Spectral Sea: Real-Time Ocean Rendering

Joanna Fisch, Nick Liu, Yuhan Liu

CIS 5650:
GPU Programming
& Architecture
12.09.2024

Spectral Sea: Meet the Team

LIVE: yuhanliu-tech.github.io/spectral-sea

Nicholas Liu

CS'25 (CGGT December '25)

Github: @liunicholas6

Email: liun0@seas.upenn.edu

Joanna Fisch

CGGT'25

Github: @pojojojo21

Email: jofisch@seas.upenn.edu

Yuhan Liu

DMD'25 (ROBO'26)

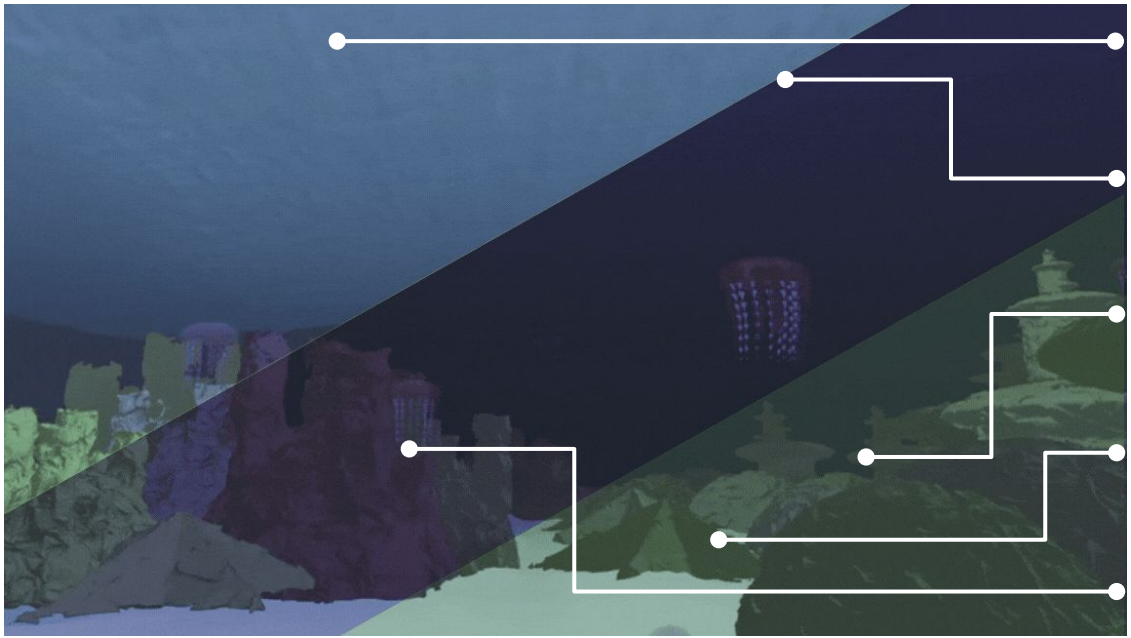
Github: @yuhanliu-tech

Email: yuhanl@seas.upenn.edu

Spectral Sea: Introduction

LIVE: yuhanliu-tech.github.io/spectral-sea

Real-time, infinitely explorable ocean, generated by combining some of the latest (2024!) publications in parallelizable graphics algorithms in **WebGPU**.



