

Zhuo Hui (Harry)

Personal Information

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Education

PhD, Carnegie Mellon University (CMU), **2014–2019**

Electrical and Computer Engineering.

GPA: 3.90/4.00

MSc, Carnegie Mellon University (CMU), **2012–2013**

Electrical and Computer Engineering.

GPA: 3.83/4.00

BEng (First Hons), The Hong Kong Polytechnic University, **2006–2011**

Electronics and Information Engineering.

GPA: 3.75/4.00

Working Experience

Facebook (Jun 2020 - Now) Seattle, WA

Senior Applied Research Scientist, Facebook Reality Lab

Project: AR/VR, Image processing and Machine learning.

SenseBrain Research (Apr 2019 - Jun 2020) San Jose, CA

Research Scientist, Computational Photography Group

Project: Mobile image denoising, Super-resolution, Demosaicing, HDR imaging.

Adobe Research (May 2016 - Aug 2016) San Jose, CA

Research Intern, Procedural Imaging Group (Mentor: Kalyan Sunkavalli, Joon-Young Lee, Sunil Hadap)

Project: Material capture in the wild

Adobe Research (Jun 2015 - Sept 2015) San Jose, CA

Research Intern, Procedural Imaging Group (Mentor: Kalyan Sunkavalli, Sunil Hadap)

Project: Image editing using flash photography

Technical Skills

Programming Python, C/C++, Objective-C, Java, Swift, Kotlin

Platform and Tools Pytorch, OpenCV, CUDA, OpenCL, OpenGL, MATLAB

Projects

Burst Image Denoising and Super-Resolution SenseBrain Research

- Aim to develop the algorithm suited for mobile device to denoise the captured image as well as to enhance the resolution under low-light with object motion.
- Provide a robust physical based model to align the multiple images and enable the capability in the image quality enhancement.
- Propose a novel learning-based method in enhancing the resolution as well as reducing the noising via the multiple images from Bayesian approach.

Learning based Images Demosaicing SenseBrain Research

- Aim to develop the algorithm suited for mobile device to better regress the RGB image from single or multiple novel bayer patterns.
- Provide a data-driven approach by progressively refining the intermediate results and lead to a better performance than the state-of-the-art methods.
- Provide a physical based prior to enhance the image quality and ship the algorithm to the product.
- Propose an end-to-end architecture to directly regress the RGB output from raw bayer pattern.

Learning to Separate the Illumination From a Single Photograph Adobe Research

- Aim to develop the algorithm to decompose the image under complex illumination into several photographs each under single light source.
- Design a multi-stage network architecture by incorporating the physical prior to constrain the underlying estimation.
- Provide a theoretical proof as well as a closed-form solution to the highly ill-posed problem by leveraging the flash unit on the mobile device.

Material Capture in the Wild

Adobe Research

- Aim to develop the algorithm suited for the commodity and light-weight setup to reconstruct surface normals and spatially-varying BRDFs of near-planar material samples.
- Perform a comprehensive theoretical and empirical analysis of the identifiability of BRDFs given sparse samples from a collocated setup.
- Propose a robust optimization scheme to recover per-pixel normals and BRDFs of near-planar real-world materials from images captured with a collocated setup.

Image Editing Using Flash Photography

Adobe Research

- Aim to white balance the images captured in a complex spatially varying combination of multiple illuminants by leveraging flash photography.
- Leverage the flash photograph to derive a closed-form solution for the perpixel white balancing kernel. The technique is completely automatic and makes no assumptions about the number or nature of the illuminants.
- Propose an extension of our scheme to handle practical challenges such as shadows, specularities, as well as the camera and scene motion.
- Showcase the accuracy of the proposed white balancing technique on a wide range of scenes.

Shape and Reflectance Estimation for Visual Complex Objects

Carnegie Mellon University

- Aim to address the problem of estimating the shape of objects that exhibit spatially-varying reflectance under a fixed view-point and varying illumination, i.e., the setting of photometric stereo.
- Propose the use of a dictionary of BRDFs to regularize the surface normal and SV-BRDF estimation. The BRDF at each pixel of an object is assumed to lie in the non-negative span of the dictionary atoms.
- Show that the surface normal at each pixel can be efficiently estimated using a coarse-to-fine search and further refined using a gradient descent based algorithm.
- Showcase the proposed SV-BRDF estimation technique on a wide range of simulated and real scenes and demonstrate that the proposed technique outperforms state-of-the-art methods.

