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## Chapter 5: Discussion and Future Work

### 5.1 Discussion

The results reinforce our earlier predictions about the issues and advantages of this algorithm. The results also support the thesis statement which upholds that for small increments and by interleaving the optic flow algorithm with ray tracing, the animation will be effectively as satisfactory as a ray traced sequence. This is done while saving immense amounts of processing resources and thereby saving significant amounts of time. The problems that occur when applying our technique are quantified and clarified and this makes it easier to devise solutions. We can see that the areas with the most problems are edges of objects, surfaces with different types of textures, and objects closer to the camera and the periphery of the field of view.

Our original goal in this project was to develop a faster, more 'realistic' graphical rendering system for a virtual environment, which deals with linear motion in a hallway environment. We used ray tracing, which is known to render realistic looking scenes. We also determined an algorithm, which would approximate the results of ray tracing that can be interleaved with the ray tracing algorithm. Is this algorithm faster or more efficient than ray tracing? As was determined earlier the Big Oh cost for ray tracing is  $O((nr)^x)$  where  $r$  is the number of pixels on the screen,  $n$  is the number of surfaces, and  $x$  is the reflectance threshold. The cost for our algorithm compared to that of the ray tracing algorithm is significantly smaller and the big Oh is  $O(r)$ .

## 5.2 Possible avenues for Future Work

A technique that we wanted to use but did not end up trying out due to time constraints is to do a reverse image zoom. Basically this means, that instead of projecting points in one frame onto the next, we can take pixels in the future frame and project them backwards to see where the point representing that pixel was in the original frame. Based on this the pixels can be colored the same color as the original pixel was. This would remove the problem of having holes in the image and might serve to be a better approximation than having the original image in the background. It will also be less computationally expensive than ray tracing all of the holes.

It is also not a very difficult task to add a rotational component to the optic flow, and in the future I hope to develop this algorithm allowing for rotational as well as linear movements as described in Chapter 3.

One of the techniques I am interested in using to try and decrease problems that occur due to occluded surfaces is determining which areas in the scene are higher probability problem spots. For example, we determined from the results we obtained that problems with occlusion generally occur around the edges of a surface. A gradient of the z-depth map can be taken to determine which areas have the largest change in depth since these areas are the most sensitive to problems. This way the areas with the largest change in depth frequency can be ray traced instead of the whole image insuring that problems with occlusions are dealt with. If we assume that we have used the no-holes expansion described

earlier in this section before taking care of the high frequency regions we will have solved both the holes and the occlusion problem.

Since we already know that this algorithm is distributable, another possible future project is actually distributing it across a system, and finally actually interfacing it with the treadport system. I have already outlined the various issues involved with distributing the algorithm and it might be a good idea to try and do this on a shared memory system.

It is also possible to do an actual study with human subjects to determine a subjective reference for the effectiveness of this algorithm and whether it is really sufficient or not.

In conclusion, there is a lot of possibility for future research in this project and it has proven to be a realistic possibility in improving the frame rate of ray tracing rendering systems for virtual environments.