Tiled-&-Blended Ocean Surface

Multiple Scattering for various Jerlov water types

Spectral Rendering & Caustics

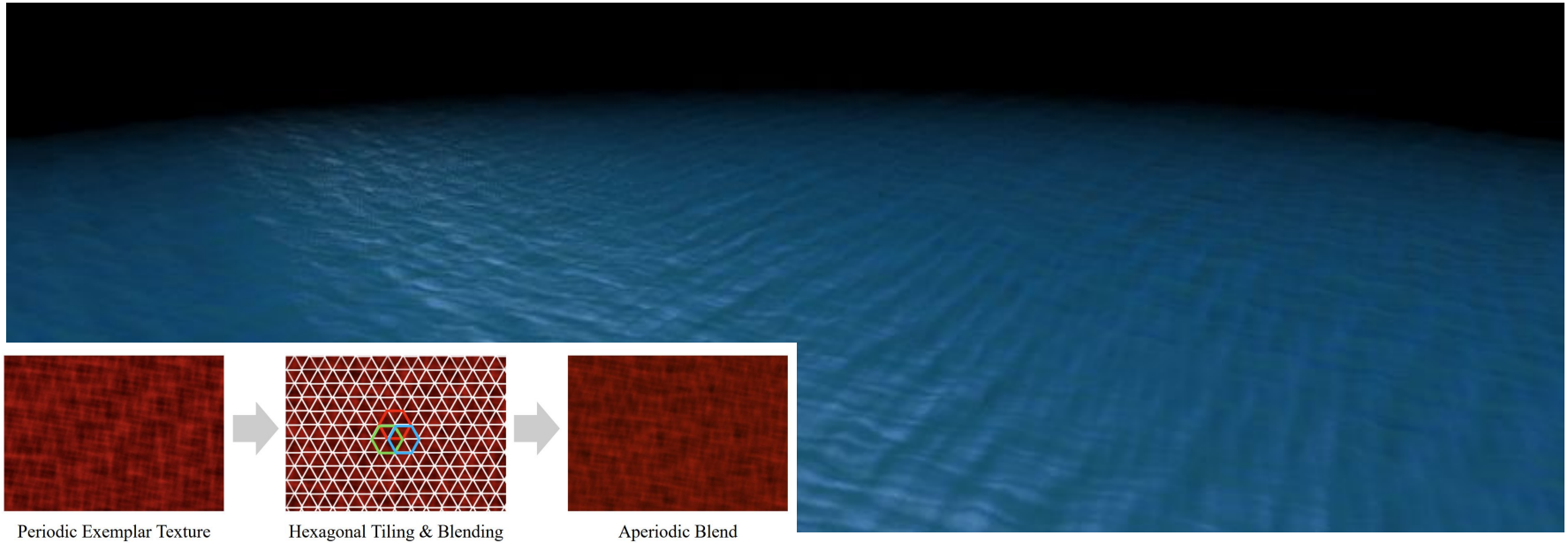
Fractal Mesh Generation & Instanced Rendering for Coral Reefs

Raymarched SDF Jellyfish Shader

LIVE: yuhanliu-tech.github.io/spectral-sea

Ocean Surface:
Tiling & Blending Compute Shader

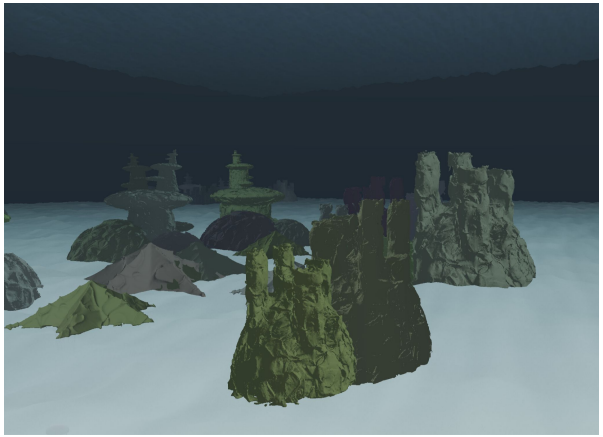
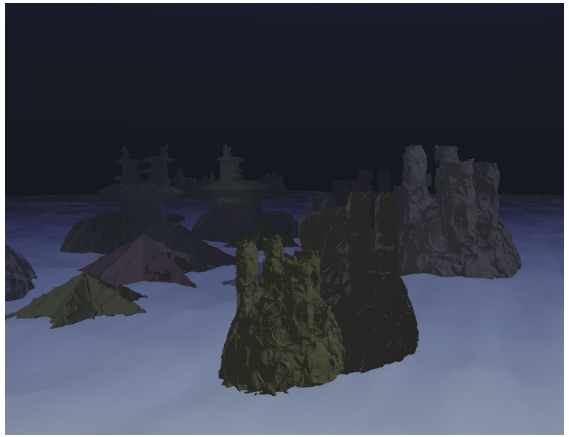
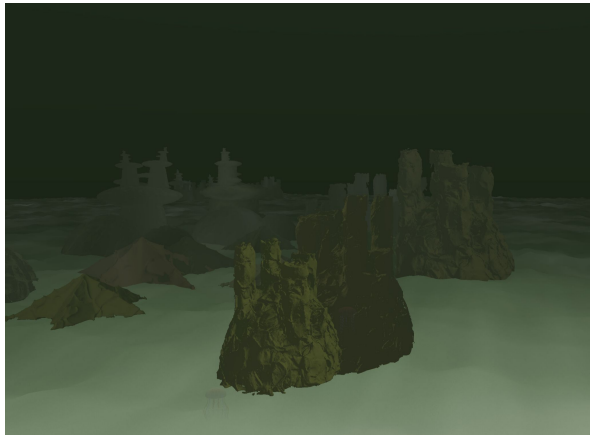
Reference Paper: [Fast orientable aperiodic ocean synthesis using tiling & blending]
N. Lutz, A. Schoentgen, G. Gilet (High Performance Graphics ‘24)



