Summary report for 2015 of project "Software development of CAD systems and 3D data visualization applications"

Jan Pečiva, Tomáš Milet, Michal Tóth, Tomás Starka, Jozef Kobrtek*
Faculty of Information Technology, Brno University of Technology

Web applications grow on popularity as various interactive content and various services can be delivered easily to users. This is in contrast with local applications that usually require hassle process of installation on the computer. In 2015, we noticed emerging demand for 3D web applications that was allowed by public acceptance of WebGL as industry standard. We started the research for algorithms that would allow to bring 3D content to this emerging platform. Particularly, 3D content specified by Cadwork visualization requirements shall include high quality fast shadow visualization.

We proposed a complex system composed of several layers. The first layer (Figure 1) is composed of algorithms for creating server data in optimized form to reduce space and network bandwidth requirements. The data are placed on the server and sent through internet on request of the client's web browser.

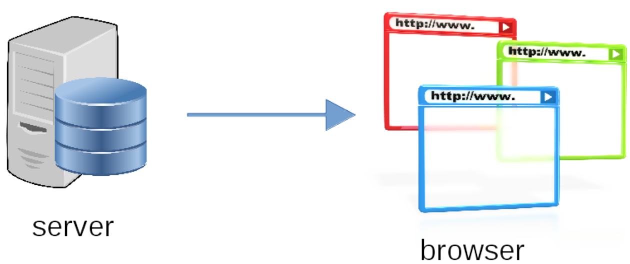


Figure 1: Data transmission layer

The second layer takes care about processing data received by client from the server (Figure 2). The data stream is parsed and scene graph is created. Then, Emscripten processing starts that creates shadow data.

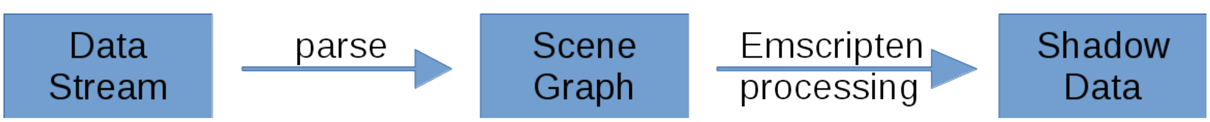


Figure 2: Data processing layer

The third layer is running on GPU and processes shadow data to create shadow volumes (Figure 3) and finally shadowed visualization. All the details of the algorithm are described in [1].

* peciva,imilet,starka,itoth,ikobrtek@fit.vut.cz

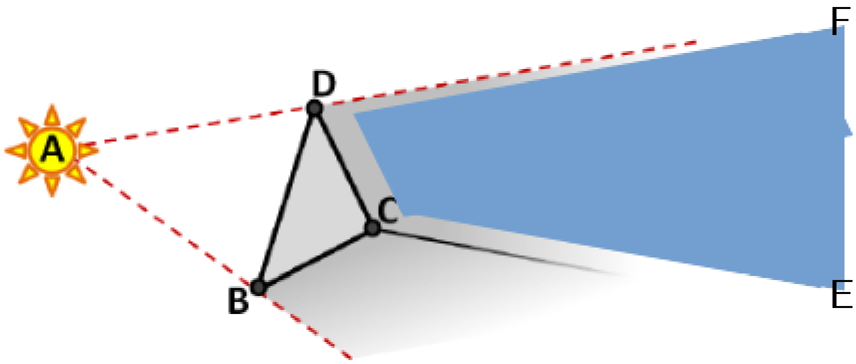


Figure 3: Shadow visualization layer

For performance tests, we have chosen well-known publicly available Crytek Sponza scene (262’000 triangles).

