INTERACTIVE AND SCALABLE 3D VISUALIZATION OF LARGE CAE MODELS IN THE CLOUD

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ABSTRACT

Over the last few years, the CAE community has seen a move towards cloud-based applications. In this architecture, CAE analyses are not only computed on remote servers as in the classical HPC paradigm, but they are also pre- and post-processed through Web-based applications. Visualizing and interacting with remote 3D models is a prerequisite for the success and efficiency of such applications, and from there, the choice of the underlying visualization technology is of paramount importance. This presentation explains why 3D object streaming seems to be an ideal candidate solution to the shortcomings of current solutions.

First, focus will be set on the most common technology used to display remote 3D models: image streaming. In this approach, the server not only creates the display model required by the user, but is also responsible for the rendering it, i.e. generating the image shown on screen: at the end of the day, the server sends images to the client who simply shows them. The approach is cheap to implement and is the simplest way to achieve client-server visualization. Also, it can be deployed on any client device with a screen and it can handle any model size provided the server resources are there.

However, the method has limitations that disqualify it as a long term solution for cloud-based CAE: generating many images on the server and sending them to the client to account for user interaction yields an uncomfortable lag, and furthermore, in order to respond to potentially large numbers of clients, the server needs to have equally large GPU resources. In a nutshell, the solution is uncomfortable for end users and not scalable in terms of hardware for software providers.

In the last 5 years, WebGL has been progressively supported by all major web browsers on the market, opening the door to displaying 3D models over the web without any extra effort than to write the client

rendering engine. For the CAE community, this new standard has a major impact, as it provides the means to design cloud applications based on 3D object streaming rather than image streaming. The second part of the presentation focuses on this approach, where the server still generates the display model, but instead of rendering it and sending an image, it streams the 3D model itself to the client, where it is rendered and then displayed. Advanced techniques for spatial domain decomposition is used to enable progressive 3D object streaming. Progressive 3D object streaming is used in combination with progressive streaming of simulation results to increase interactive performance and hence obtain a desktop-like user experience. Of course this solution requires a larger development effort, but it also totally eliminates the lack of comfort and scalability of older technology. A first implementation of this technology - cloud.ceetron.com - was put on the market by Ceetron AS in November 2014, both for end-users and as a demonstrator for software tool providers.

If 3D object streaming is to provide a solution to the blocking points encountered in image-streaming-based applications, it will need to include special handling of cases in which the client resources our insufficient to render and display very large models. This issue will be discussed in the third and final part of the presentation with special interest being given to current and future work at Ceetron AS on the subject.

The presentation is believed to be of special relevance for members of the CAE community who are developing or using cloud-based CAE applications, whether as tool provider or as end user.