Underwater Spectral Rendering: Multiple Scattering

LIVE: yuhanliu-tech.github.io/spectral-sea

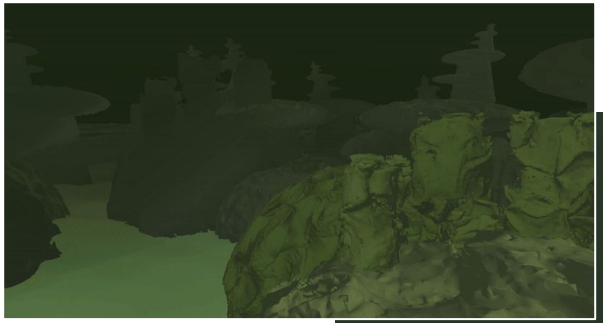
Reference Paper: Real-Time Underwater Spectral Rendering
N. Monzon, D. Gutierrez, D. Akkaynak and A. Muñoz (High Performance Graphics ‘24)

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.

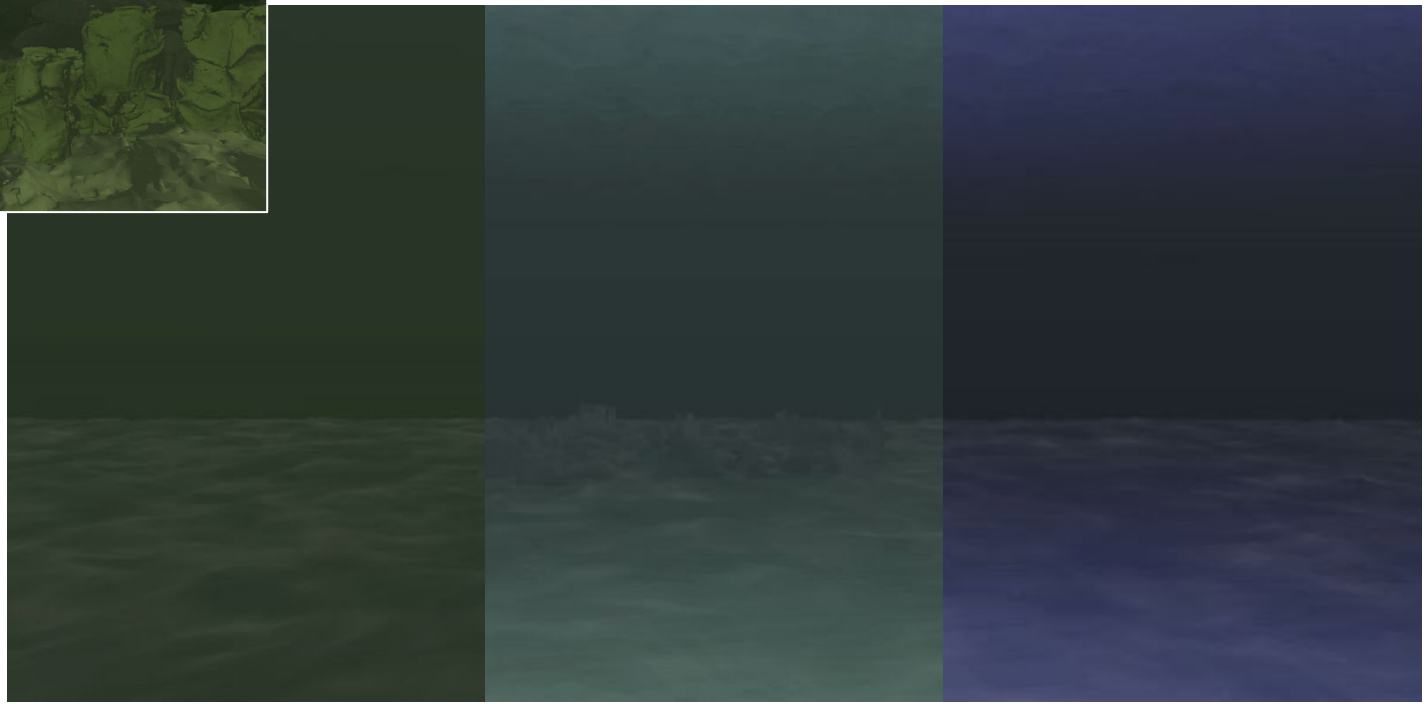
Underwater Spectral Rendering: Caustics

