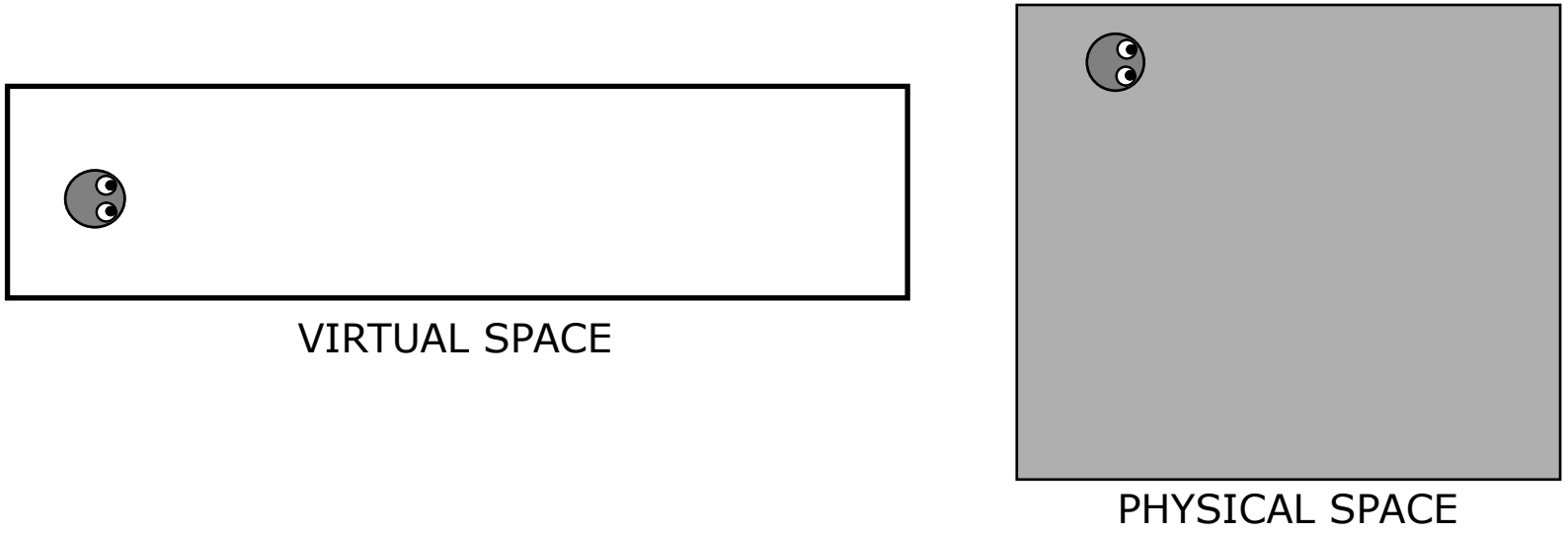


Redirected Walking (Rotation)



[Razzaque, Kohn, and Whitton, 2001]

Redirected Walking (Curvature)

