Capture of Virtual Environments for Analysis of Immersive Experiences

Camden Bock
University of Maine

This poster addresses emerging technologies for the capture and reconstruction of participants experiences in immersive virtual environments. These methods might improve communication of participants experiences when solving mathematical problems in three-dimensional contexts.

Keywords: Technology, Virtual-Reality, Mixed-Reality, Geometry

Virtual, mixed and augmented reality technologies provide novel opportunities for undergraduate students to investigate three-dimensional mathematical phenomena. For solid geometry, these immersive dynamic spatial displays support dynamic construction with virtual manipulatives in an immersive space without numeric measurements (Dimmel & Bock, 2017). Recent studies observing students solving mathematical problems use a two-dimensional projection of the first-person perspective in immersive (Lai et al, 2016; Bock & Dimmel, 2017) and augmented environments (Radu et al, 2015). However, these renderings might limit researchers' ability to analyze student's experiences in the virtual environment. This poster discusses the research question: How can participant's experiences solving mathematical problems in immersive three-dimensional mediums be understood through two-dimensional mediums? To address this question, this poster explores mixed-reality video capture, three-dimensional gesture capture, and figure logging provide as partial solutions for the reconstruction of a student's experience.

Mixed Reality Video Capture

Mixed Reality video capture can be used to record and stream live video of the physical participants inside their virtual environment (Figure 1), using both physical and virtual external cameras (Blueprint Reality, 2017). This provides more context about the participant's environment than a first-person view (Figure 1), while it can still be managed within traditional 2-d mediums.

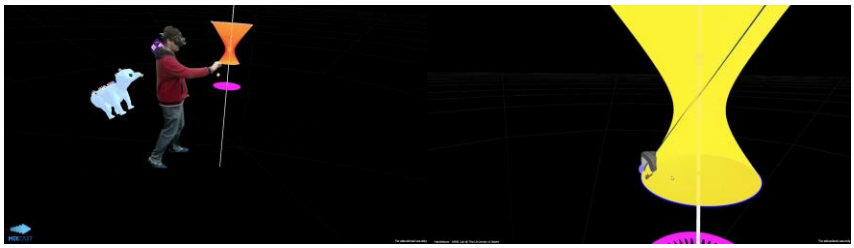

Figure 1. First Person (left) and Mixed Reality (right) views of the virtual environment.

Applications to Future Research

These data capture methods might improve studies using immersive dynamic spatial displays in addition to the first-person screen captures, when researching small groups of participants or sharing research data between multiple researchers. Immersive renderings of dynamic figures might be relevant for future studies of the teaching and learning of college mathematics in contexts where three-dimensional properties are difficult to render in 2D, including solids of revolution, constructions in solid geometry and gradients of three-dimensional surfaces.

References

Blueprint Reality. (2017, September). MixCast Studio [Computer software]. Retrieved from https://blueprintreality.com/

Bock, C., & Dimmel, J. (2017). Explorations of Volume in a Gesture-Based Virtual Mathematics Laboratory. In E. Galindo & J. Newton (Eds.), *Proceedings of the Thirty-Ninth Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 371–374). Indianapolis, IN: PMENA.

Dimmel, J., & Bock, C. (2017). HandWaver: A gesture-based virtual mathematics making environment. In A. G. T. J. (Ed.), *Proceedings of the 13th International Conference on Technology in Mathematics Teaching* (pp. 323–330). Lyon, France: International Conference on Technology in Mathematics Teaching.

Lai, C., McMahan, R. P., Kitagawa, M., & Connolly, I. (2016). Geometry Explorer: Facilitating Geometry Education with Virtual Reality. In *Virtual, Augmented and Mixed Reality* (pp. 702–713). Springer International Publishing.

Radu, I., Doherty, E., DiQuollo, K., McCarthy, B., & Tiu, M. (2015). Cyberchase shape quest: pushing geometry education boundaries with augmented reality. In *Proceedings of the 14th International Conference on Interaction Design and Children* (pp. 430–433). ACM.