

# Spectral Sea: Real-Time Ocean Rendering

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CIS 5650:  
GPU Programming  
& Architecture  
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# Spectral Sea: Meet the Team

LIVE: [yuhanliu-tech.github.io/spectral-sea](https://yuhanliu-tech.github.io/spectral-sea)



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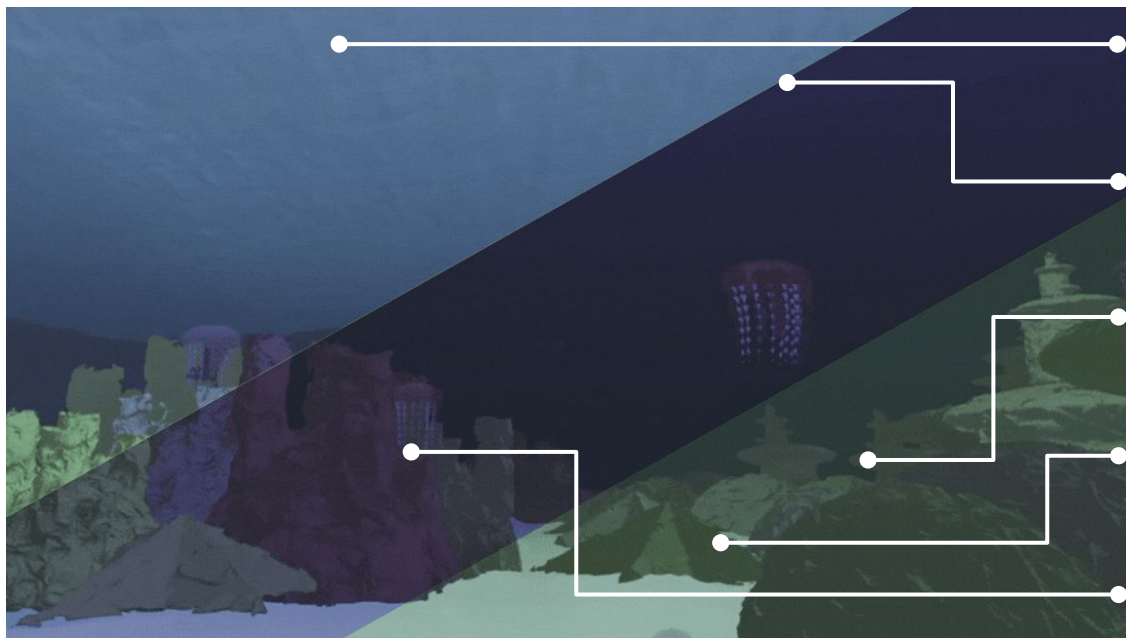
**Github:** @yuhanliu-tech

**Email:** yuhanl@seas.upenn.edu

# Spectral Sea: Introduction

LIVE: [yuhanliu-tech.github.io/spectral-sea](https://yuhanliu-tech.github.io/spectral-sea)

Real-time, infinitely explorable ocean, generated by combining some of the latest publications in parallelizable graphics algorithms.



