

Projection for VR Summary

Trenton Plager

Introduction & Related Work (Overview of Algorithms)

This paper regarding VR Projection is largely concerning the inability of current projection practices to effectively render for virtual reality devices. This inability is a direct result of the current main method of projection, that method being flat projection onto a single plane. Attempting to use this method for virtual reality results in massive inefficiencies because of the multiple steps that must be used to effectively render pixels at the periphery. In an attempt to solve this problem the writers of this paper studied a selection of different algorithms such as Cube Projection, Multi-Res Shading, and others to determine if a better method of rendering for virtual reality was possible, even introducing a novel method of their own, Multi-Plane Projection. This method is somewhat similar to Multi-Res Shading in that the projection is divided into multiple planes, however it differs in that the planes can be tilted, stretched, and sheared.

Methods (Optimization)

In order to complete the task of determining a better method for rendering in virtual reality scenes, the authors of the paper sought to optimize the algorithms they tested by reducing some cost metric. For the purpose of this paper, both Cube algorithms (4 and 5 planes) were tested as well as various configurations of Multi-Res Shading and Multi-Plane Projection. Because of the nature of these algorithms, each had a set number of projections that the initial projection would be divided into meaning that certain costs wouldn't be sensitive to the current variables the researchers were examining. The cost was defined as the sum of all the sub-projections costs, which were themselves defined as a product of their width, their height, and their masked ratios, all modified by a parameter vector. This parameter vector was optimized by stochastic optimization. To compute the sub-projection resolutions, they first calculated the matrix of the sub-projection, ignoring all pixels outside of the projection's frustum, then computed the normalized device coordinates for the remaining pixels.

Results

The results of the authors' optimization tests showed that all of the virtual reality devices could benefit from using some method of rendering that split the initial projection into sub-projections, but the devices that could benefit the most were those with wider fields of view. For each device, the authors' approach of Multi-Plane Projection was consistently more cost-effective. Even when rendering more planes, in the case of MPP 3x3 vs. Cube 4 and Cube 5. In addition, this method shows very little distortion, even compared to the baseline method that is currently used of rendering a single plane. In addition, they tested this effect in a professional game engine by creating a multi-camera setup in Unity that would replicate their process. This also allowed them to test the algorithm with high quality assets. In these cases, the MPP algorithm still consistently performed better or similarly to other algorithms.

Discussion

Though the authors admit that the nature of virtual reality is continuing to change, they believe this experiment still has merit. This is largely because, even though raytracing may someday make rasterization methods obsolete, rasterization currently remains the only viable option for most rendering, especially in immersive environments such as virtual reality. As a result, any method, such as this one, that can improve rasterized rendering is important. Though their own method did consistently perform better, they also admit that any method of splitting single plane rendering into multiple rendered sub-planes is more efficient because the resolution of each individual sub-plane can be altered without reducing quality. They also noticed in the study that devices with a higher degree of distortion had more to gain from using these methods of splitting the single plane into sub-planes. Overall, the authors believe that their method of MPP that renders 4 sub-planes should meet current demand, and in some time, when consumer electronics have become sufficiently advanced, their 9 sub-plane method should become more useful.

Conclusion (Future work)

As for future work, the team of authors believes the most important avenue that could be pursued based on their own work is how this method can be expanded by taking into account eye tracking cameras being used in some virtual reality devices. This is because they believe these eye tracking devices will soon become standard. They also believe a user study to further define acceptable resolutions could be helpful in further optimizing the work that they have done. In addition, they believe that the algorithms for common post-processing effects need to be updated to take into account the distortion that can be present by splitting the plane into sub-projections.