Rui XU

Email: *rxu17988@usc.edu*
Homepage: *https://xrr-233.github.io*
LinkedIn: *https://www.linkedin.com/in/ruixu33*
GitHub: *https://github.com/xrr-233*

1280 W 37th Pl
Los Angeles, CA 90007
+1 (424) 485-3899

EDUCATION

University of Southern California 08/2023 - 05/2025 (exp.)
M. S. in Computer Science (Multimedia and Creative Technologies)

- GPA: 3.95/4.0
- Core Courses: 3-D Graphics and Rendering, Computer Animation and Simulation, Game Engine Development, Advanced Computer Vision

City University of Hong Kong 09/2019 - 06/2023
B. S. in Computer Science

- GPA: 3.81/4.3 (3.76/4.0, First Class Honour, Top 7%/145)
- Core Courses: Computer Graphics, Artificial Intelligence, Computer Vision for Interactivity, Machine Learning
- Exchanges:
  - **Peking University** - *Summer School*: Control Theory
  - **University of California, Los Angeles** - *Summer Session*: Ordinary Differential Equation

RESEARCH INTERESTS

My current research mainly focuses on 3D reconstruction and neural rendering utilizing Gaussian Splatting techniques for efficient scene representation & rendering, particularly in exploring methods for scene decomposition and relighting.

I am also enthusiastic about broader topics in Graphics & Vision, including Digital Humans and Character Animation, Physics Simulation, 3D Vision, Game Engines and Visual Effects, VR/AR and Immersive Technologies, etc.

RELATED EXPERIENCE

University of Southern California Institute for Creative Technologies (USC ICT) 01/2024 - Now
Geospatial Terrain Research *Supervisor: Dr. Andrew Feng*
Student Researcher

- **Advanced Relighting in Gaussian Splatting Context:** Tackled sunlight-shadow separation and material-illumination decoupling for outdoor drone-captured scenes, using both 3DGS and 2DGS representations under static/dynamic lighting conditions.
- **Custom CUDA-based BVH Tracer:** Developed and optimized a differentiable ray tracer for GS primitives with high-accuracy accumulated features and shadow maps, achieving efficient memory usage and accurate physically-based shading (PBR), while handling complex occlusion and large-scale scene geometry.
- **Scene Visualization:** Enhanced a C++/Qt-based platform (SIBR) to stream PBR attributes, hard-shadow masks, and other features from Python. Later integrated nerfview/viser for multi-pipeline (rasterizer/tracer) inspection, accelerating debugging and iteration.
- **Geometry & Lighting Alignment:** Investigated drone imagery (with GPS/metadata) and COLMAP pose data to estimate solar direction, identifying key alignment challenges, and refined the pipeline accordingly.
- **Quantitative & Qualitative Benchmarking:** Performed alignment and metric-based evaluations (Chamfer, PSNR) on DTU and in-house drone datasets, comparing NeuS, Neuroangelo, 3DGS, SuGaR, and other state-of-the-art GS variants to guide pipeline refinements.

City University of Hong Kong Shenzhen Research Institute (CityU SRI) 06/2021 - 06/2022
Architecture and Civil Engineering Research Center *Supervisor: Dr. Xiaowei Luo*
Research Assistant (Intern)

- **VR-based Crane Training System:** Developed a prototype Unity-based training scene for on-site construction crane operation, including physical simulation (wind, rope, collision), hardware integration (VR, handles, joy-sticks), remote host synchronization. and 3D assets modelling using 3ds Max.
- **Scene Simulation and Data Analysis:** Conducted crowd behavior experiments using Unity and VR to evaluate the influence of crowd flow on evacuation way-finding.

