SIIM2018 ANNUAL MEETING
INSPIRING COLLABORATION
May 31 – June 2 | Gaylord National Resort | National Harbor, MD

Low-cost Workflow of Generating and Remotely Visualizing 3D Holographic Models for Clinical Practice using Augmented or Virtual Reality

Brian M. Currie, MD, Hospital of the University of Pennsylvania, Penn Image-Guided Interventions Lab;
Greg J. Nadolski, MD; Stephen J. Hunt, MD, PhD; Terence P. Gade, MD, PhD; Brian J. Park, MD, MS

Background/Problem Being Solved

Augmented/virtual reality and 3D holographic models overcome many of the physical limitations and drawbacks of 3D printed models, including faster model turnaround time, decreased costs, and improved robustness. This emerging technology has not yet been studied in-depth in clinical practice. But like 3D printed models, procedural planning with 3D holographic models may have beneficial impacts on procedure times, patient care, and outcomes.

We describe a workflow process of generating and visualizing surface-rendered 3D holographic models of patient anatomy for clinical applications. The workflow process is similar to generating 3D printed models but with few additional post-processing steps to optimize rendering and remote viewing. This process may be used with many augmented or virtual reality headset devices since Unity plugins are available from a variety of manufacturers. Additionally, rendering can be performed remotely on a workstation and sent wirelessly in real-time to the headset device for visualization, bypassing hardware constraints of the device.

Interventions

Workflow process of generating and visualizing surface-rendered 3D holographic models of patient anatomy was demonstrated on Microsoft HoloLens (see Figure 1). Cross-sectional patient imaging, either CT or MRI, was exported from our institution's picture archiving and communication system (PACS). Semi-automated segmentation software was used to segment relevant anatomy. Data reduction was performed to optimize rendering performance. Additional model enhancements were made, such as assigning colors and transparencies. Real-time wireless remote viewing was performed through Unity and Microsoft Holographic Remoting Player.

Figure 1

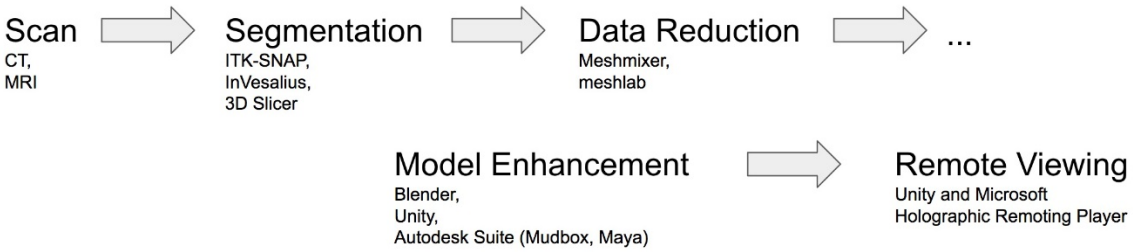

Figure 1. 3D Holographic modeling workflow for Microsoft HoloLens

Outcome

We were able to generate surface-rendered 3D holographic models of patient anatomy in less than 60 minutes (see Figure 2). Models were able to be remotely rendered and visualized on the HoloLens anywhere within the hospital with an available Wi-Fi signal. Remote rendering performance was smooth and without lag as long as the wireless connection was reliable. Aside from the cost of the headset device, all software and additional tools used in this workflow process are freeware applications.

Figure 2

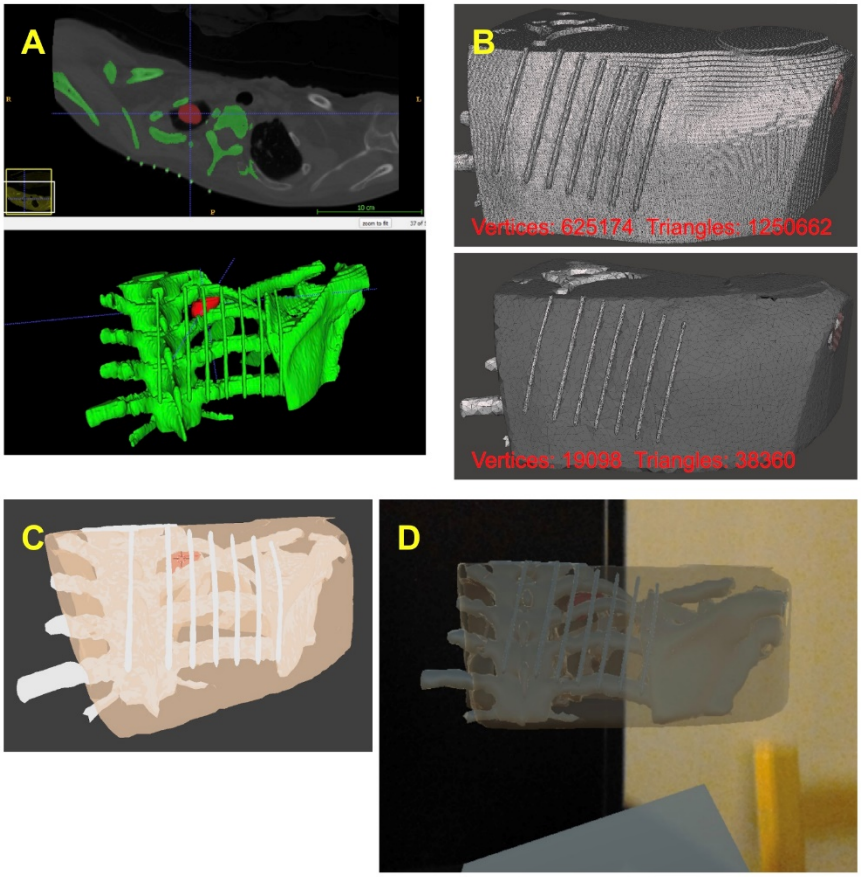

Figure 2. Workflow demonstrated on Microsoft HoloLens. **A.** Segmentation of CT. **B.** Data reduction by over 95%. **C.** Model enhancement. **D.** Remote rendering and real-time visualization.

Conclusion

3D holographic models of patient anatomy can be generated quickly and easily using various freeware applications. The described workflow process can be applied to many augmented or virtual reality headset devices. Augmented/virtual reality can provide a more cost-efficient and productive alternative to 3D printed models for clinical applications.

Statement of Impact

We hope this will encourage the development of novel clinical applications using augmented/virtual reality to advance patient care. Additional features and custom software can be developed to manipulate and interact with the models upon generation.

Keywords

augmented reality, virtual reality, radiology, interventional radiology