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RESEARCH INTEREST

My research interests include computer vision, computer graphics, computational photography, and machine learning. With the goal of improving visual experience of users, artists and audiences, I love everything that is creative and visually intuitive, with particular interest on 3D geometry, image-based rendering, image processing and interactive computational design. I am also interested in self-supervised representation learning and other perceptual sciences, with the emphasis of geometry and optics (physics). My previous projects covered a variety of topics including 3D reconstruction from images/videos, structure-from-motion, image synthesis, image and video understanding and pose analysis.

EDUCATION

Tsinghua University, Department of Electronic Engineering

Aug 2015 - Present

Bachelor of Engineering in Electronic Engineering

- **Academics:** Top 10% of 224 students. (GPA: 3.75/4.0)
- **Selected Courses (A+/A: 4.0/4.0 top 5%):** Linear Algebra, Calculus, Probability and Stochastic Processes, Discrete Mathematics, Signals and Systems, Computer Program Design, Introduction to Auditory-visual Information System, Fundamental of digital logic and processor, Physics for Scientists and Engineers, Quantum and statistical mechanics.
- **Honors:**
 - Research Excellence Scholarship (2016, 2017, 2018) – top 10%.
 - Qualcomm Scholarship (2017) – top ~2% (50 / 3300).
 - Sensetime Scholarship (2017) – 30 per year in China

High School Affiliated to Renmin University of China

Sep 2009 – Jul 2015

EXPERIENCE

ETH Zurich - Zurich, Switzerland

Jul 2019 – Nov 2019

Computer Vision and Geometry Group (CVG), Led by Prof. Marc Pollefeys.

- Topic: 3D reconstruction (structure-from-motion, differentiable rendering)

Microsoft Research Asia - Beijing, China

Dec 2018 – May 2019

[Research Intern] Visual Computing Group, Advised by Dr. Han Hu & Dr. Steve Lin.

- Semantically aligned deformation modeling (RepPoints): learning a set of 2D representative points for object detection, contour matching, instance segmentation and geometric/semantic correspondence.

University of Pennsylvania [Remote] – Philadelphia, PA, United States / Beijing, China

Jul 2018 – Feb 2019

GRASP Lab, Advised by Prof. Jianbo Shi.

- Normalized diversification (safe interpolation & active extrapolation): a complete and closed mapping of the output space.
- Modeling cross-domain alignment between deformed pose domain and warped image domain.

Tsinghua University – Beijing, China

Sep 2017 – Sep 2018

Intelligent Vision Group (IVG), Advised by Prof. Jiwen Lu.

- Conditional single-view shape modeling for multi-view reconstruction via multi-view consistency optimization.
- Developed an improved evaluation framework to partially address the problem of FID.

Sensetime – Beijing, China

Jun 2017 – Mar 2018

[Research Intern] Group "Video Intelligence" (camera department), Advised by Dr. Hongwei Qin.

- Major developer of a complete online real-time system for face identification in the wild (already been applied to market products). This involves video object detection, visual tracking, and face analysis.

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PUBLICATIONS (* indicates equal contribution.)

5. **Shaohui Liu**, Yinda Zhang, Songyou Peng, Boxin Shi, Marc Pollefeys and Zhaopeng Cui, "DIST: Rendering Deep Implicit Signed Distance Function with Differentiable Sphere Tracing". In CVPR, 2020.
4. Wang Zhao, **Shaohui Liu**, Yezhi Shu and Yong-Jin Liu, "Towards Better Generalization: Joint Depth-Pose Learning without PoseNet". In CVPR, 2020.
3. Ze Yang*, **Shaohui Liu***, Han Hu, Liwei Wang and Stephen Lin, "RepPoints: Point Set Representation for Object Detection", In ICCV, 2019.
2. **Shaohui Liu***, Xiao Zhang*, Jianqiao Wang and Jianbo Shi, "Normalized Diversification", In CVPR, 2019.
1. Yi Wei*, **Shaohui Liu***, Wang Zhao*, Jiwen Lu and Jie Zhou, "Conditional Single-view Shape Generation for Multi-view Stereo Reconstruction", In CVPR, 2019.

SELECTED PROJECTS

5. **A Differentiable Renderer on Implicit Signed Distance Function**⁵ Jul 2019 – Nov 2019
Computer Vision and Geometry Group (CVG), ETH Zurich. Led by Prof. Marc Pollefeys. To appear in CVPR 2020 (First-author).
 - Proposed a novel differentiable sphere tracing algorithm to efficiently render 2D observations over implicit signed distance function and enable effective inverse optimization over learned shape priors on both single-view and multi-view applications.
 - Achieved great generalization on 3D reconstruction against various noise and showed texture re-rendering applications on object-level 2nd view synthesis, relighting and super resolution. <https://arxiv.org/abs/1911.13225>
4. **RepPoints: Representing 2D Objects with Ordered Point Sets**³ Dec 2018 – Jul 2019
Visual Computing Group, Microsoft Research Asia. Led by Dr. Han Hu & Dr. Steve Lin. In ICCV 2019 (First-author).
 - Learning a set of 2D representative points enabled both aligned feature extraction and flexible geometric representation for top-down object detection, contour matching, instance segmentation and geometric/semantic correspondence. Achieved an effective single-shot object detector without need of anchors and bounding boxes. <https://arxiv.org/abs/1904.11490>
3. **Normalized Diversification**² Jul 2018 – Feb 2019
GRASP Lab, University of Pennsylvania. Remotely advised by Prof. Jianbo Shi. In CVPR 2019 (First-author).
 - Studied generative modeling and proposed *normalized diversification*, a complete and closed mapping of the output space which measures the divergence with respect to both the latent space and the output space. Used as a soft constraint, this term simultaneously encourages safe interpolation in the latent space and active extrapolation towards the outer important states.
 - Outperformed strong baselines on multiple vision tasks including image synthesis, conditional image translation and hand pose estimation, etc. <https://arxiv.org/abs/1904.03608>
2. **Conditional Single-view Shape Generation for Multi-view Reconstruction**¹ Mar 2018 – Nov 2018
IVG, Tsinghua University. Advised by Prof. Jiwen Lu. In CVPR 2019 (First-author). <https://arxiv.org/abs/1904.06699>
 - Modeled the ambiguity of a single RGB image with an implicit conditional generative model with partial supervision only on the frontal part with respect to the perspective camera.
 - Performed online optimization at inference by considering deterministic multi-view reconstruction as taking the intersection of the spanned spaces of multiple conditional models under object-centric coordinate space.
1. **Project August: Efficient Multi-Frame Aggregation for Robust Tracking** Jun 2017 – Dec 2017
Sensetime. Led by Dr. Hongwei Qin.
This project has been applied to market products. [Short demo: <https://www.youtube.com/watch?v=OK33HHoVd7E>]
 - Studied regression-based methods and proposed a flexible tracking framework using efficient multi-frame aggregation, where we cached, reused and shared the intermediate features on video processing.
 - Integrated and delivered the project to real-world market products with more than 1k fps face tracking on CPU.

TECHNICAL SKILLS

Programming: C/C++, Python, MATLAB, R, HTML/CSS, JavaScript, SQL, Verilog, L^AT_EX, Linux/Unix
Language: Mandarin, English (fluent, GRE: Verbal 152 AW 4.0)