Water Animation and Interaction | Sailing+ | Luc Jonker

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Background 1

The Sailing+ application is an AR/VR app for experiencing sailing regattas, and needs more realistic water that can run well on mobile hardware.

Realistic water-geometry representation techniques are generally expensive simulations.

Question 2

What solutions for **dynamic water** geometry animation are **effective** (performant and aesthetically pleasing) **in AR/VR** and allow **interacting wavefronts** with boats, buoys, and static land meshes?

- How can we represent such dynamic water and effects (foam, boat wakes, splashes)?
- What are techniques to optimize said solution for good mobile performance?

Methodology 3

Mesh Generation

Mesh generation using clip-map technique [1]:

- Highly customizable
- Mesh doesn't change after it is generated
- Mesh follows the camera for high LOD close to user

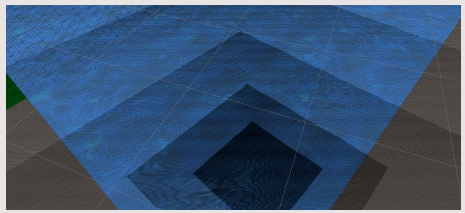


Fig.1: Underlying Clip-Map Mesh

Static Macro Wave Geometry

Macro waves represented using superimposed trochoidial Gerstner waves [2]:

- Cheap to process
- Convincing ocean appearance
- Customizable parameters (wavenumber, direction, etc.)

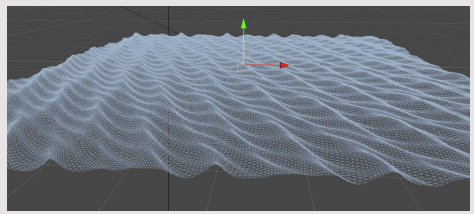


Fig.2: Gerstner Wave Geometric Displacement

Dynamic Micro Water Effects

Micro effects represented using texture based kelvin wake approximation:

- Processed in parallel on GPU
- Wake shape at any time point
- Texture based approach has lots of room for extension

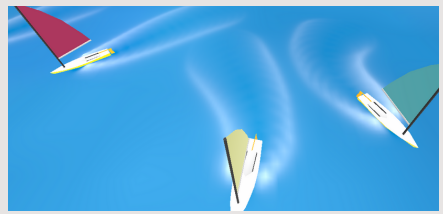
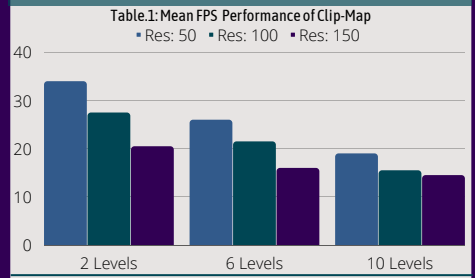
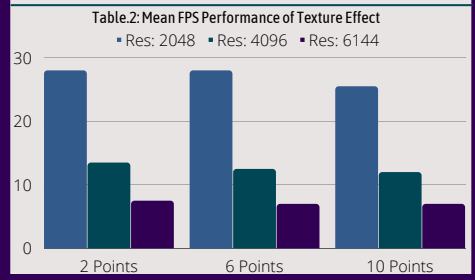


Fig.3: Dynamic Boat Wake Effect

Results 4





Conclusion 5

Clip-map technique supports high mesh resolution near the user without performance overhead of changing the mesh.

Gerstner waves provide convincing macro behavior at no noticeable performance cost.

Dynamic Wave technique performs well but suffers slowdowns on mobile at texture resolutions required for visually appealing result.

Future Work 6

Extend clip-map to support a boundless surface instead of constrained to a play area.

Implement dynamic water effects for other geometry such as shorelines and buoys.

Investigate dynamic texture optimization by lowering texture resolution through a technique like signed-distance fields [3].

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[1] A. Asirvatham and H. Hoppe, "Terrain rendering using gpu-based geometry clipmaps," GPU Gems 2, 2005.
[2] M. Lachman, "An open programming architecture for modeling ocean waves," 2007.
[3] C. Green, "Improved alpha-tested magnification for vector textures and special effects," 2007