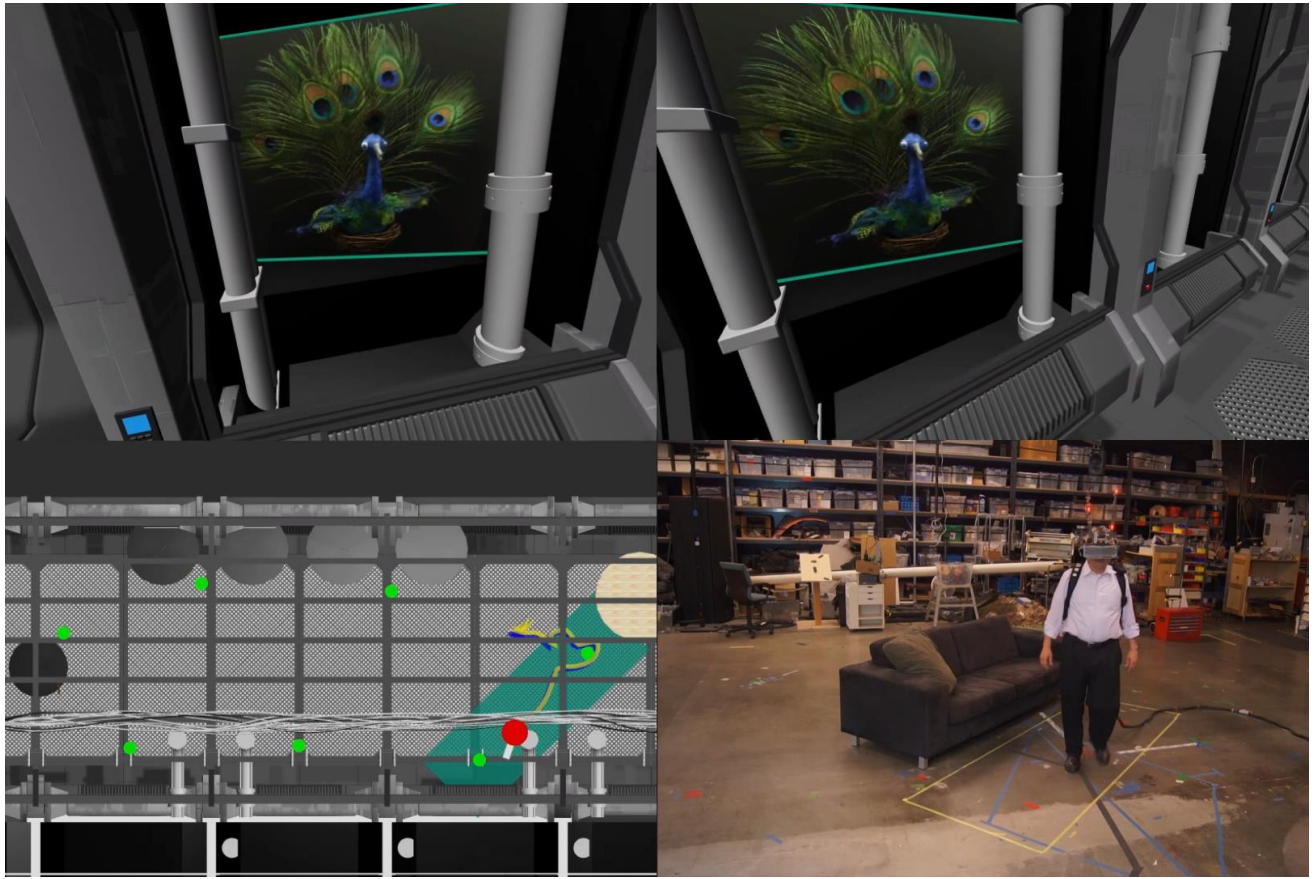


[Razzaque, Kohn, and Whitton, 2001]

Redirected Walking (Translation)

PHYSICAL SPACE

VIRTUAL SPACE



Why does redirection work?

Vision dominates **vestibular** sensation.

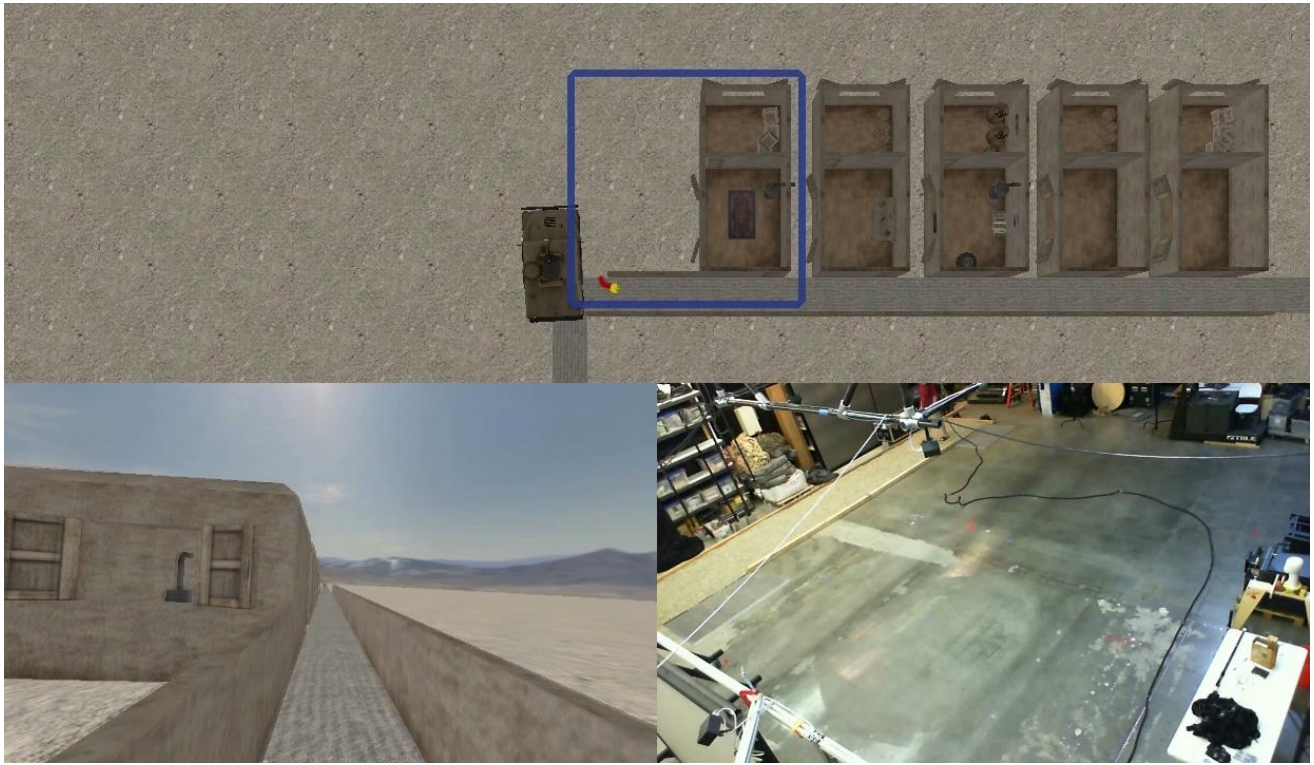
(within perceptual limits)