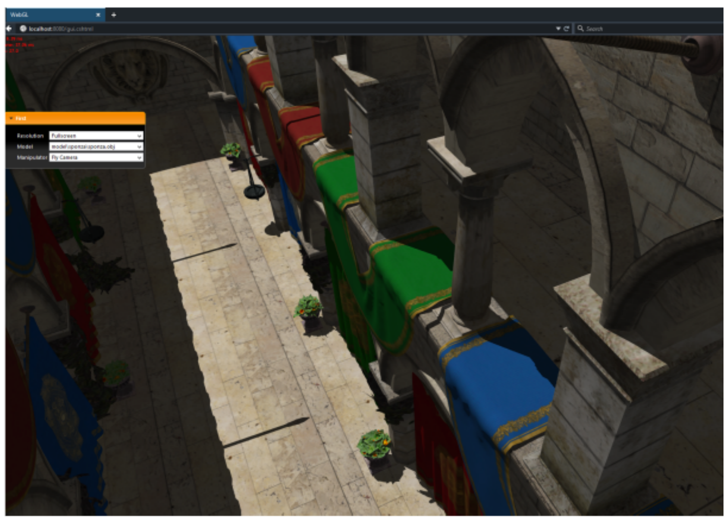
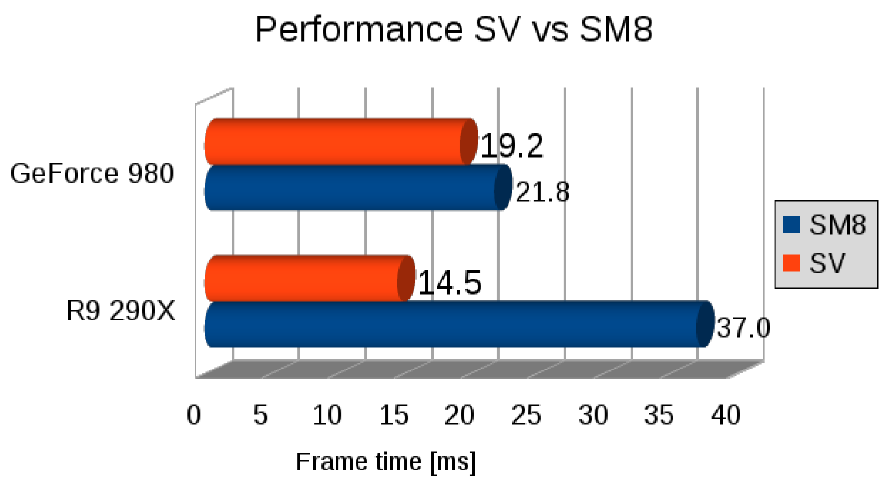


Figure 4: Crytek Sponza scene (262’000 triangles) with shadows

We setup our test bed on i7-4790K with high-end graphic cards GeForce 980 and R9-290X, Windows 7 and Firefox 36.0 web browser. We compared the performance of our algorithm with well-known shadow mapping algorithm. The shadow mapping was modified to support omnidirectional shadows by rendering 6 shadow maps instead of one. We used high resolution shadow maps as these seems to better match with emerging high resolution 4K and 8K displays. The results are shown in the graph 1. As can be seen, our algorithm performs about 10% better on Nvidia platform and 2.5x better on AMD platform.



Graph 1: Performance comparison between our shadow volumes (SV) and standard omnidirectional shadow mapping with resolution 8192x8192x6

For the future work, we would like to address further optimizations for complex scenes and remove silhouettes that are already in shadow. Especially CAD models might benefit from such optimization. More naturally looking soft shadows are another research challenge. Static scenes and static lighting might profit from the research of precomputed precise shadows that we would like to address as well.

References:

[1] MILET Tomáš, TÓTH Michal, PEČIVA Jan, STARKA Tomáš, KOBRTEK Jozef and ZEMČÍK Pavel. Fast robust and precise shadow algorithm for WebGL 1.0 platform. In: ICAT-EGVE 2015 - International Conference on Artificial Reality and Telexistence and Eurographics Symposium on Virtual Environments. Kyoto: Eurographics Association, 2015, pp. 85-92. ISBN 978-3-905674-84-2.