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Parallelization of Random Accessible Progressive Streaming of Compressed 3D Models over Web

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Abstract : Three-dimensional (3D) meshes are data structures, which store geometric information of an object or scene, generally in the form of vertices and edges. Current technology in laser scanning and other geometric data acquisition technologies acquire high resolution sampling which leads to high resolution meshes. While high resolution meshes give better quality rendering and hence is used often, the processing, as well as storage of 3D meshes, is currently resource-intensive. At the same time, web applications for data processing have become ubiquitous owing to their accessibility. For 3D meshes, the advancement of 3D web technologies, such as WebGL, WebVR, has enabled high fidelity rendering of huge meshes. However, there exists a gap in ability to stream huge meshes to a native client and browser application due to high network latency. Also, there is an inherent delay of loading WebGL pages due to large and complex models. The focus of our work is to identify the challenges faced when such meshes are streamed into and processed on hand-held devices, owing to its limited resources. One of the solutions that are conventionally used in the graphics community to alleviate resource limitations is mesh compression. Our approach deals with a two-step approach for random accessible progressive compression and its parallel implementation. The first step includes partition of the original mesh to multiple sub-meshes, and then we invoke data parallelism on these sub-meshes for its compression. Subsequent threaded decompression logic is implemented inside the Web Browser Engine with modification of WebGL implementation in Chromium open source engine. This concept can be used to completely revolutionize the way e-commerce and Virtual Reality technology works for consumer electronic devices. These objects can be compressed in the server and can be transmitted over the network. The progressive decompression can be performed on the client device and rendered. Multiple views currently used in e-commerce sites for viewing the same product from different angles can be replaced by a single progressive model for better UX and smoother user experience. Can also be used in WebVR for commonly and most widely used activities like virtual reality shopping, watching movies and playing games. Our experiments and comparison with existing techniques show encouraging results in terms of latency (compressed size is ~10-15% of the original mesh), processing time (20-22% increase over serial implementation) and quality of user experience in web browser.

Keywords : 3D compression, 3D mesh, 3D web, chromium, client-server architecture, e-commerce, level of details, parallelization, progressive compression, WebGL, WebVR
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