Rotation Gains
49% amplification
20% dampening

Curvature Gains
arc radius >= 20 meters

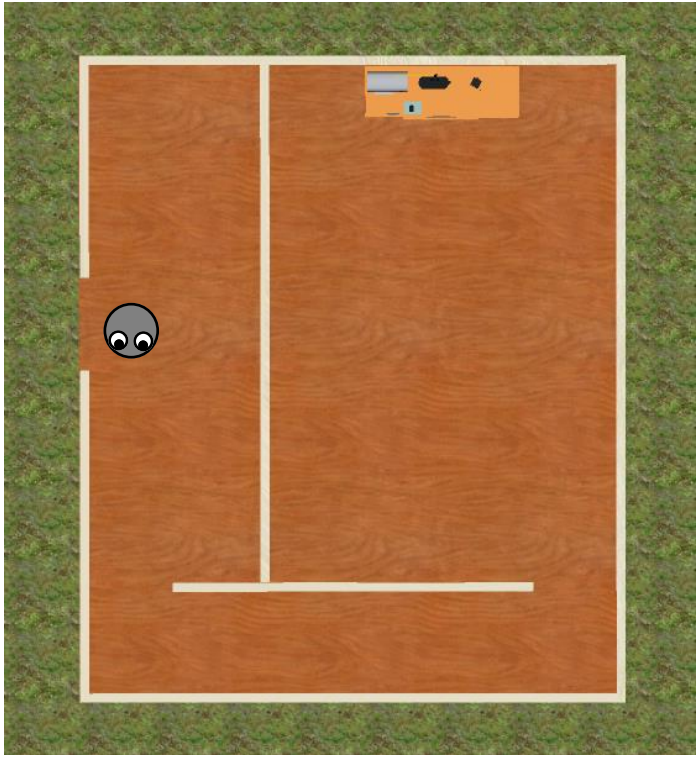
Translation Gains
26% upscale
14% downscale

[Steinicke, Bruder, Jerald, Frenz, and Lappe, 2010]

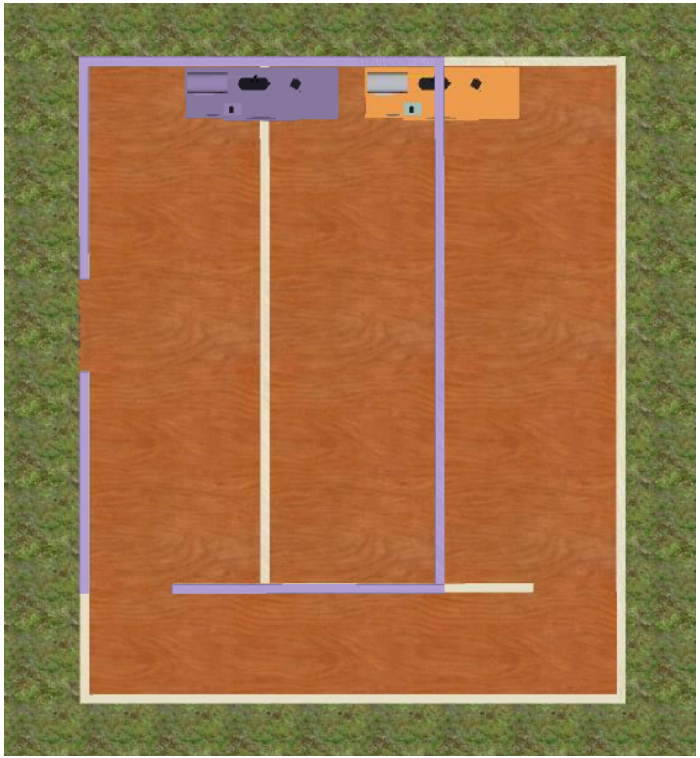


Change Blindness Redirection

[Suma, Clark, Finkelstein, Wartell, Krum, and Bolas, 2011]



