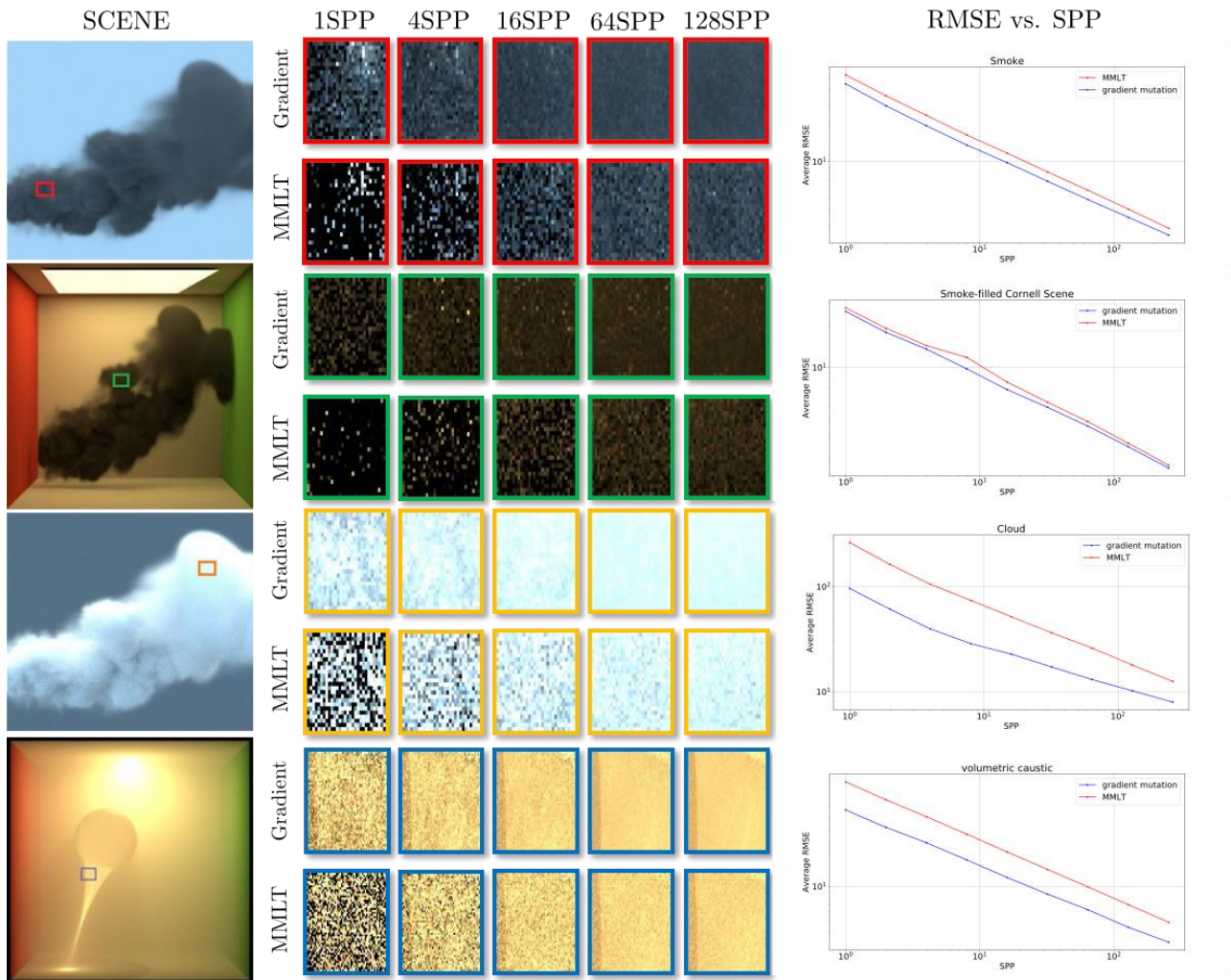


# (Peter)G.Lu

Project portfolio

# Master's thesis project

## Gradient-Domain Volume Rendering



We compute the path-space gradient of one light path with respect to one vertex in the medium; then, we design a strategy to generate correlated paths in MMLT and use this gradient algorithm to estimate the contributions. We can do so with limited computation, as we avoid the expensive construction and radiance evaluation of entirely new paths.

# Small project

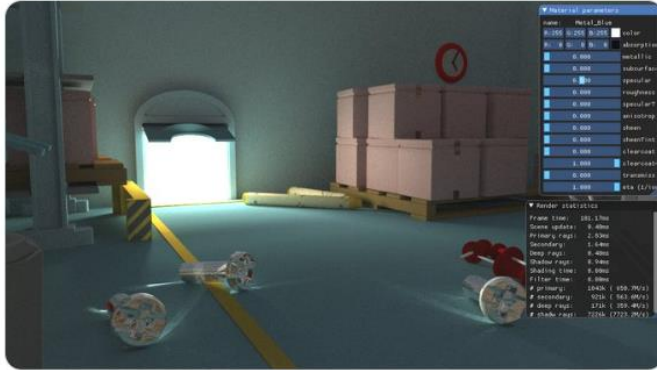
## Streaming BDPT based on Light House 2



