


Virtual and augmented reality tools to demystify clinical complexity


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Acknowledgements



Chris Larkee
John Venn
Sophia Shanahan
Madison Hertel



Nick Peterson
Francis Kim MD
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Carmen Bergom, MD, PhD
Monica Shukla, MD
Melinda Stolley, PhD
Gui Garcia, PhD
Alan Silverman PhD, Praveen Goday MD
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This work was supported by:

- Marquette University Strategic Innovation Fund
- MCW Cancer Center Multi PI Seed Funding Program
- Marquette University Opus College of Engineering Undergraduate Research Fellowship
- National Center for Advancing Translational Sciences NIH Grant UL1TR001436
- NIH R01HL142955 (J LaDisa) & R15HL096096 (J LaDisa)
- AHA CIA Award 15GRNT25700042 (J LaDisa)

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Motivation

Immersive experiences allowing for motion in realistic environments:

- active learning
- critical thinking
- improved performance

Particularly useful when training in the physical world is complex, dangerous or logistically challenging.



e.g. a diver is more likely to recall instruction when it is learned in water rather than on land

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What is an immersive experience?



immersive

[ih-mur-siv]

adjective

1. noting or relating to a digital technology or image that actively engages one's senses and may create an altered mental state
2. noting or relating to activity that occupies most of one's attention, time or energy
3. experiences that facilitate full body motion of a participant
4. Covers a large portion of your field of view

Adapted from Dictionary.com & Patel et al. 2006

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Types of immersive technology



Virtual Reality (VR)

- uses head-mounted displays (HMD)
- computer-generated world
- manipulate objects using controllers
- For example, Ready Player One



Augmented Reality (AR)

- overlays digital info on the real-world
- enhances real world using digital details
- Creates new layers of perception
- For example, Pokémon Go



Adapted from www.torbes.com

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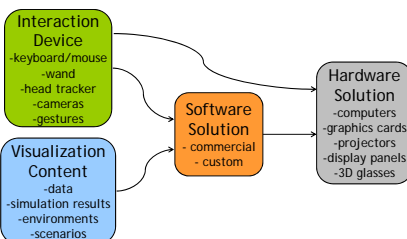
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System components



Display source onto which a specific environment is generated and adapted through the movements of one or more users



Adapted from Trellet et al 2018

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What's the point?

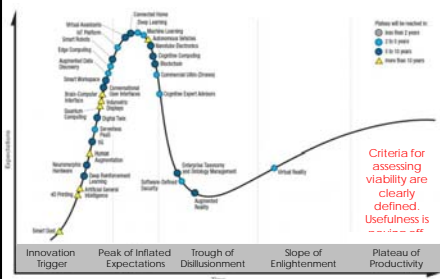


Immersive visualization, augmented reality and virtual reality are not just for video games or hobbies.

They allow us to break down complex situations and show them in ways that are natural and realistic to improve understanding.

Our application today is clinicians and patients.

However...beware the Hype Cycle



1. Content creation can be challenging, and takes time
2. Is there a benefit of immersion to clinicians and/or patients?
3. Results should be linked to outcomes.

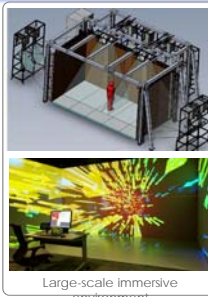
Content creation can be challenging & takes time



MARVL opened Jan. 16, 2014 with shared resources to create immersive content for research, teaching, industry and outreach initiatives

- Goal is to create custom immersive content and teach the theory related to this area

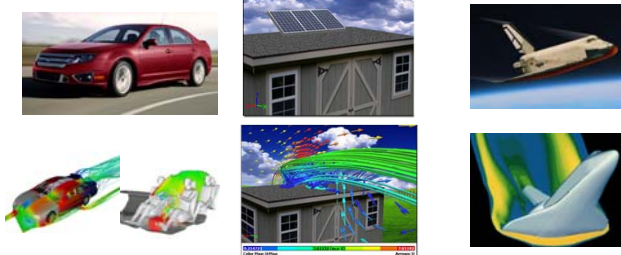
> 50 projects to date across a range of



E.g. computational fluid dynamics (CFD)



CFD helps analyze this complexity for analysis and improvements

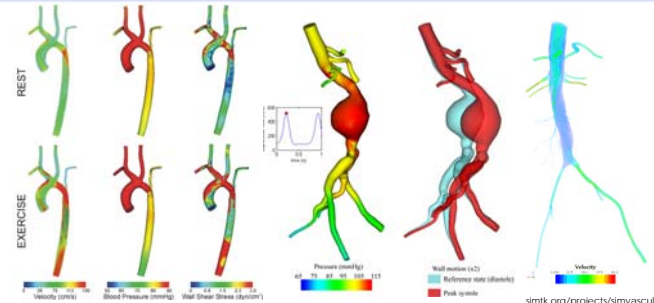


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E.g. CFD in arteries...the old way