PUBLICATIONS

Computer Graphics & Vision Research:

- **AtomGS: Atomizing Gaussian Splatting for High-Fidelity Radiance Field**
  Rong Liu, **Rui Xu**, Yue Hu, Meida Chen, Andrew Feng
  BMVC 2024

Additional Publications (Selected):

- **Human Decision Change in Crowd Evacuation: A Virtual Reality-based Study**
  Ming Zhang, **Rui Xu**, Ming Fung Francis Siu, Xiaowei Luo
  Journal of Building Engineering (IF: 7.144, 9/138 in ENGINEERING, CIVIL)
- **Human–robot Collaboration for On-site Construction**
  Ming Zhang, **Rui Xu**, Haitao Wu, Jia Pan, Xiaowei Luo
  Automation in Construction (IF: 10.517, 1/138 in ENGINEERING, CIVIL)

SELECTED PROJECTS

- **Ocean Simulation and Atmospheric Scattering**
  Simulated ocean wave dynamics and atmospheric scattering using Direct3D.
- **Particle Simulation, IK, and Ray Tracing Techniques**
  Developed a particle physics engine and IK-driven skeletal animation system; explored secondary illumination effects using ray tracing within OpenGL and Direct3D frameworks.
- **3D Digital Avatar: Physically-based Face & Hair Reconstruction and Real-time Rendering**
  Developed a Unity URP + ShaderLab + HLSL system to render virtual 3D avatars from RGB-captured real-world human faces. Implemented hair shading models (Kajiya-Kay, Marschner, Scheuermann) and subsurface scattering for skin, based on an in-depth understanding of Unity's PBR-BRDF rendering scheme.
- **Jiaran Diana**
  Conducted a comprehensive exploration of NPR shaders, skeleton & motion animation, and physics simulation in Unity.
- **Research on Point Cloud Registration**
  Experimented with SOTA point cloud descriptor generation frameworks including PPF-FoldNet, Perfect Match, FCGF, D3Feat, and SpinNet; built and visualized a dataset by sampling from 3DMatch intermediate files and conducted ICP-based fine local registration using the Open3D toolbox.
- **Undergraduate Final Year Project (FYP)**
  Adopted, analyzed, and strengthened the NeuS method by incorporating NeRF volume rendering and SDF representation to achieve automatic vertex-level texture assignment on meshes. Experimented with various 3D reconstruction and novel rendering models to establish a pipeline that converts image sets into textured 3D meshes, including MVSNet, Occupancy Network, and NeRF-based methods.
- **VRChat PPO**
  Designed an immersive learning scene for teaching activities in public administrative courses, developed using Unity and the VRChat SDK.

SELECTED HONORS & AWARDS

Talented Development Scholarship, the Hong Kong Special Administrative Region Government Scholarship 07/2023
The Hong Kong, China – Asia-Pacific Economic Cooperation Scholarship 06/2022
Talented Development Scholarship, the Hong Kong Special Administrative Region Government Scholarship 06/2022
Bronze Award, **Macau, Asia Regional, International Collegiate Programming Contest (ICPC)** 05/2021
Silver Award, **Jinan, Asia Regional, International Collegiate Programming Contest (ICPC)** 12/2020
Silver Award, **Changchun, China Collegiate Programming Contest (CCPC)** 11/2020

SKILLS

Spoken Languages: English: Fluent; Chinese Mandarin: Native; Chinese Cantonese: Conversational
Programming: C/C++, C#, CUDA, Python, Ubuntu CLI, HTML/CSS/Javascript/Typescript/Vue, Java, etc.
IDEs & Tools: Visual Studio, Visual Studio Code, PyCharm, Anaconda, Git, Fork, CMake, etc.
Libraries, Packages & Frameworks: OptiX, Direct3D, OpenGL, Jekyll, PyTorch, Open3D, OpenCV, etc.
3D & VR/AR: Meshlab, CloudCompare, Unity, HTC Vive, VRChat, 3ds Max, Blender, NeuronMocap, etc.
Documentation: LaTeX, Overleaf, Markdown, Obsidian, Photoshop, Premiere Pro, After Effects, Vegas Pro