William Alizio **Literature review 3**

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Main article: "The Virtual Marathon: Parallel Computing Supports Crowd Simulations" (IEEE Computer Graphics and Applications July/Aug 2009 volume 29 Issue:4 pages 26-33)

Secondary article: "Impostors, Pseudo-instancing and Image Maps for GPU Crowd Rendering" (The International Journal of Virtual Reality March 2007 volume 6 number 1 pages 35–44)

The main article I chose to review is "The Virtual Marathon: Parallel Computing Supports Crowd Simulations". What this deals with is the problem of efficiently utilizing the computing power of GPU's and CPU's when simulating very large crowds graphically. The example they chose to work with is simulating a large crowd of people as you would find in a marathon scenario. They simulate over a million virtual people (mostly spectators) using the latest techniques available on today's graphics cards. In particular they utilize the parallel processing capabilities of CUDA which came out in 2007. They use some fuzzy logic for their artificial intelligence and utilize CUDA to process this for them. It is interesting because they compare doing the same processing the AI of 1 million people using the CPU instead of on the parallel GPU and it took over 20 times as long to compute the same thing. They also use a technique called LOD (level of detail) in order to be able to render such a large number of objects at once. It is based on viewing distance. Those closest in view are fully rendered with the most amount of complexity in polygons. The farthest away are just a one polygon representation: a square. They have an intermediate level of detail as well for three total. The view volume is divided in three sections and depending where the object is; it gets assigned that level of detail.

The secondary article: "Impostors, Pseudo-instancing and Image Maps for GPU Crowd Rendering" describes techniques for rendering large crowds of objects. All the techniques in it are used and expanded upon by the authors of the main article. This article goes into detail describing a way to divide up level of detail into two parts. They define an imposter as the term for the lowest level of detail. In this case it is a single polygon: a square. Pseudo-instancing is the term for the un-simplified version of the object that is closest in view. They walk you through the 10 step process of accomplishing the task of rendering a massive scale scene describing the algorithms they use to get this done. It was nice because they use a language I can pretty much understand and grasp the concept of what they are doing. Also interesting is the comparison of this articles reported frames per second for rendering a million people simultaneously. The

fastest they were able to accomplish was 1.7fps while the authors of the main article achieved 10 to 30 fps using the new parallel processing technology and latest hardware.

In conclusion, of the three literature reviews I did for this class, I enjoyed this one the most. The main reason is the subject matter is close to my heart. I am a long distance runner and it was nice to read some graphics literature that relates to my life in some way. I have not run a marathon yet but plan to and it was cool that someone decided to simulate one. Both articles talk in terms familiar to me after learning the material in this graphics class. For example, if I read this article a few months ago, I would think "what the heck is a view frustum?!" But now I know having done some basic computer graphics coding and absorbing what I can from the lectures. Also the fact that the majority of the simulated people in these examples are just different color squares makes the accomplishment of rendering a million people not sound that amazing. The first thought I had when I started reading this was wow: a million people all at once! But I guess this is the way it must be done since it is a computational waste to render such unneeded detail for the people so far away. As a computer gamer, reading these articles gives me some understanding of the difficulties a game programmer faces when trying to efficiently code an MMORPG with thousands of objects moving around at once. One final thought I have is that when doing these comparisons between articles I see first-hand how technology is moving so rapidly forward. These two articles are written only 2 years apart and are basically doing the same thing only the more recent one with newer hardware and software and it cut down the processing time by a factor of 20! I look forward to seeing what new graphics technologies come out in the future.

Main Article:

@ARTICLE{5167485,
author={Yilmaz, E. and Isler, V. and Cetin, Y.Y.},
journal={Computer Graphics and Applications, IEEE}, title={The Virtual Marathon: Parallel Computing Supports Crowd Simulations},
year={2009},
month=july-aug. ,
volume={29},
number={4},
pages={26 -33},
keywords={GPU algorithm;crowd simulation;dynamic entity;fuzzy logic;parallel computing architecture;participant behavior simulation;
pedestrian simulation;urban model;vehicle simulation;virtual athlete;virtual marathon simulation;fuzzy logic;parallel algorithms;road
vehicles;sport;traffic engineering computing;virtual reality;},
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Secondary article:

http://www.ijvr.org/issues/issue1-2007/4.pdf

@ARTICLE{4,
author={Erik Millán and Isaac Rudomín1},
journal={Computer Graphics and Applications, IEEE}, title={Impostors, Pseudo-instancing and Image Maps for GPU Crowd Rendering},
year={2007},
month=march ,
volume={6},
number={1},
pages={35–44},