LIVE: yuhanliu-tech.github.io/spectral-sea



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

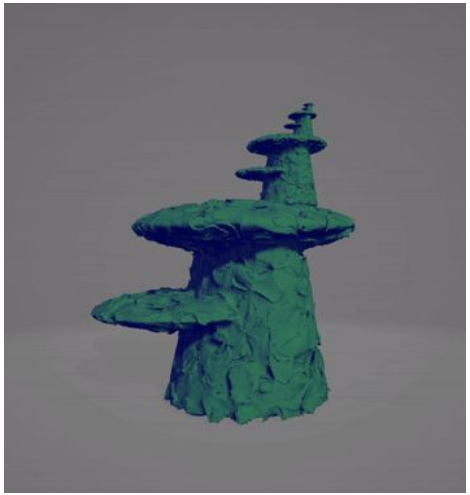
Underwater light simulation by combining surface light and our caustics pattern at each point.

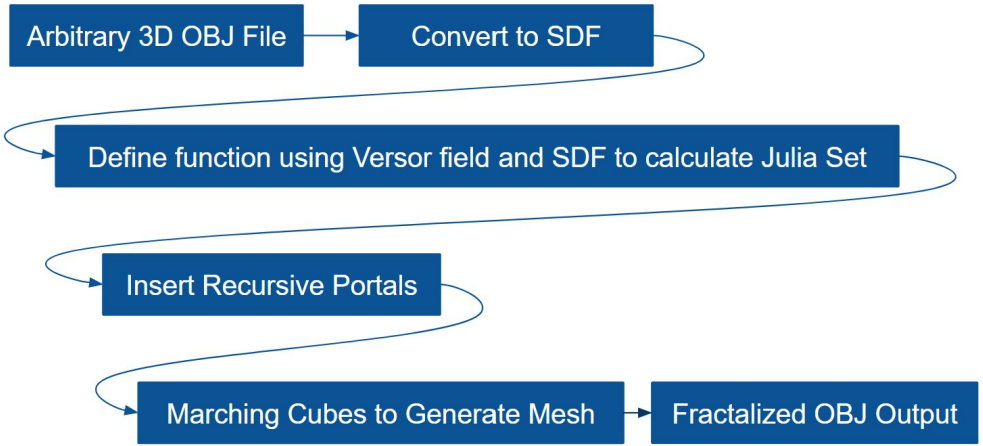


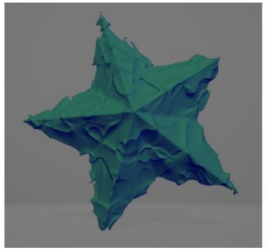
Coral Reefs: Fractal Mesh Generation

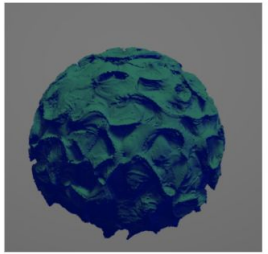
LIVE: yuhanliu-tech.github.io/spectral-sea

