

# 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

Applied Research Scientist, Computational Photography Group

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)*

- **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)
- **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)
- **Zhuo Hui** and Kin-Man Lam. Two-stage Patch-based Multi-View Face Super-resolution *APSIPA Annual Summit Conference* (ASC 2011)
- **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. Pulkrit Grover.

**Nonlinear Optimization**, *CMU 18799-B*,

**Spring 2013**

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

## References

Prof. Aswin Sankaranarayanan

Dr. Kalyan Sunkavalli

Carnegie Mellon University

Adobe Research

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