Tiled-&-Blended Ocean Surface

Multiple Scattering for various Jerlov water types

Spectral Rendering & Caustics

Fractal Mesh Generation & Instanced Rendering for Coral Reefs

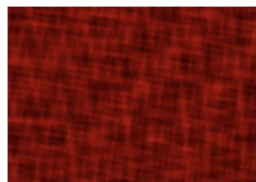
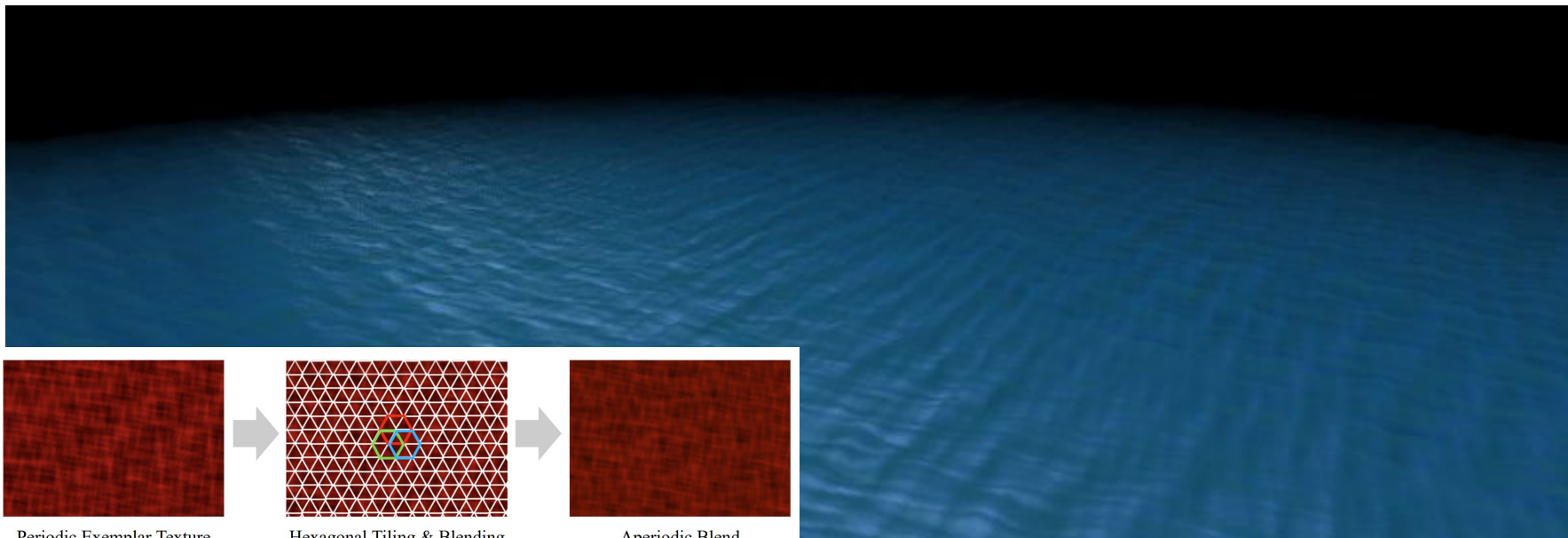
Raymarched SDF Jellyfish Shader

# Ocean Surface: Tiling & Blending

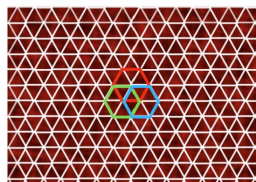
LIVE: [yuhanliu-tech.github.io/spectral-sea](https://yuhanliu-tech.github.io/spectral-sea)

Reference Paper: [Fast orientable aperiodic ocean synthesis using tiling & blending](#)

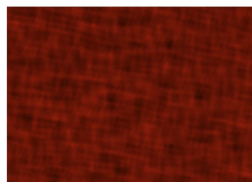
N. Lutz, A. Schoentgen, G. Gilet (High Performance Graphics '24)