Jacco Bikker  
@j\_bikker

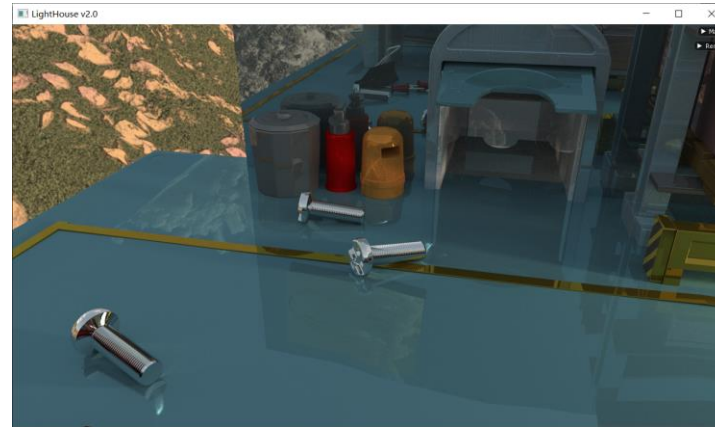
Lighthouse 2 now features a BDPT core, built by Guowei (Peter) Lu [github.com/pasu](https://github.com/pasu). The new core is now available on Github:

[github.com/jbikker/lighthouse2](https://github.com/jbikker/lighthouse2). Also in the latest version: improvements to the SVGF filter, the reference core and the reference (Lambert) material.



10:39 AM · Nov 14, 2019 · Twitter Web App

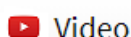
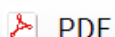
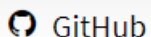
12 Retweets 47 Likes



Light House 2 is a rendering framework for real-time ray tracing. I built this streaming BDPT render system, which can handle difficult lighting setting such as caustic and non-symmetric scattering situations including refraction and shading normal.

Major skills include:

- C++
- CUDA
- OptiX
- Wavefront
- Batching Ray for visibility test



# Path Tracing (GPU&WebGPU)

## C++/JS/Compute Shader

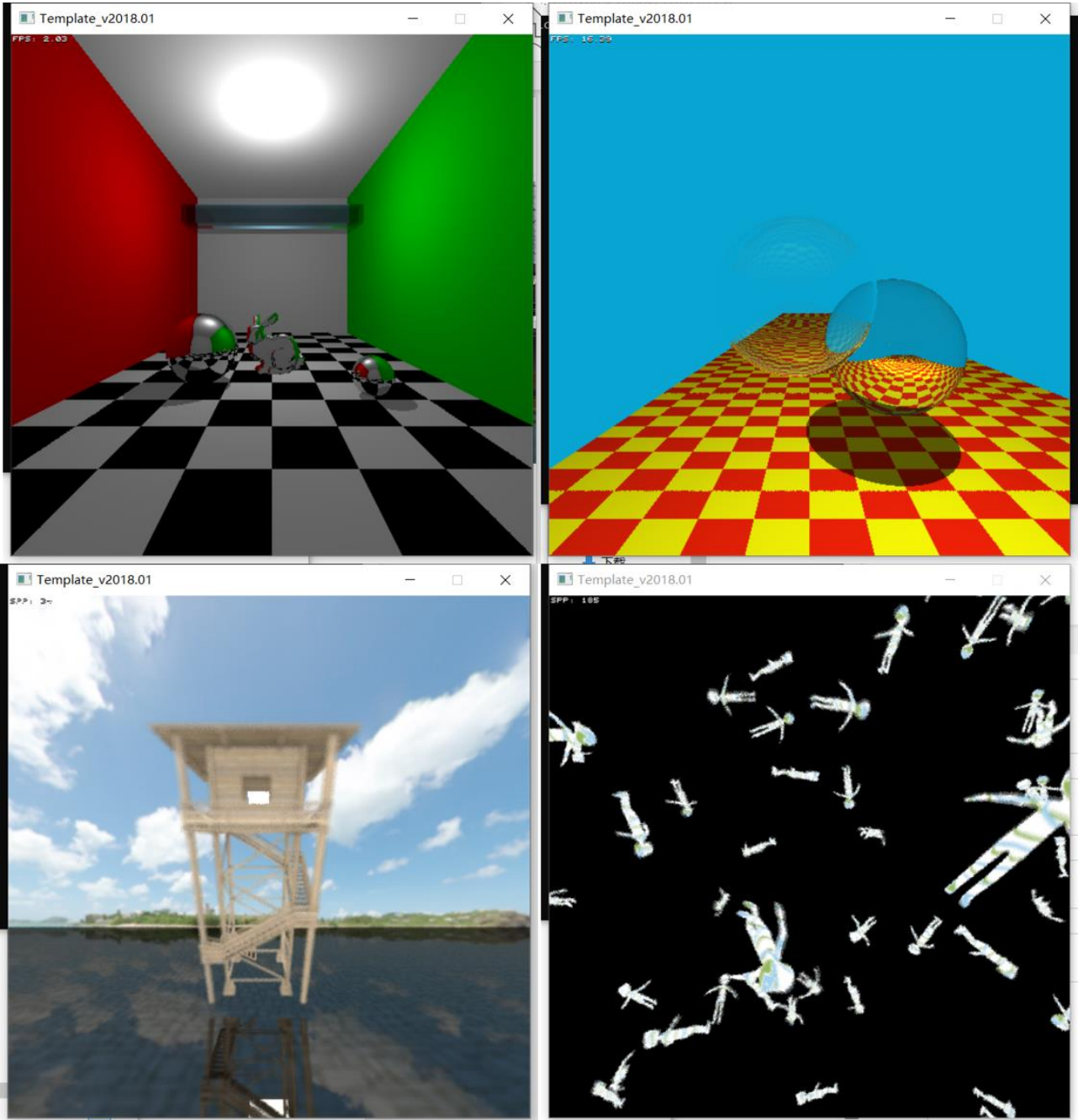


A path tracing toy written in C++ and JS. Uses computer shader. You can build the BVH of the scene and save it as binary on the desktop, then, load this binary and view the scene interactively on the Browser which supports WebGL 2.0 Compute. It supports wavefront and megakernel.



