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Project Title:	**Simulating Wavefronts in Real-Time using Wave Particles**
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Director of Studies:	**Dr R. K. Harle**
Overseers:	**Prof L. Paulson & Dr I. J. Wassel**

In brief, the goal of my Part II project is to implement a real time water wave simulation technique called Wave Particles, that captures how wavefronts form and propagate by representing them as particles on a 2D plane. Applications such as complex video games and virtual reality experiences frequently use innacurate real-time approximations of physical systems. Therefore I made it my goal to implement this system within the Unity game engine.

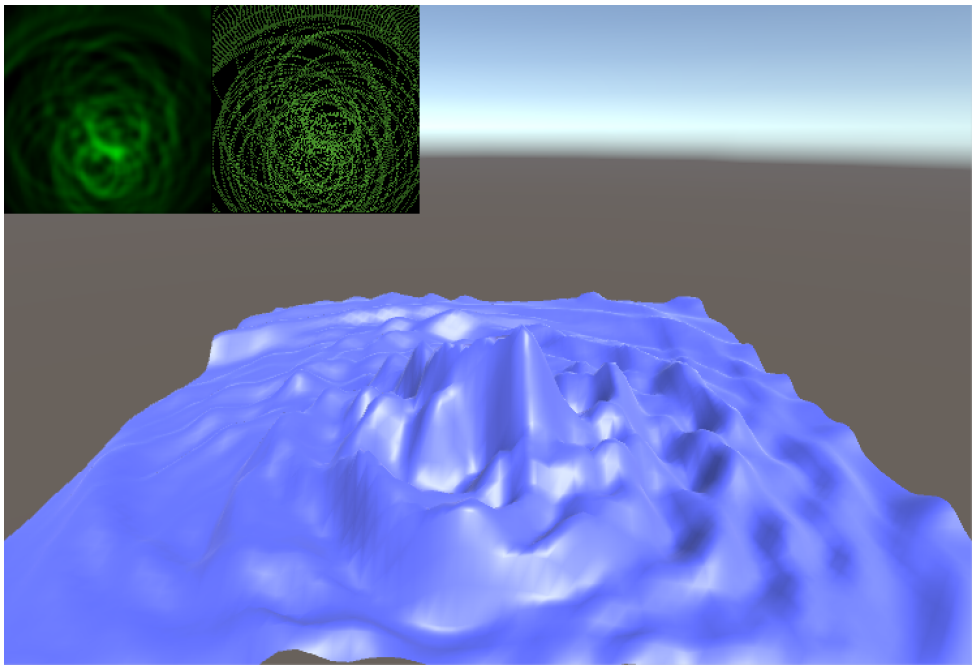

Figure 1: *Succesfully convolving wave particles on the GPU. The top-left box in the image shows the Wave Particles texture, while the one next to it shows the position of Wave Particles on the plane.*

Sticking to schedule, I made effective use of the first two weeks to gain a thorough understanding of the paper on Wave Particles and additional material in the field of fluid simulation and real-time systems.

The next task I engaged in was learning the Unity game engine and graphics programming as I had never done either before. The scripting language used by Unity, C# is very similar to Java which I am experienced in, so the focus of learning was Unity's APIs, working with the creation tools, and shader programming. As Unity is so complex, getting the initial foothold that got me started was rather difficult, and for the first month everything required various attempts to get right. I also realised that achieving some my goals out-of the order I had planned would be best, as I gained a better understanding of all the systems involved. A good example of this was the initial intention to implement everything on the CPU before porting everything to the GPU. As each component of the Wave Particles system are individually complex on the CPU, it ended up making sense to incrementally

implement components on the GPU before moving onto the next one on the CPU. The slowdown handling every system together on the CPU, would have been a major burden on viewing the results and iteration times.

For this reason I have yet to completely implement fluid-object interaction, but am slightly ahead of schedule on porting code to the GPU. One major issue worth mentioning, was a mistake made in attempting to port Wave Particle convolution to the GPU which led to the issue shown in Figure 2.

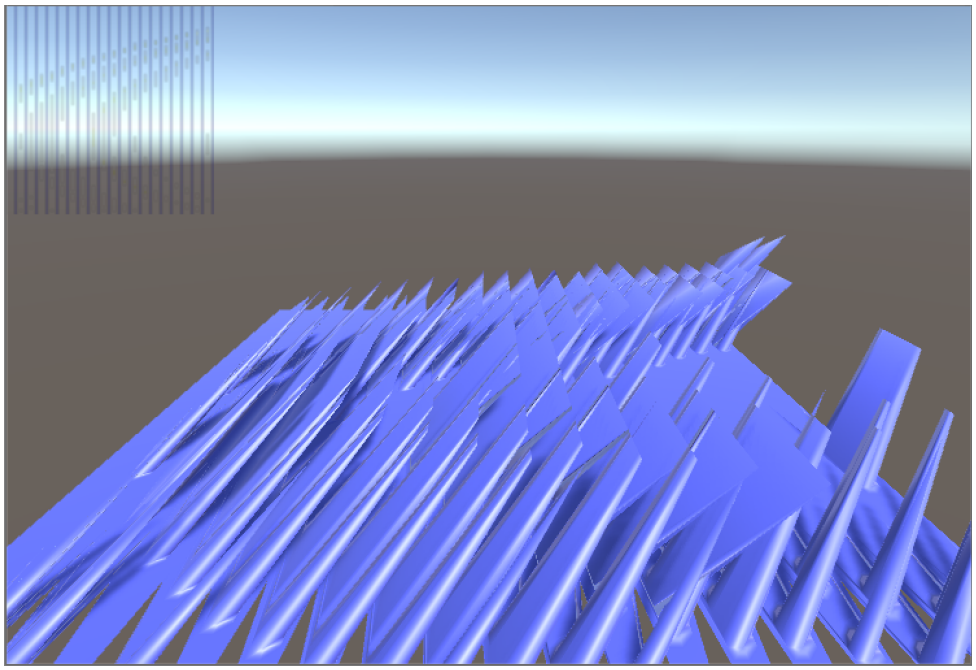

Figure 2: *The first attempt at Texture convolution on the GPU.*

This was because I had accidentally set one of the textures involved to the ARGB32 format, as opposed to the intended RGBAFLOAT format. However, as the other textures were all set to the correct format, copying from one to the other caused incompatability major issues! The problem being that Unity didn't complain about this obvious error. It took 4 sets of eyes and 3 weeks for this one issue to be resolved (other aspects of the system were worked on in the mean time, but this one issue did cause some slowdown!).

To conclude, most of my schedule has been achieved, including being further ahead in some aspects. I have written a first-draft of the introduction of my dissertation and implemented the core of the Wave Particles system on the CPU in addition to some aspects on the GPU. Whilst tying everything into the Unity Game Engine. However, I have reshuffled some aspects of my timetable, such as when fluid-object interaction should be completed, now being the 20th of February. Therefore, I would estimate that I am approximately a week behind in what I aimed to achieve, but progress has accelerated significantly in the past month. Despite some of the hurdles faced, my original schedule has provided enough flexibility to handle them and I am not concerned about hitting my targets in the coming weeks.