Periodic Exemplar Texture



Hexagonal Tiling & Blending



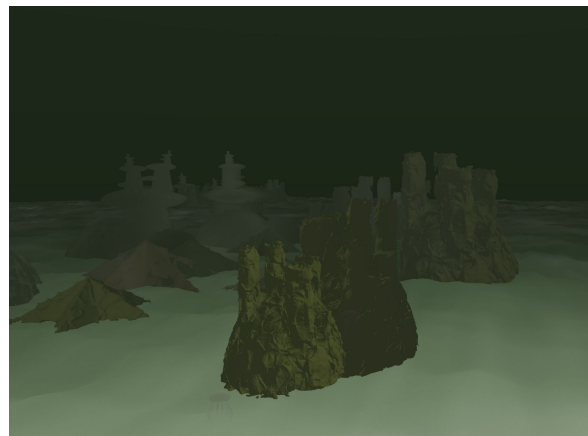
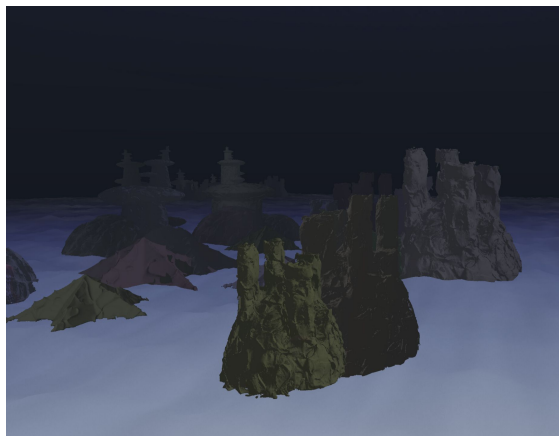
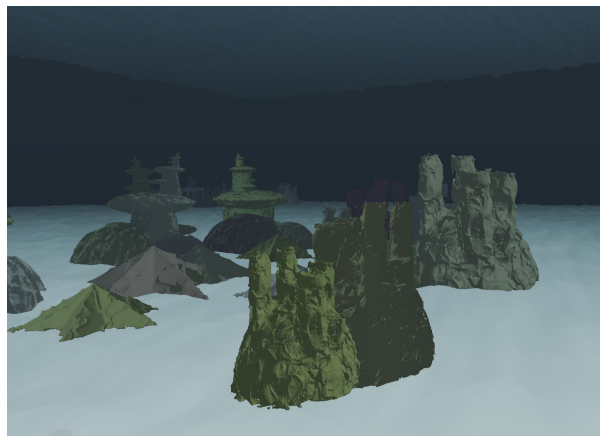
Aperiodic Blend

# Underwater Spectral Rendering: Multiple Scattering

LIVE: [yuhanliu-tech.github.io/spectral-sea](https://yuhanliu-tech.github.io/spectral-sea)

Reference Paper: [Real-Time Underwater Spectral Rendering](#)

N. Monzon, D. Gutierrez, D. Akkaynak and A. Muñoz (High Performance Graphics '24)

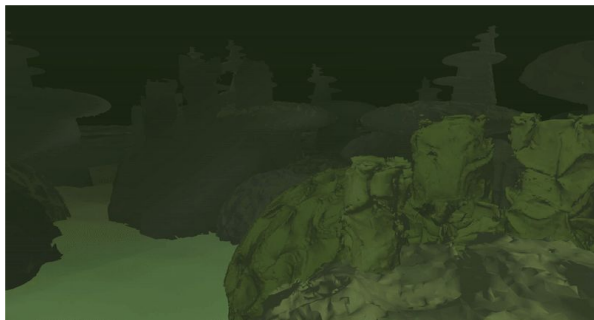


Constant-time multiple scattering estimation for many different physically-accurate Jerlov water types. Results using different water properties show various water hues and levels of turbidity.