# Path Tracing (CPU)

## C++

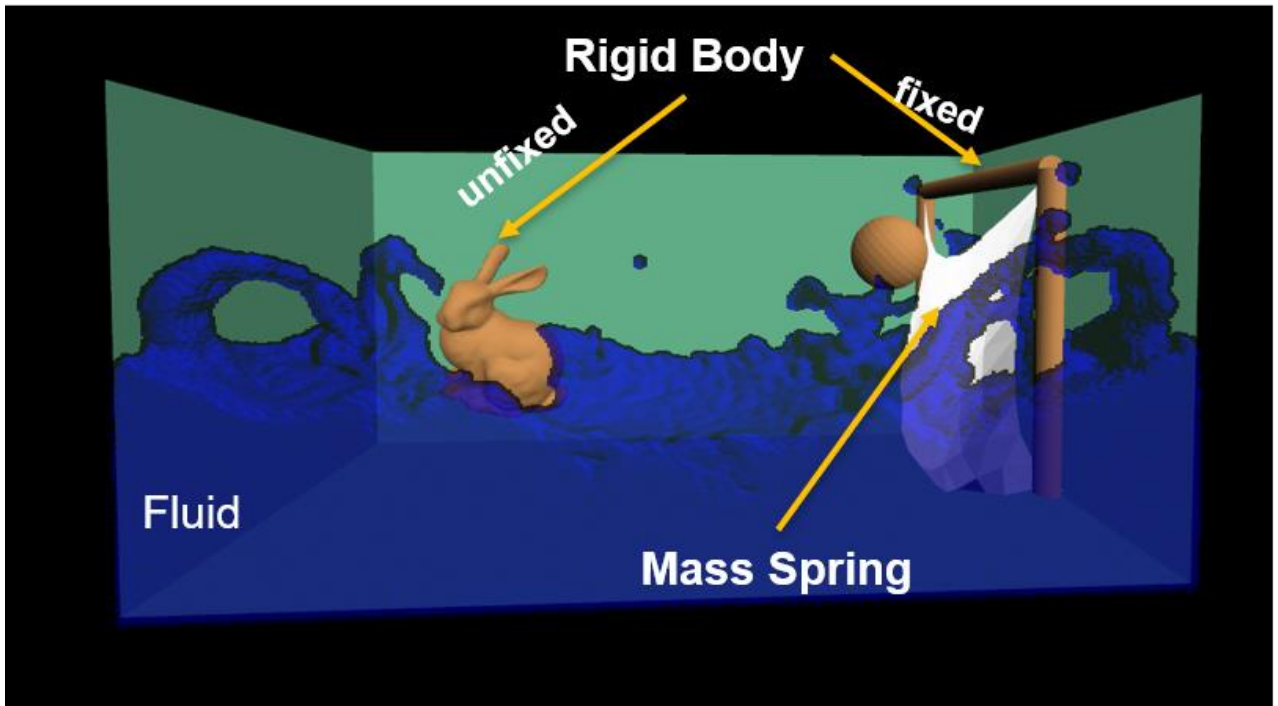


A fully featured ray tracing, which is the assignment of the Advanced Graphics. Major features are:

- BVH (SAH + Top-Level + SIMD Intersection)
- NEE+MIS, Photon Mapping (Simple), Ray Packets
- Depth Field, Motion Blur
- Multithreading, Filter

# Position Based Fluid Simulation

## C++/Compute shader/OpenGL



Particals	Time Per Iteration	Frame Rate
64K	1.3ms	110fps
128K	2.0ms	70fps

Fluid simulation is the Mini-project of the course 'Game Physics', which was inducted into the **Game Physics Hall of Fame** (2<sup>nd</sup> place). The key idea is enforcing incompressibility using position constraints. It includes fluid-rigid body, fluid-cloth interaction and fluid surface reconstruction.

# Rigid and Soft Body Simulation

## C++



This is the assignment of the course 'Game Physics'. It includes three parts:

- Rigid bodies and collision
  - multiple interpenetrations and collisions
  - impulse-based collision resolution
- Constraints
- Finite-Element Soft-Body Deformation

