A Standalone Interface for Web-Based Virtual Reality of Calculated Fields

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Abstract

Virtual Reality (VR) provides an immersive experience of 3D simulation results. Using modern web technology an interactive VR interface is presented to visualize COMSOL Multiphysics® simulation results. It extends the existing standalone web-based visualization system [1] and enables an application across multiple platforms like mobile phones, tablet computer and 3D-TVs. Since no deployment is required it is also applicable for head mounted VR displays.

The framework uses simulation models loaded on the COMSOL Server™ and forwards COMSOL Multiphysics® visualization data to the user by the subsystems Data-Exporter, Web-Server and Web-Client. To do so the COMSOL Multiphysics Java® Application Programming Interface is used for data access. The lightweight web application runs on all common browsers that supports WebGL 1.0. Its graphical user interface is shown on a mobile phone as well as on a tablet computer for one model from the model library.

To enable the stereoscopic experience depth information is provided by a binocular vision [2]. Therefore, two images with an offset of the interpupillary distance are rendered to imitate the human sight. Displaying them on a 3D-TV with 1920×1080 pixels, the interlaced representation requires two figures with 1920×540 pixels each and the usage of 3D or shutter glasses. To provide the VR experience additional input devices are needed. Alternatively the screen is divided into two viewports with 960×1080 pixels each. For VR mounts an additional shader corrects lens distortion effects like vignetting or spatial and chromatic distortion. To enable the interactive stereoscopic visualization, motion tracking of the mobile devices is used to rotate the figures.

To avoid motion sickness [3], a frame rate above 60 frames per second (FPS) and a low latency between motion and display updates is required. Results given in the table below prove their achievement for common mobile phones, different operating systems and various internet browsers.

Device	Browser	Screen(pixel)	FPS
Mate9Pro	Chrome	2560×1440	60
Mate9Pro	Firefox	2560×1440	60
iPhone6+	Chrome	1920×1080	60
iPhone6+	Safari	1334×750	60
iPhone6	Chrome	1920×1080	60

|iPhone6|Safari|1334×750|60|

Updating the visualization is forced when the model is moved or its orientation changes. The table below shows the visualization performance distribution for 17 ms on a mobile phone.

Scripting	1.4ms
Rendering	0.2ms
Painting	0.1ms
Other	1.3ms
Idle	14.2ms

The presented VR interface shows good performance on devices used by a large variety of users. It is compatible with modern web browsers and platforms. For applications like product presentations, teaching and further simulation result discussions it provides a interactive low-cost VR experience for COMSOL Multiphysics® numerical results. A more interactive and enhance experience is created when using VR kits with additional sensors and input interfaces [4] or a Web Speech API [5].

Reference

[1] M. Jüttner, S. Grabmaier and W. M. Rucker, Web Based 3D Visualization for COMSOL Multiphysics, Cambridge, UK: European COMSOL Conference, 2014.

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[3] J. J. LaViola Jr., A discussion of cybersickness in virtual environments, ACM SIGCHI Bulletin, pp. 47-56, 2000.

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[5] H. Wennborg and S. Glen, "Web speech api specification.," Final Report, W3C, 2012.

Figures used in the abstract

Figure 1: Web-Client on a mobile phone and on a table.