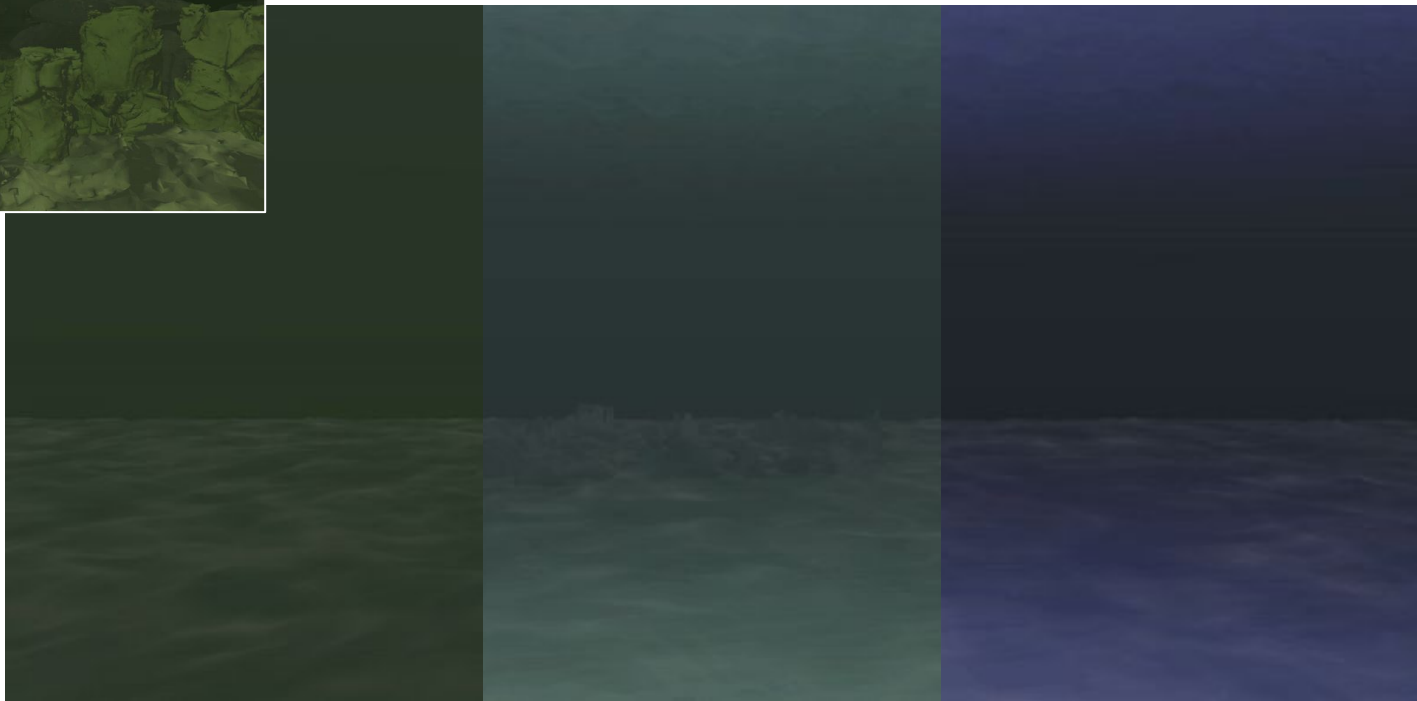
# Underwater Spectral Rendering: Caustics

LIVE: [yuhanliu-tech.github.io/spectral-sea](https://yuhanliu-tech.github.io/spectral-sea)



Procedural caustics texture to create realistic & efficient light patterns on the ocean floor.

Underwater  
light simulation  
by combining  
surface light  
and our caustics  
pattern at each  
point.

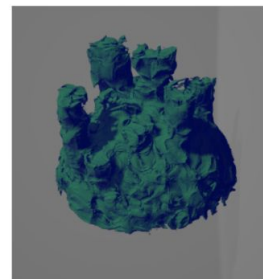
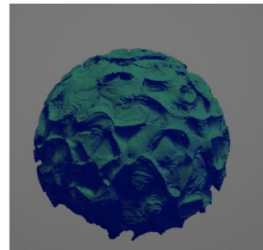
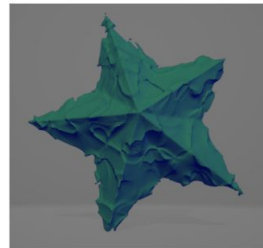
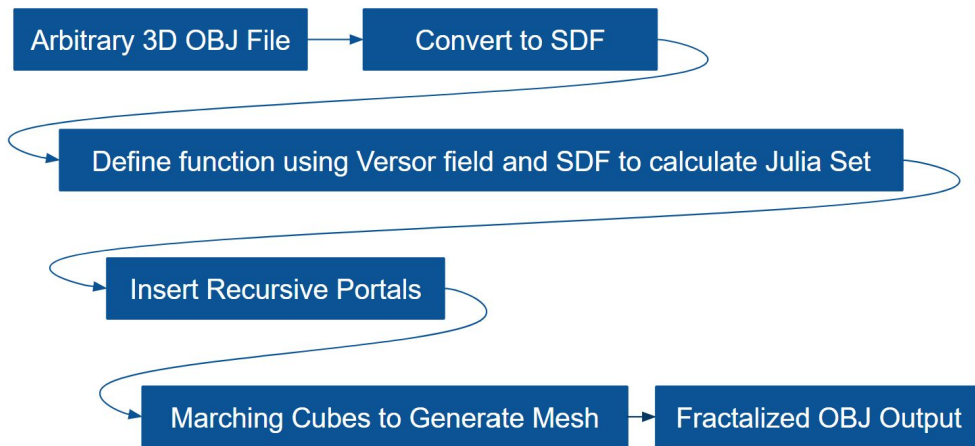
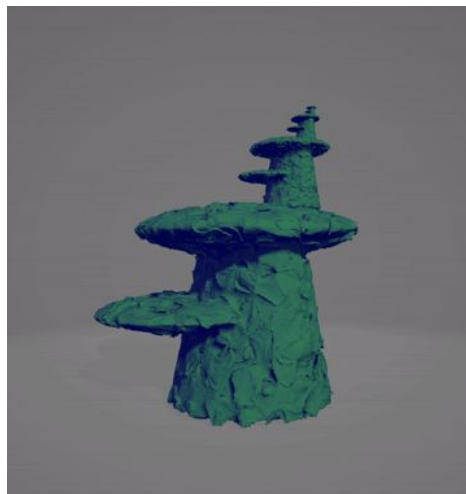