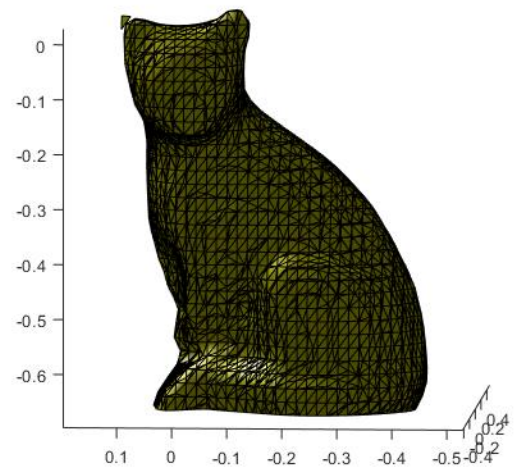
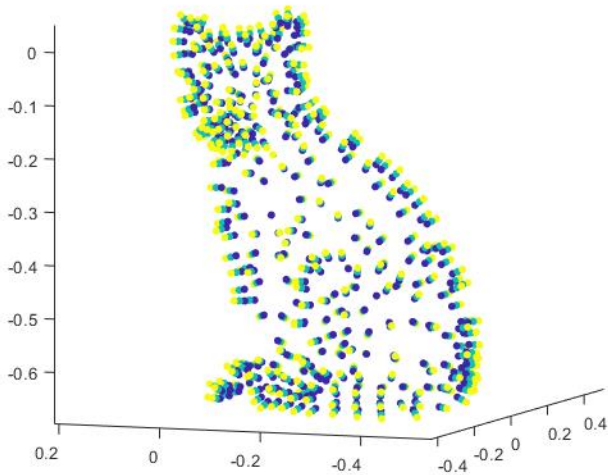
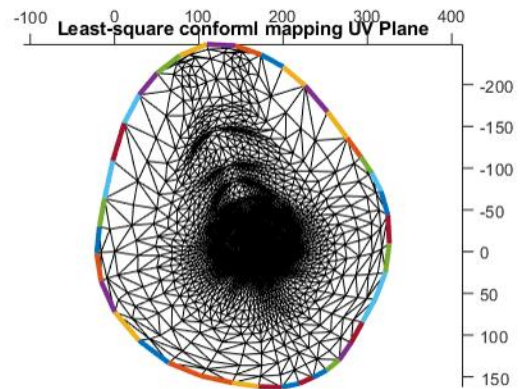
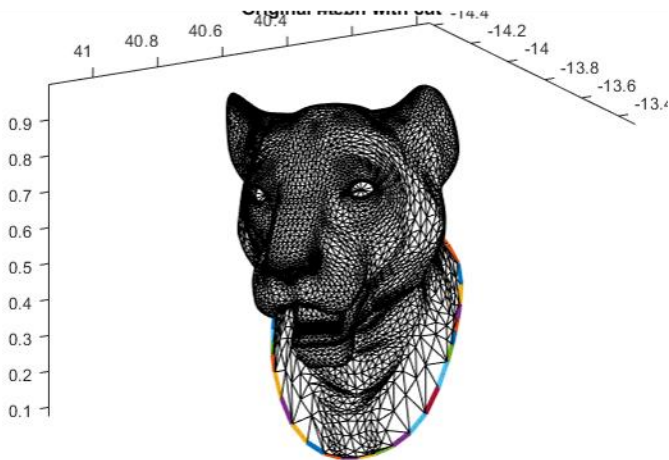
Rigid bodies and collision: [GitHub](#)

Constraints : [GitHub](#)

Soft-Body Deformation: [GitHub](#)

[Video](#)

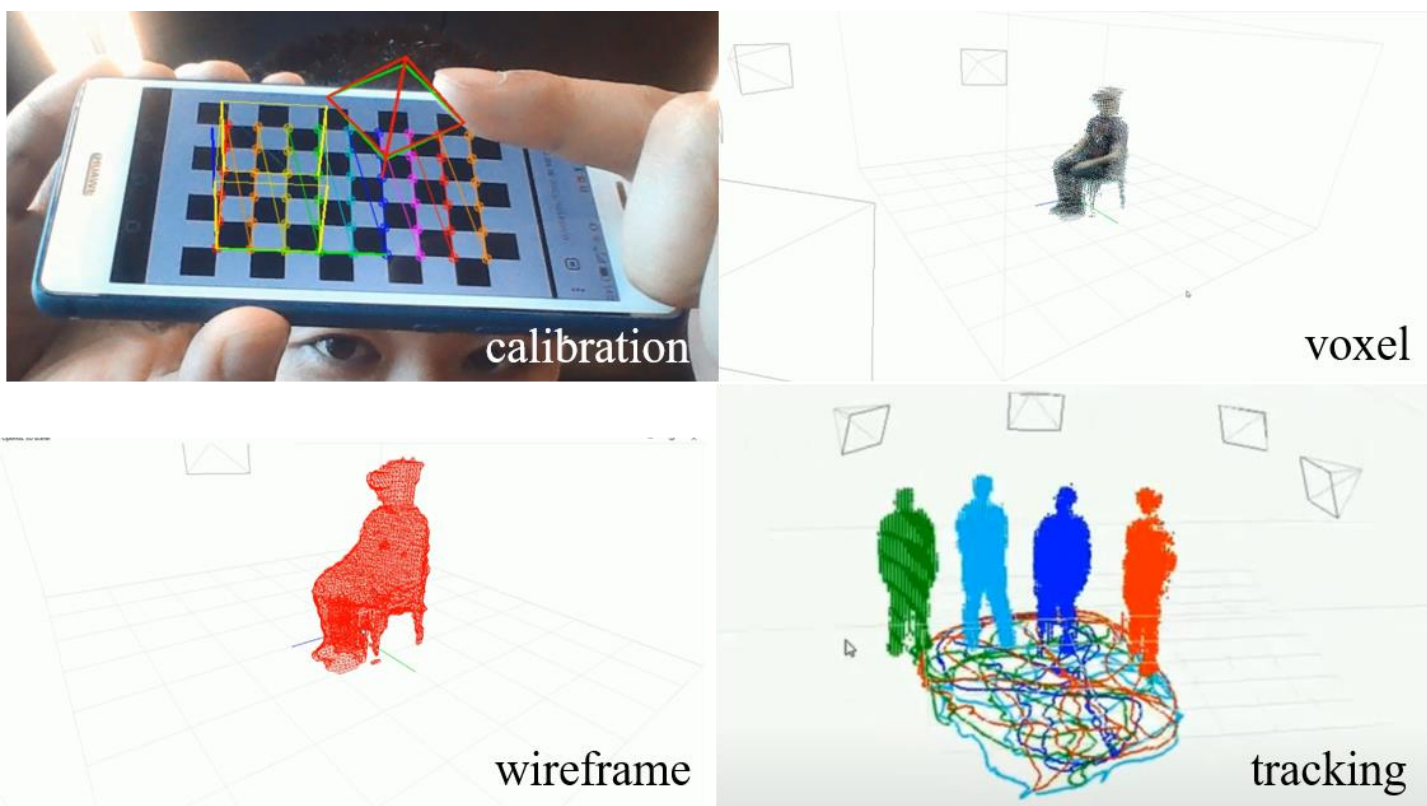
# 3D Model matlab



I self-studied the course '3D model' and did these practices including linear least-squares system using sparse matrices, a simple version of the moving least squares, and Least-Squares Conformal Mapping algorithm. **Academic integrity:** I did this practice with the help of the reference code. Strictly speaking, this is not my own code