Selected Publications

Journal Paper

- **Zhuo Hui**, and Aswin Sankaranarayanan. Shape and Spatially-Varying Reflectance Estimation From Virtual Exemplars. *IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI)*, vol. 39 (10), pp. 2060-2073, 2017.
- **Zhuo Hui**, Wenbo Liu, and Kin-Man Lam. A Novel Correspondence-based Face-hallucination Method. *Image and Vision Computing (IVC)*, vol. 60, pp. 171-184, 2017.
- **Zhuo Hui** and Kin-Man Lam. Eigentranformation-based Face Super Resolution in the Wavelet Domain. *Pattern Recognition Letters (PRL)*, vol. 33, pp. 718-727, 2012.

Conference Paper

- Anqi Yang, Feng Pan, Vishwanath Saragadam, Duy Dao, **Zhuo Hui**, Jen-Hao Chang and Aswin Sankaranarayanan. SliceNets — A Scalable Approach for Object Detection in 3D CT Scans. *Winter Conference on Applications of Computer Vision (WACV 2021)*
- **Zhuo Hui**, Ayan Chakrabarti, Kalyan Sunkavalli and Aswin Sankaranarayanan. Learning to Separate Multiple Illuminants in a Single Image. *IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2019)*
- **Zhuo Hui**, Kalyan Sunkavalli, Sunil Hadap and Aswin Sankaranarayanan. Illuminant Spectra-based Source Separation Using Flash Photography. *IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2018)* **Oral**, acceptance rate 2.1%
- **Zhuo Hui**, Kalyan Sunkavalli, Joon-Young Lee, Sunil Hadap, Jian Wang and Aswin Sankaranarayanan. Reflectance Capture using Univariate Sampling of BRDFs. *IEEE International Conference on Computer Vision (ICCV 2017)*
- **Zhuo Hui**, Aswin Sankaranarayanan, Kalyan Sunkavalli and Sunil Hadap. White Balance under Mixed Illumination using Flash Photography. *IEEE International Conference on Computational Photography (ICCP 2016)*
- **Zhuo Hui**, and Aswin Sankaranarayanan. A Dictionary-based Approach for Estimating Shape and Spatially-Varying Reflectance. *IEEE International Conference on Computational Photography (ICCP 2015)*
- Zhiding Yu, Weiyang Liu, Wenbo Liu, Xi Peng, **Zhuo Hui**, and B.V.K. Vijaya Kumar. Generalized Transitive Distance with Minimum Spanning Random Forest. *International Joint Conference on Artificial Intelligence (IJCAI 2015)*
- Zhiding Yu, Chunjing Xu, Deyuan Meng, **Zhuo Hui**, Fanyi Xiao. Transitive Distance Clustering with K-Means Duality *IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2014)*

- o **Zhuo Hui** and Kin-Man Lam. Multi-view face hallucination based on sparse representation *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP 2013)*
- o **Zhuo Hui** and Kin-Man Lam. An efficient local-structure-based face-hallucination method *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP 2012)*
- o **Zhuo Hui** and Kin-Man Lam. Two-stage Patch-based Multi-View Face Super-resolution *APSIPA Annual Summit Conference (ASC 2011)*
- o **Zhuo Hui** and Kin-Man Lam. Wavelet-based eigentransformation for face super-resolution *Pacific-Rim Conference on Multimedia (PCM 2010)*

Patents

Material capture using imaging Patent number: 10818022

Local white balance under mixed illumination using flash photography Patent number: 10070111

Lighting and material editing using flash photography Patent number: 9781399

Honors and Awards

Graduation with First honors

Awarded to the top 5% of Seniors in The Hong Kong Polytechnic University

Technical Excellence Award in Honor Project

Awarded to the top 3 Students in Final Year Project Competition in The Hong Kong Polytechnic University

Best GPA award 2006 - 2011

Awarded to the top 3 Students with highest cumulative GPA

Dean's List 2006 - 2011

Awarded to the Students with semester GPA larger than 3.5

First Prize in Liaoning Province in National Mathematics Olympiads

Awarded to the top 20 high school students on the Mathematics Competition in the whole province

Courses and Teaching

Courses Taken:

Artificial Intelligence, Computer Vision, Computer Graphics, Machine Learning, Pattern Recognition

Nonlinear Optimization, Digital Signal Processing, Compressive Sensing, Linear Systems, Intermediate Statistics

Teaching Assistant:

Image and Video Processing, CMU 18793,

Fall 2017

Instructor: Prof. Aswin Sankaranarayanan.

Signal and Systems, CMU 18290,

Fall 2015

Instructor: Prof. Byron Yu and Prof. Pulkit Grover.

Nonlinear Optimization, CMU 18799-B,

Spring 2013

Instructor: Prof. Joao Paulo Costeira and Prof. João Xavier.

References

Prof. Aswin Sankaranarayanan

Carnegie Mellon University

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Dr. Kalyan Sunkavalli

Adobe Research

sunkaval@adobe.com