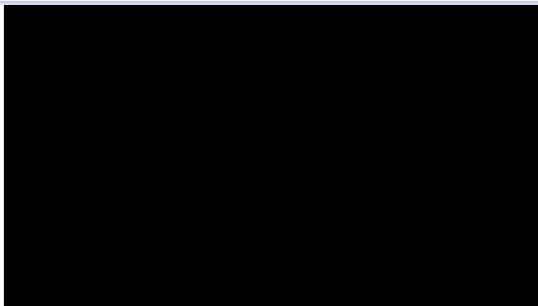


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E.g. Immersive CFD in arteries

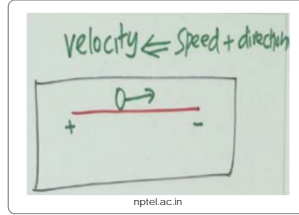
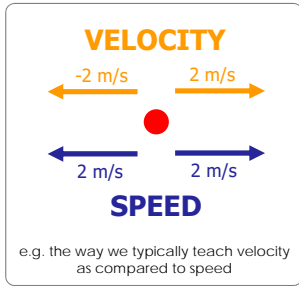


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Immersive VR can facilitate active learning



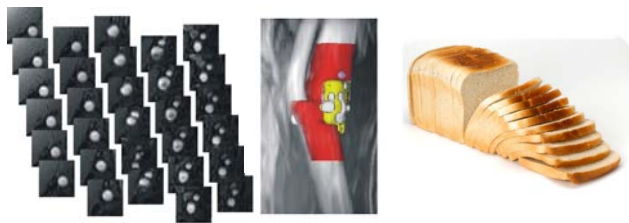
The prior immersive approach facilitates active learning!

Is immersion beneficial to clinicians and/or patients?



"In VR we are currently still at the stage similar to that of the transition between theater and movies. Movies were originally just another way to show

E.g. immersive viewing of medical imaging data



Adapted from LaDisa et al Medical Physics. 2010. 37(2): 784

E.g. immersive viewing of medical imaging data



Hololens AR demonstration

Outcomes-based research using immersive VR



- >350,000 patients get radiation therapy (RT) for cancer annually
- 60% of patients experience anxiety during the preoperative stage of RT treatment, and 80% develop anxiety postoperatively
- Reports describe a virtual environment for RT originally created for students training to be radiation therapists
- 45% of breast cancer patients receiving RT treatment suffer from clinically-relevant levels of anxiety
- A similar approach might be useful to alleviate anxiety and related issues in breast cancer patients undergoing RT



www.rockmountaincancercenters.com

VR-based exposure therapy



- Exposure Therapy is the gold standard in psychology
- There are limitations to implementing with all cancer patients
- VR-based Exposure Therapy for RT could realistically display anxiety-provoking stimuli in a convenient, safe and controlled environment

Objective: Reduce anxiety levels while increasing preparation and understanding for breast cancer patients receiving radiation therapy by allowing them to virtually undergo treatment prior to their actual treatment

Clinical Trial - immersive VR for cancer patients



Study Design

- Multi-site, Randomized Controlled Trial involving 36 patients
- Experimental group (VR experience) vs Control (standard video)

Measures

- Visual Analog Scales

1. How important is it for you in your present situation to have information on the following items:	Rating 1-9 1= Not important 9= Very important	Met	Partially Met	Unmet
Please circle number that applies				
1. Why I need to receive radiation therapy	1 2 3 4 5 6 7 8 9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. What radiation therapy will involve	1 2 3 4 5 6 7 8 9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. What happens during the planning appointment	1 2 3 4 5 6 7 8 9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. How my treatment is planned	1 2 3 4 5 6 7 8 9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How prepared are/were you for the radiation treatment experience?

0 10 20 30 40 50 60 70 80 90 100

Not prepared at Completely prepared

- State-Trait Anxiety Inventory

- Informational Needs Scale⁶

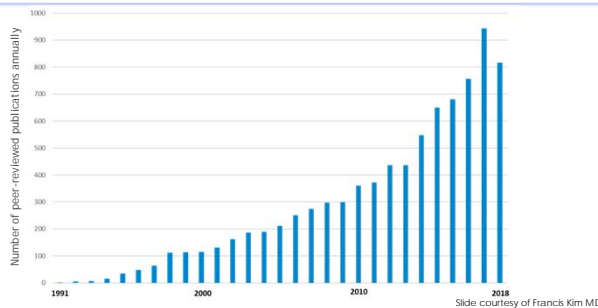
S. Shanahan - MS Thesis work

Clinical Trial - immersive VR for cancer patients



Oculus Rift VR demonstration

Exponential research - VR publications in PubMed



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