# Voxel-based 3D Reconstruction and Tracking C++/OpenCV



This is the assignment of the course 'Computer Vision', which includes the camera calibration, voxel-based 3D reconstruction and tracking. The major skills are:

- Marching cube
- K-means



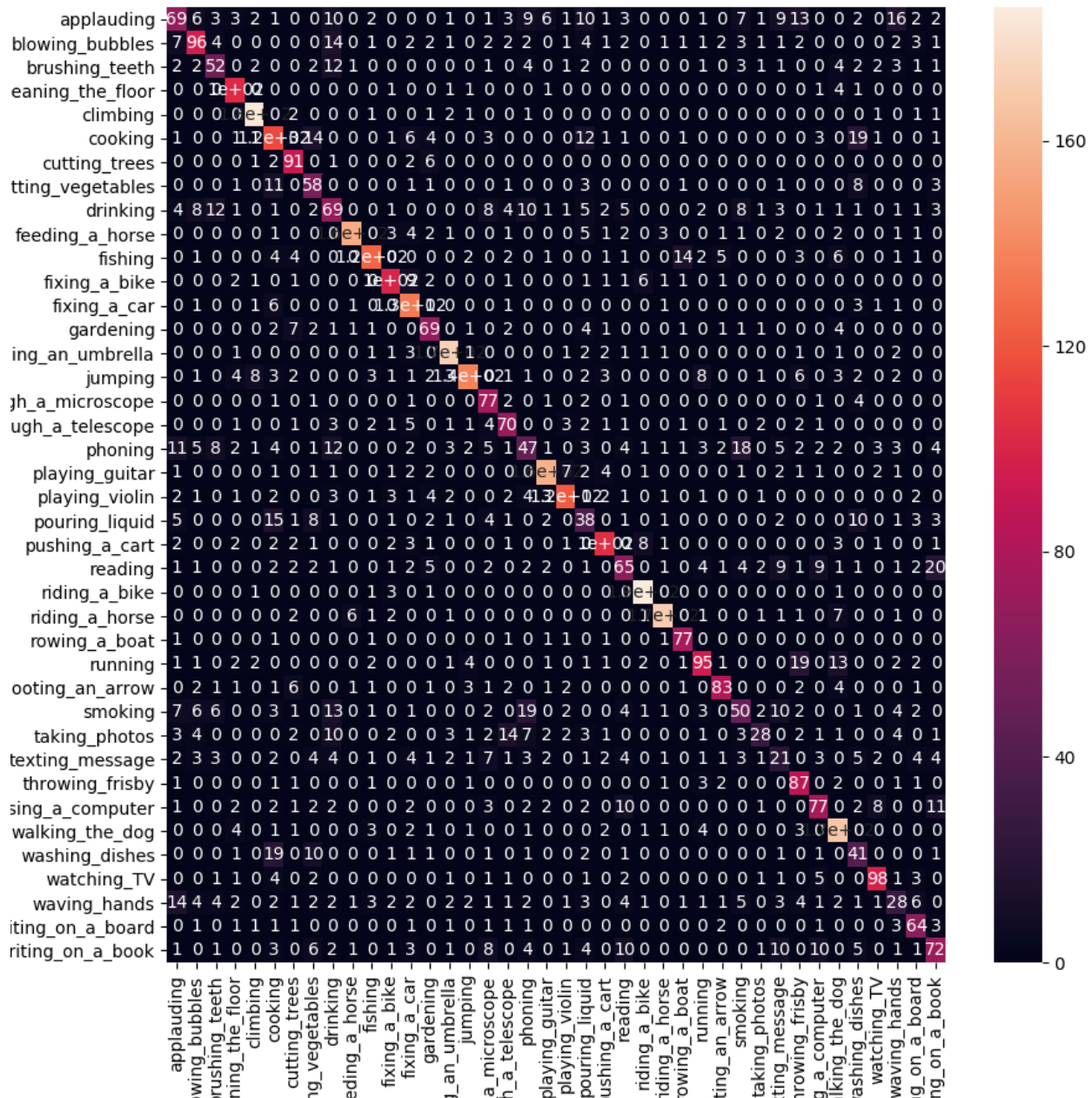
GitHub



Video

# Action Recognition with Automatic Model Search

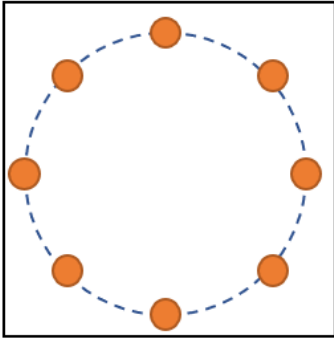
## Python/Keras/Tensorflow



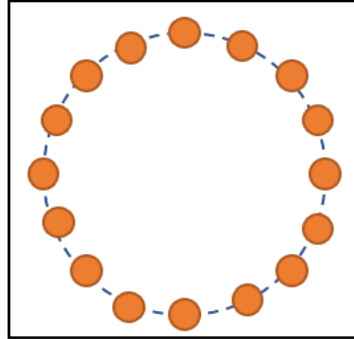
This is the project in the course 'Computer Vision'. We created a Neural Network architecture capable of classifying human actions of the Stanford-40 dataset and optimized it by using methods such as Transfer Learning, weight decay, and custom learning rates.