# Coral Reefs: Fractal Mesh Generation

LIVE: [yuhanliu-tech.github.io/spectral-sea](https://yuhanliu-tech.github.io/spectral-sea)

Reference Paper: [Into the Portal: Directable Fractal Self-Similarity](#)

A. Schor, T. Kim (SIGGRAPH '24)

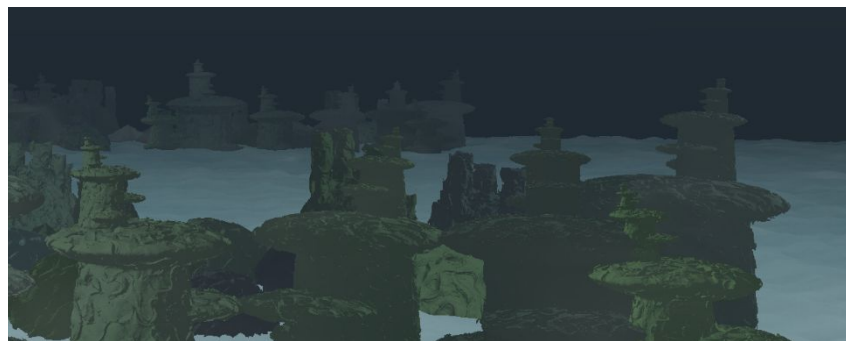
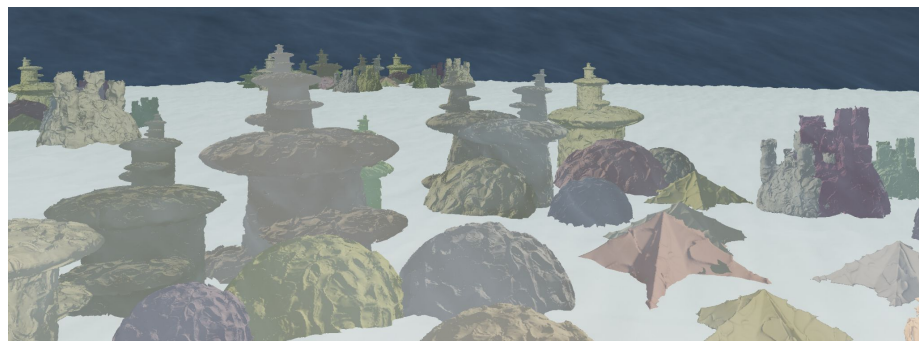
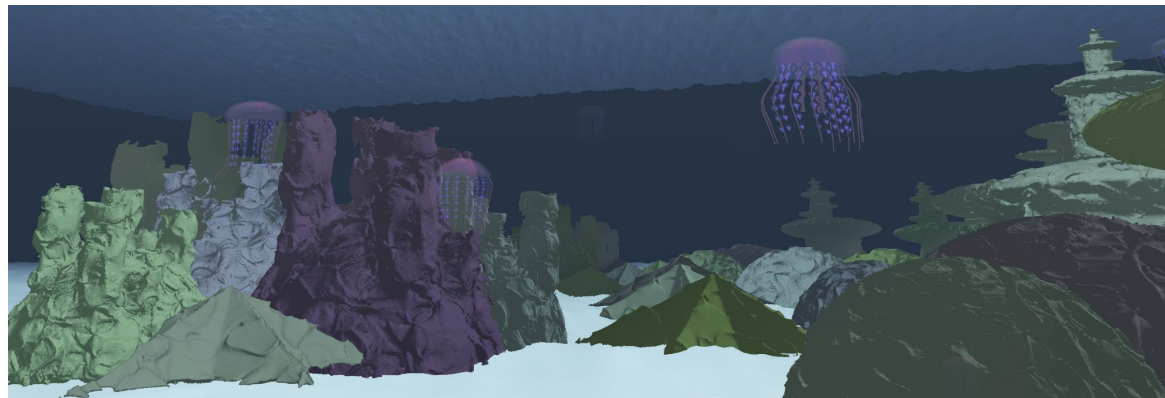
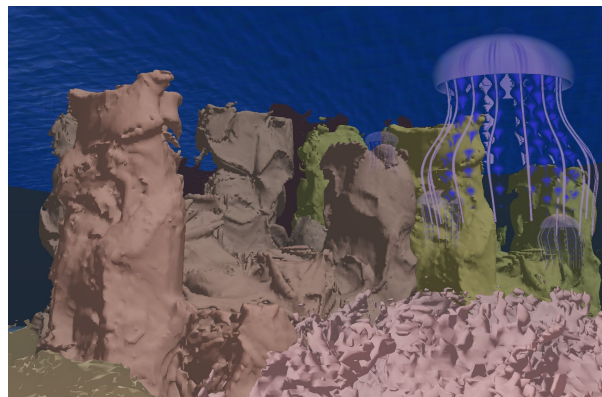