Impossible Spaces
[Suma, Lipps, Finkelstein, Krum, and Bolas, 2012]



Impossible Spaces
[Suma, Lipps, Finkelstein, Krum, and Bolas, 2012]

Flexible Spaces

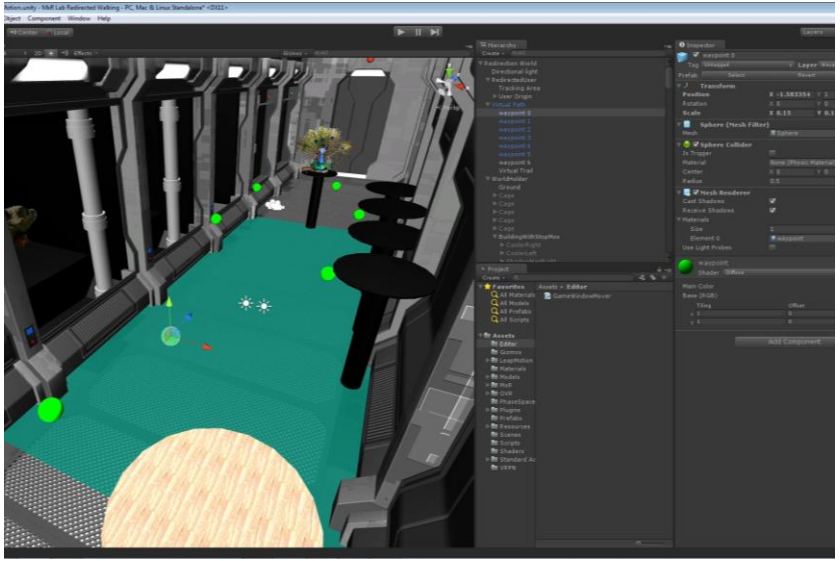
[Vasylevska, Kaufmann, Bolas, and Suma, 2013]

Summary

- In VR, laws of physics are changeable
- Human perception is malleable
- We can leverage this to improve usability
- We can create surreal, magical experiences

Redirected Walking Toolkit

- Plug-and-play toolkit for Unity
- Supports Rift, Vive, and custom VR setups
- Open-source (BSD license)
- Free for commercial use



http://projects.ict.usc.edu/mxr/rdwt

VRDC

Pablo Figueroa
Associate Professor

Universidad de los Andes, Colombia

Software Architectures

- Software Engineering and Architectures for Realtime Interactive Systems
- How can we build better MR?
- How we report findings in this area?

Software Architectures

- Architectures: Dataflows, Layered, VMs
- Programming languages: Scala, Haskell, Python, …
- Videogames in different VR setups: CAVEs, Table Tops, AR, under water (mobile)
- Capabilities: Multimodality, AI, haptics, …