# A Comparative Study of Collision Avoidance Algorithms

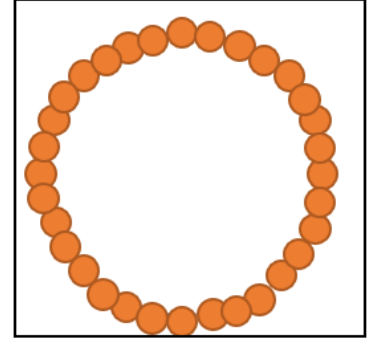
## C++



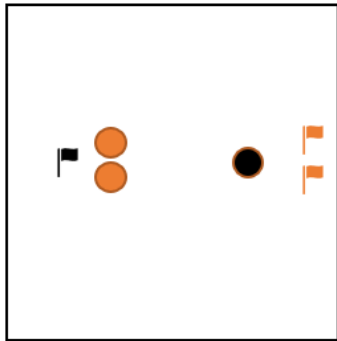
8-way-confusion



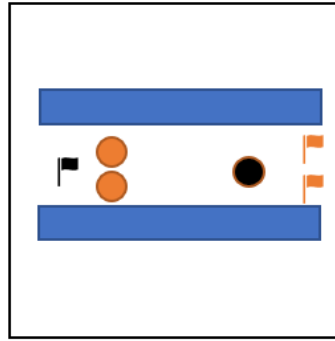
16-way-confusion



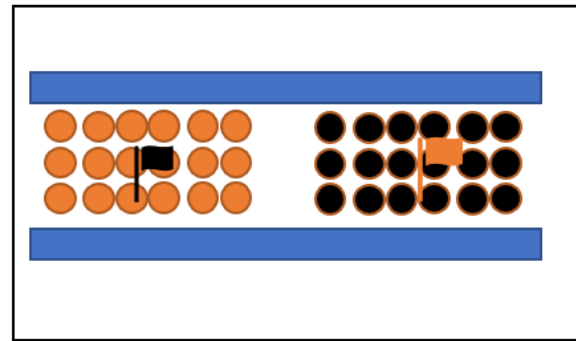
32-way-confusion



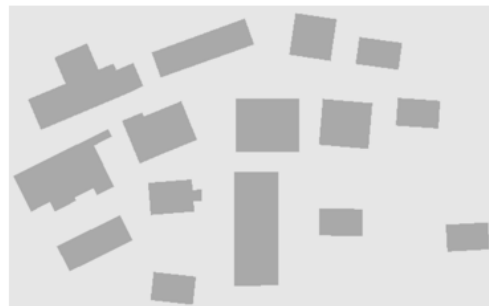
crossing



Squeeze crossing



Group intersection



Large scale scenario

This is the project of the course 'Crowd Simulation', we added the *implicit crowd algorithm* to the UUCS (Utrecht University Crowd Simulation) framework. UUCS is a closed source project. We compared this algorithm with other major algorithms in several test scenes.



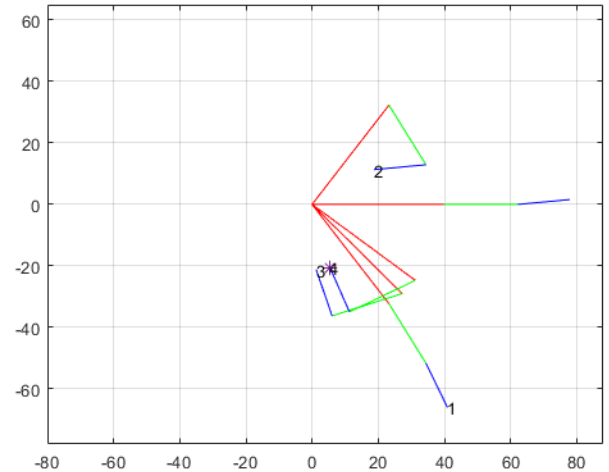
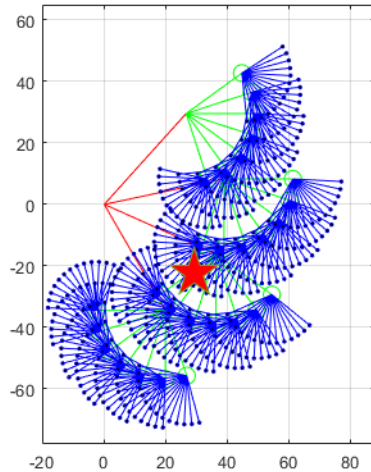
PDF



Video

# Inverse Kinematics for Human Fingers

## matlab



This is the project of the course 'Motion and Manipulation'. First, we simulate the positions one finger (with three joints) can reach. And we use the inverse Kinematics method to compute the angle of each joint iteratively to reach one given position with the constrained joint angles. We provided three solvers:

- Pseudo Inverse
- Pseudo Inverse with Optimization Derivation
- Extended Jacobian Method



