Review on *Yang, X., Pi, X., Zeng, L., & Li, S. (2005). GPU-based real-time simulation and rendering of unbounded ocean surface. Proceedings - Ninth International Conference on Computer Aided Design and Computer Graphics, CAD/CG 2005, 2005, 428–433. https://doi.org/10.1109/CAD-CG.2005.45*

This paper presents a multi-resolution mesh model of the ocean surface. The main aim of this research is to present a framework for real-time simulation and rendering of large-scale oceans. To achieve this they have introduced a concept called Wrapped Fractal Surface (WFS) for generating height field map of the ocean.

In the previous work, four main approaches for modeling ocean surface are been used. The first approach is to model ocean surface based on geometrical models. They have used a linear combination of the sine function and quadratic function to create the shape of waves. But the scenes were realistic. The second method is to use physical models. The third method is to use statistical models. Both those methods are very complex and do not fit for real-time Simulation and Rendering. The fourth method is to simulate based on time-varying fractals. This method use noise synthesis approach to simulate waves from a distance. And it is simple and more realistic compared to other methods. Authors highlight the point that none of the above methods uses LOD algorithm.

This paper empathizes that it is efficient to reduce triangle patches with direct rendering in the GPU rather than Continuous LOD in CPU. Since the proposed algorithm is based on Tiled Quad-tree, it has more advantages over other algorithms. According to this paper batched LOD has achieved more in terrain rendering. Levenberg has presented an algorithm called CABBT, which operates on clusters of geometry called aggregate triangles rather than manipulating triangles. This algorithm also improved caching on GPU. And Levenberg built an aggregated LOD algorithm called chunked LOD.

Algorithm proposed in this paper is as follows. It divides the whole large-scale ocean surface into a Tiled Pyramid and builds a Tiled Quadtree. They create a multi-resolution LOD tree with Visible Quad-tree (VQT) and Renderable Quad-tree (RQT) to estimate ocean surface tiles . To solve the crack in between tiles with different LOD, they have used a method called “Joint Index Template” which can be implemented in GPU. To apply this method to solve cracks, ocean tiles should satisfy some precondition. Quad-tree which satisfy this condition is called “restricted quad-tree”. And then they create a multi-resolution mesh of planar ocean surface using Tiled Quad-tree. Fractal surfaces are created by layering multiple noise-functions at different frequencies and amplitudes on top of each other. They have called the Fractal surface as the Wrapped Fractal Surface (WFS). For a given time fractal surface of the ocean height map can be generated by interpolating of adjoining Fractal surface at adjacent times. They have done some research to model shallow ocean waves as well. They have used contour line of coast terrain and underwater terrain to create the shallow water model.

In overall this research has done a significant contribution on real-time simulation and rendering of unbounded ocean surface. And experiments are also proved that their algorithm is capable of real-time rendering. They have done a graphical simulation and results look promising. Snapshots of simulating shallow water, ocean with wavelets, ocean with middle waves and ocean with billowy waves are presented in this paper. They have covered both deep ocean waves and shallow ocean waves. Algorithm for real-time ocean surface rendering in the deep ocean is given and explained with examples.

One drawback of this paper is that it has a lot of less meaningful sentences which makes harder to understand the content. Some acronyms were not been introduced properly. And another issue is that it has not done enough testing or they don’t mention as such. Only one method was used to do the comparison. According to the literature survey, there are lot other researches that can be used to evaluate this proposed algorithm. But this paper had only used a single algorithm which has an inherently low frame rate. And even for the given comparison not enough graphs and details were provided. Test results were not evaluated properly. Only a frame rate comparison is given. It’s better if they had given more information about the algorithm they have developed for shallow oceans waves.

In conclusion, this research has done a significant contribution by introducing a new algorithm for GPU-based real-time simulation and rendering of unbounded ocean surface. Even though authors have described related work in detail, nowhere in the paper they have compared the performance results of their algorithm with that related work. Hence the actual improvements achieved by this proposed algorithm is hard to be reviewed.