More Ideas

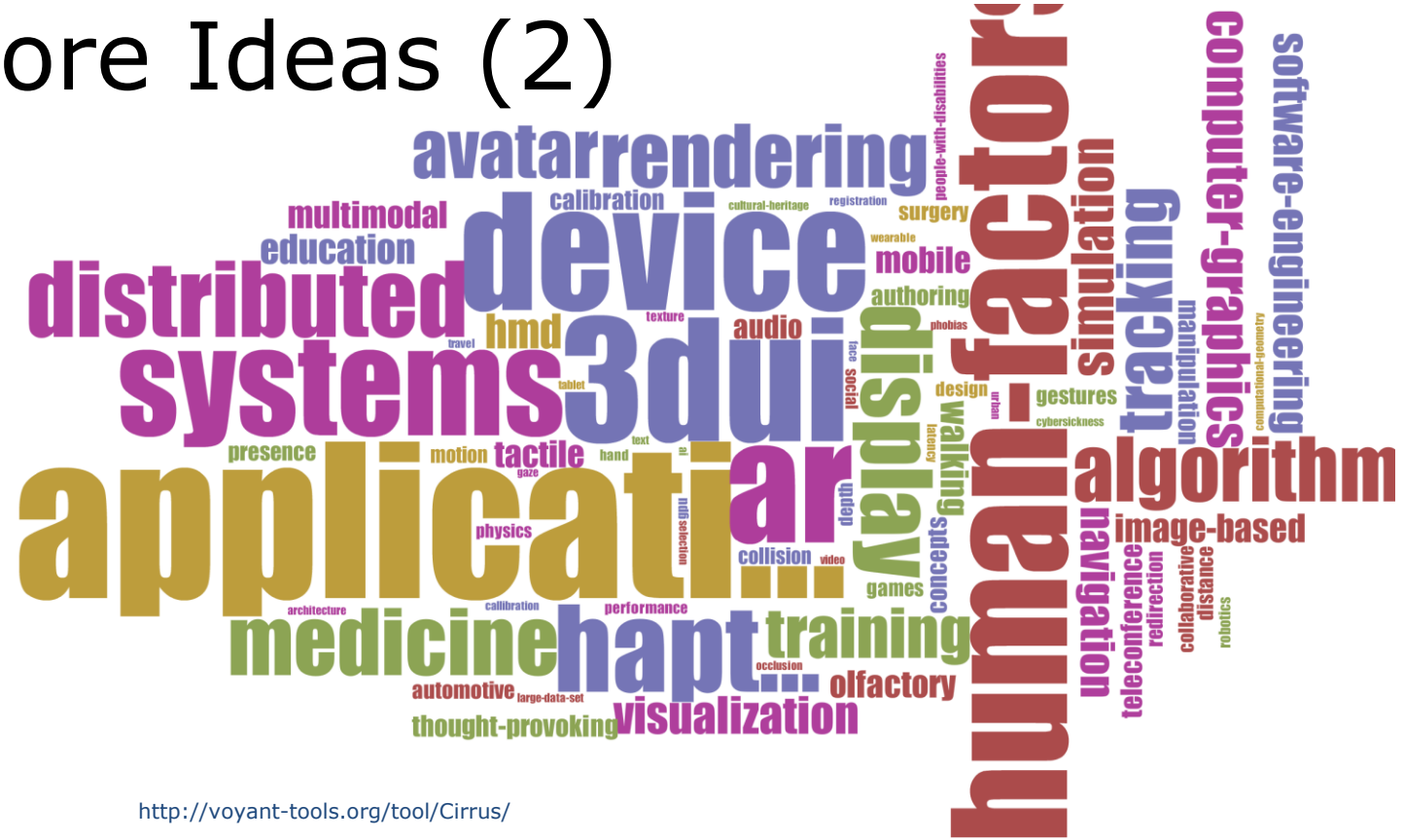
List of Papers IEEE VR

File Edit View Insert Format Data Tools Add-ons Help All changes saved in Drive

	A	B	C
1	Year	Keywords	Data
3974	2008		
3975		display,FOV	Providing a Wide Field of View for Effective Interaction in Desktop Tangible Augmented Reality
3976			Seokhee Jeon ; Kim, G.J.
3977			Publication Year: 2008, Page(s):3 - 10
3978			Cited by: Papers (6)Multimedia
3979			| Abstract | PDF (15247 KB)
3980			
3981			
3982		AR,image-based,rendering	Capturing Images with Sparse Informational Pixels using Projected 3D Tags
3983			Li Zhang ; Subramaniam, N. ; Lin, R. ; Raskar, R. ; Nayar, S.
3984			Publication Year: 2008, Page(s):11 - 18
3985			Cited by: Papers (2)Multimedia
3986			| Abstract | PDF (2687 KB) | | HTML
3987			

https://docs.google.com/spreadsheets/d/1fGHRGQ1Rf8dI7h0a6-UXhAMaJb9qQhxmCpUxnzsCymg/edit?usp=sharing

More Ideas (2)



http://voyant-tools.org/tool/Cirrus/

More Ideas (3): applications

Community

- Welcome to mirriad (Mixed Reality Research and Development) group
- Post a trailer, overview, or contribution of your MR experience
- Post questions or issues that you would like researchers to address
- mirriad@googlegroups.com

Thanks!

Questions?

mirriad@googlegroups.com

Figure 3. Hoop frame

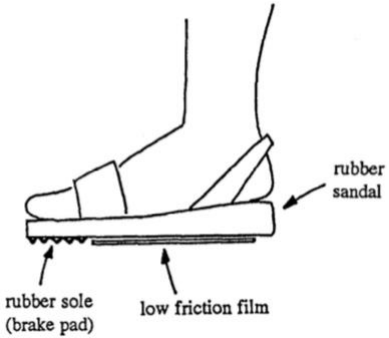


Figure 4. Simplified sliding device