GitHub



PDF

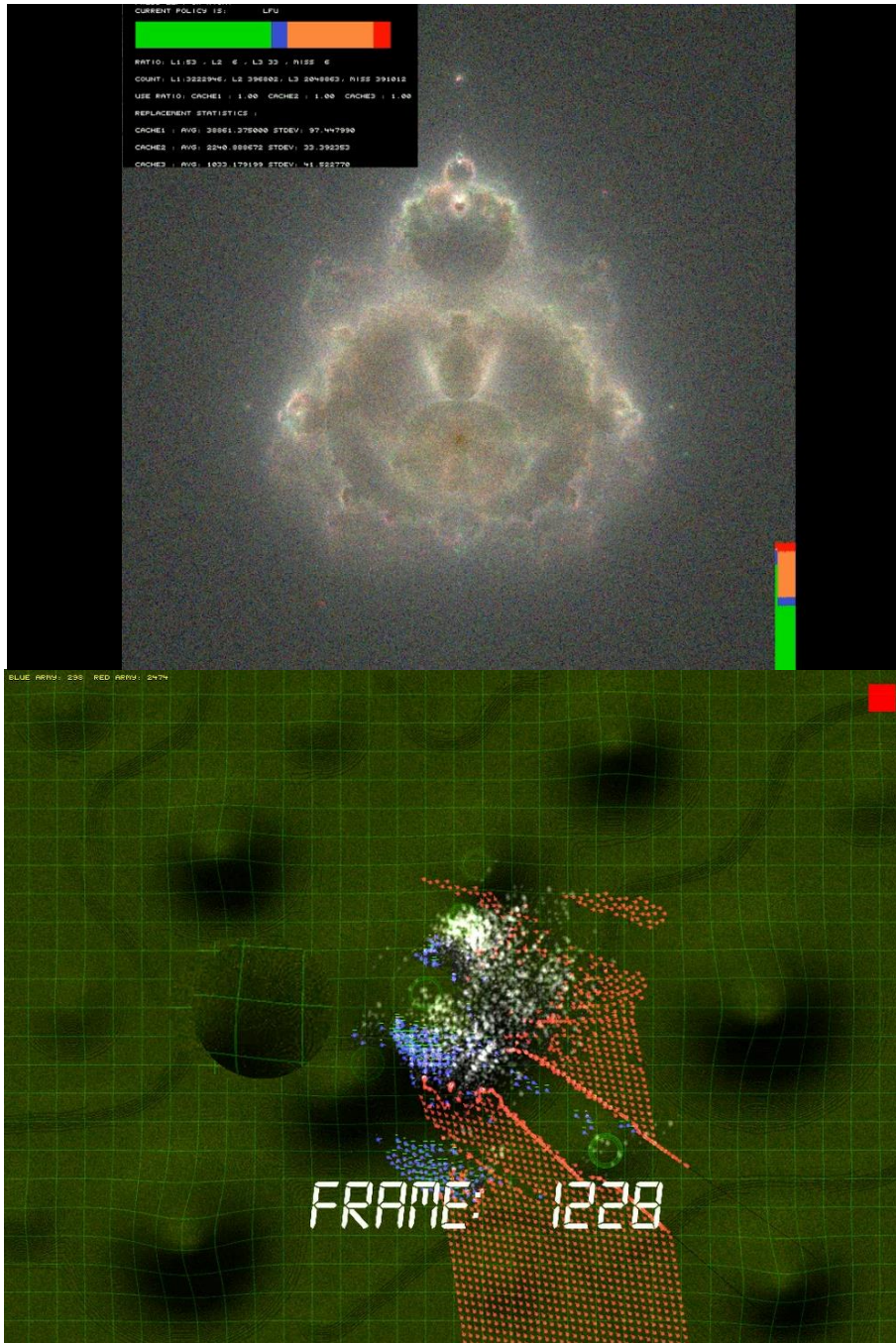


Video



# CPU Cache Simulator and Optimization

## C++



The assignments of the course 'Optimization and Vectorization'. In the cache simulator, there are three levels cache, and we provide six eviction policies. A tool is provided to monitor the hit ratio. Finally, we can use all the skills we learned to optimize the performance of a small game. I speedup 25 times



# Examples for Cesium JS/WebGL

 GitHub

 Watch

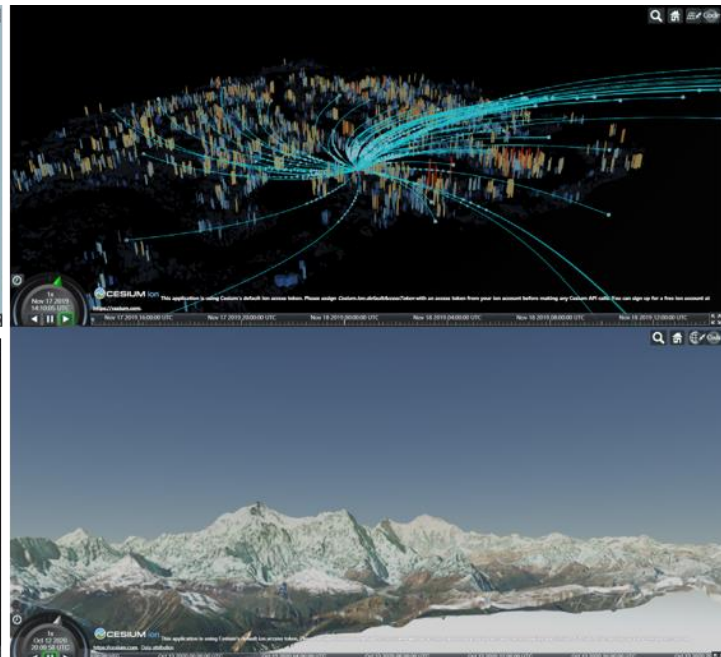
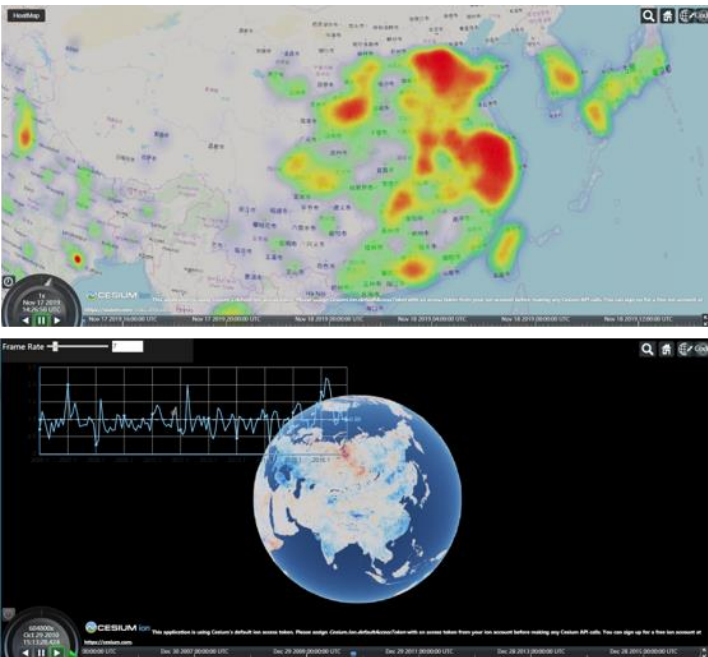
42