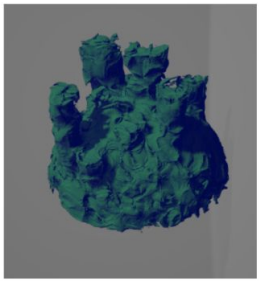
Reference Paper: [Into the Portal: Directable Fractal Self-Similarity](#)
A. Schor, T. Kim (SIGGRAPH ‘24)







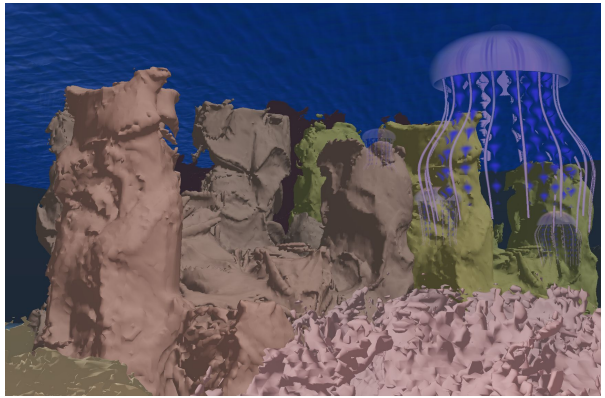


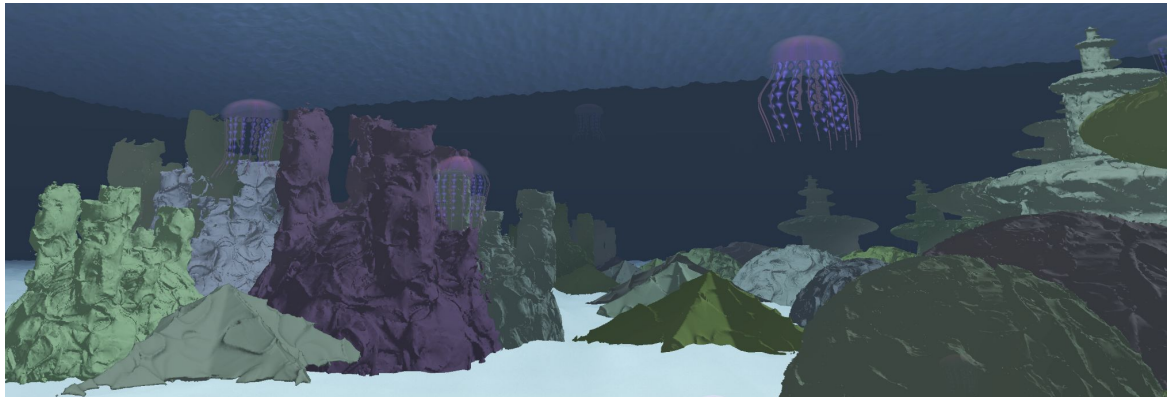


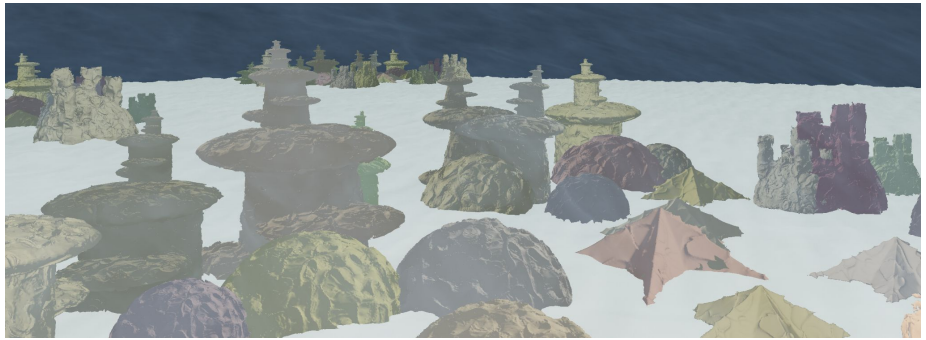
Uses Julia-set inspired dynamical system to generate specifiable self-similar regions with chaotic details.