Uses Julia-set inspired dynamical system to generate specifiable self-similar regions with chaotic details.

# Coral Reefs:

## Instanced Rendering for Procedural Cluster Placement

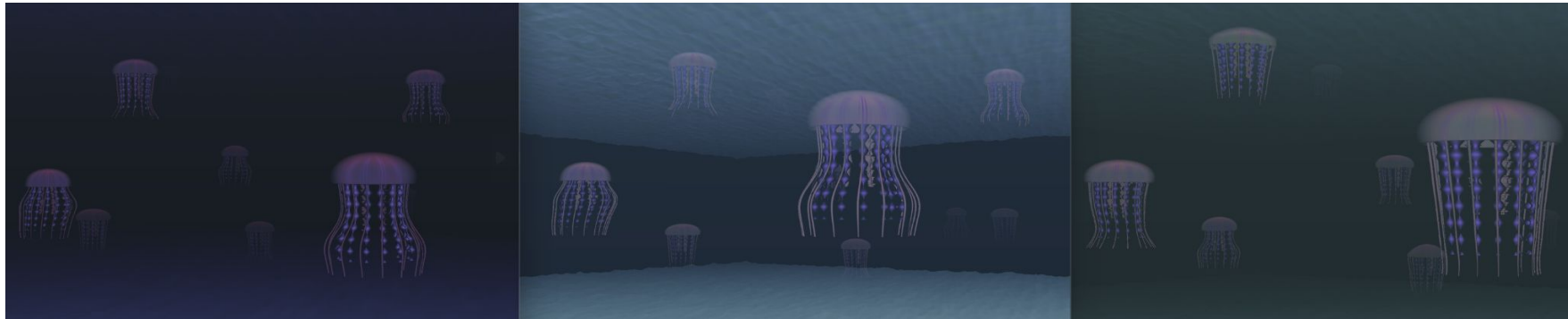
LIVE: [yuhanliu-tech.github.io/spectral-sea](https://yuhanliu-tech.github.io/spectral-sea)





## Jellyfish: Ray-marched SDF NPCs

LIVE: [yuhanliu-tech.github.io/spectral-sea](https://yuhanliu-tech.github.io/spectral-sea)



Ray marching, procedural noise,  
volumetric effects to simulate  
movement and appearance



## Acknowledgements:

Big Thank You to...

LIVE: [yuhanliu-tech.github.io/spectral-sea](https://yuhanliu-tech.github.io/spectral-sea)



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