 Star


320


 Fork

135



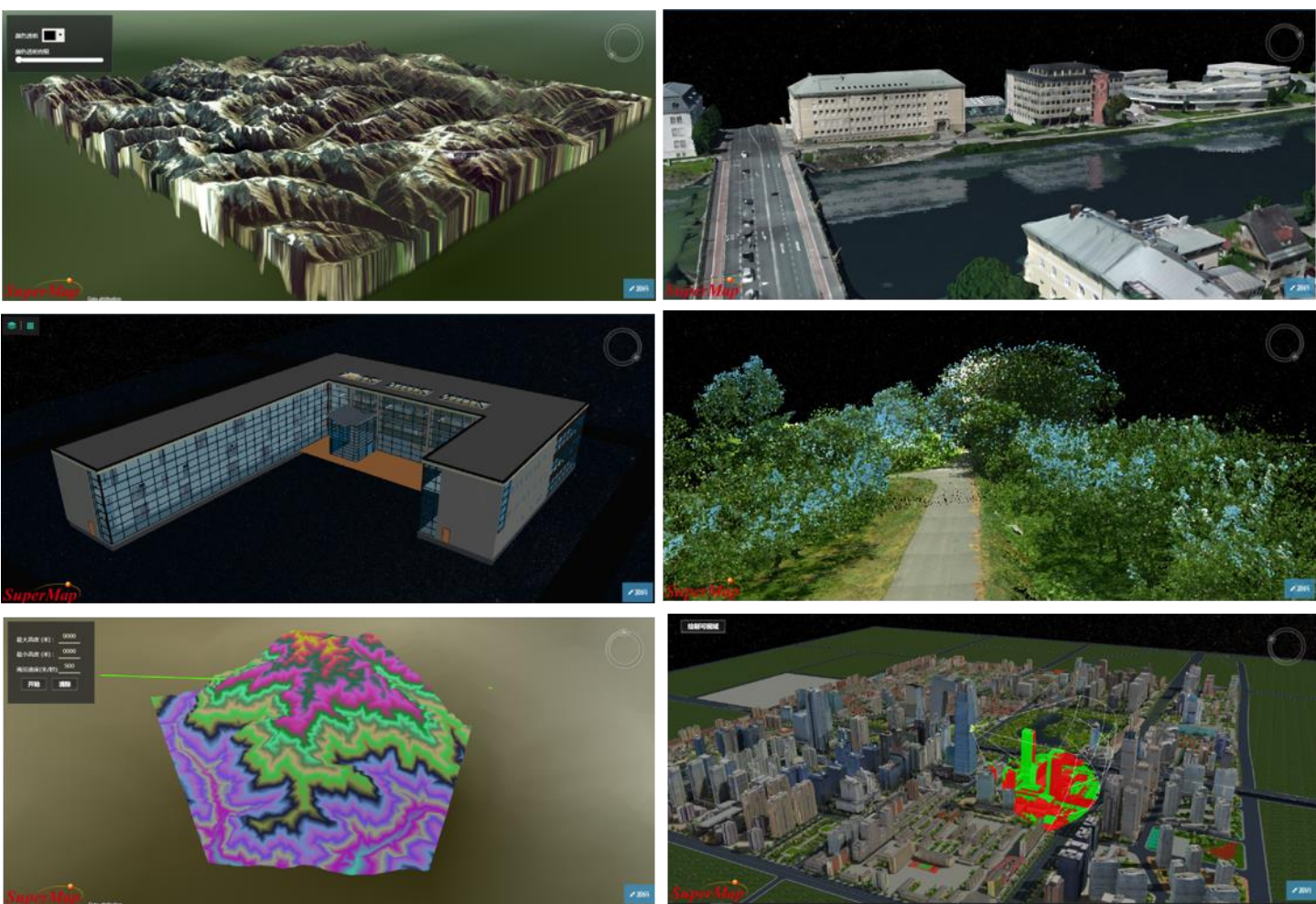
CesiumJS is an open source JavaScript library for creating world-class 3D globes and maps. I create several visualization demos based on this library, such as real-time global AQI(air quality index), tax flow, ten years of global temperature change, and global terrain.

 GitHub

 Video

# S3M

C++/JS/WebGL



S3M is one specification (T/CAGIS 1-2019) in China for the transmission and loading of massive meshes, including oblique photograph, BIM and point cloud. We can do the analysis and visualization on this Spatial geographic data. I was the core engineer to design and develop this format, including the data generation, loading and rendering on the Browser.