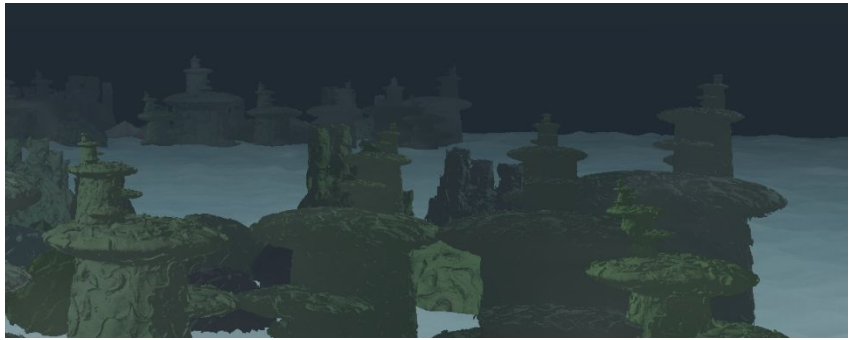
Coral Reefs:
GPU Instanced Rendering for Procedural Cluster Placement

LIVE: yuhanliu-tech.github.io/spectral-sea



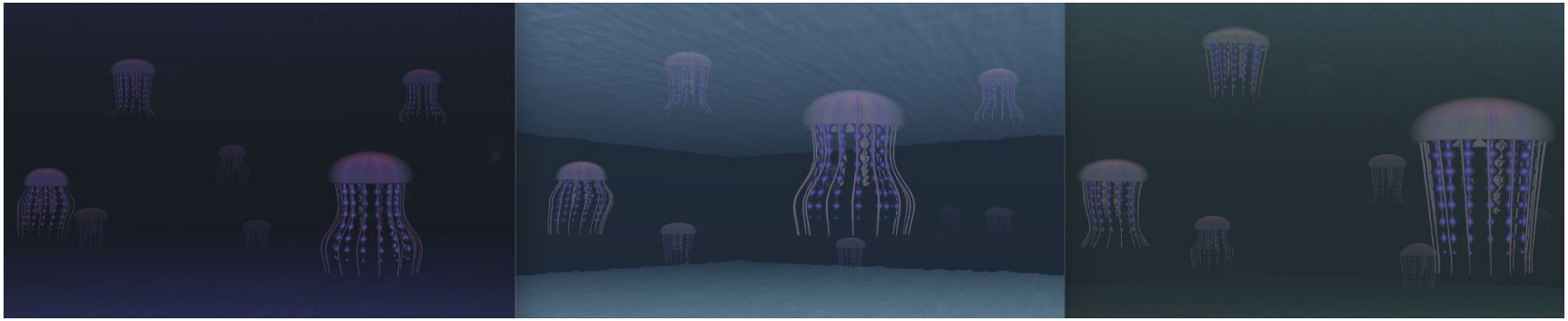






Jellyfish: Ray-marched SDF NPCs

LIVE: yuhanliu-tech.github.io/spectral-sea



Spectral Sea: Real-Time Ocean Rendering

Joanna Fisch: jofisch@seas.upenn.edu

Nick Liu: liun0@seas.upenn.edu

Yuhan Liu: yuhanl@seas.upenn.edu

Big Thank You:

A. Schorr & G. Gilet,
& referenced paper authors -
for their cutting-edge work, knowledge, and willingness to speak with us

Our Shadow Team: Nadine, Dominik, & Shreyas -
for mutual support & team therapy :)

REPO: github.com/yuhanliu-tech/spectral-sea
LIVE: yuhanliu-tech.github.io/spectral-sea