

Chloe A. LeGendre

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RESEARCH STATEMENT I develop and apply computer vision and computational photography techniques to solve problems in computer graphics, towards the goal of creating compelling, photo-realistic content for people to enjoy.

RESEARCH INTERESTS Computational Photography, Appearance Capture, Lighting Capture, Color Imaging & Measurement, Computer Vision for Computer Graphics

EDUCATION **University of Southern California**, Los Angeles, CA **August 2015 - May 2019**
Ph.D., Computer Science; GPA: 3.82
Dissertation: "Compositing Real and Virtual Objects with Realistic, Color-Accurate Illumination"

Stevens Institute of Technology, Hoboken, NJ **September 2012 - May 2015**
M.S., Computer Science; GPA: 4.00

University of Pennsylvania, Philadelphia, PA **September 2005 - May 2009**
B.S. in Engineering; GPA: 3.69

PROFESSIONAL EXPERIENCE **Netflix**, Los Angeles, CA **Aug 2021 - present**
Staff Research Scientist - Production Innovation

- Core technology research and development for virtual production and visual effects using machine learning and computational photography techniques.

Google Research, Los Angeles, CA **June 2020 - July 2021**
Senior Software Engineer - Computational Photography

- Core technology research and development for computational photography.
- Developed machine learning based [lighting estimation module](#) for the [Portrait Light](#) feature, a hero launch for the Google Pixel 2020 phone in both Google Camera and Google Photos.

Google Daydream (VR/AR), Los Angeles, CA **June 2019 - June 2020**
Software Engineer - Augmented Reality

- Core technology research and development for mobile AR.

Student Researcher - Augmented Reality **December 2017 - May 2019**

- ML-based lighting estimation technique was published at CVPR 2019 and shipped as the [Environmental HDR Lighting Estimation module for ARCore](#) in June 2019.
- Trained ML models using distributed Tensorflow environment.

Software Engineering Intern - Augmented Reality **June 2017 - August 2017**

- Developed mobile AR lighting estimation techniques for Google Pixel Phone's AR Stickers camera mode (Playground).
- Developed software in Unity (C#), OpenGL/GLSL, and C++.

USC Institute for Creative Technologies, Playa Vista, CA **August 2015 - May 2019**
Graduate Research Assistant

- Advisor: Professor Paul Debevec

- Research topics: Multispectral imaging, lighting reproduction, computational photography, appearance capture, spectroscopy, high-resolution facial scanning.
- Led high resolution facing scanning efforts for film production clients, including training lab technicians and directing high profile actors (2016 - 2017).
- Led cloud-based rendering efforts to develop datasets for deep learning.

Stevens Institute of Technology, Hoboken, NJ
Adjunct Faculty Member (Computer Science)

January 2021 - May 2021

- Developed and taught CS-537: “Interactive Computer Graphics with WebGL”

Graduate Research Assistant (part-time, CS)

January 2014 - July 2015

- Advisor: Professor Philippos Mordohai
- Research topics: 3D reconstruction, binocular and multiview stereo vision from video and high resolution images.

L’Oréal USA Research & Innovation, Clark, NJ

Senior Scientist I/II, Emerging Technologies

May 2013 - June 2015

- Sourced core computer vision technology partner for *Makeup Genius*, an augmented reality mobile application that uses facial feature tracking to virtually apply cosmetic products in real time (over 20M downloads globally).
- Developed embedded machine learning algorithms for *Skintone Pro*, a low-cost spectrophotometer device for cosmetic product recommendations (US Patent 9,924,778).

Scientist, Instrumentation and Imaging Laboratory

September 2011 - April 2013

- Developed instrumentation and imaging methods for skin health assessment.

Johnson & Johnson Consumer Products Company, Skillman, NJ

Scientist I/II, R&D Leadership Program

June 2009 - August 2011

- Developed instrumentation and imaging methods for skin health assessment.

SELECTED PUBLICATIONS

LeGendre C., Lepicovsky L., and Debevec P. Jointly Optimizing Color Rendition and In-Camera Backgrounds in an RGB Virtual Production Stage. The Digital Production Symposium (DigiPro) 2022.

Debevec P. and **LeGendre C.** HDR Lighting Dilation for Dynamic Range Reduction on Virtual Production Stages. SIGGRAPH 2022 Posters.

Weidlich A., **LeGendre C.**, Aliaga C., Hery C., Aubry J-M., Vorba J., Siragusano D., and Kirk, R. Practical Aspects of Spectral Data in Digital Content Production. SIGGRAPH 2022 Courses.

Pandey R.*, Escolano S-O.*, **LeGendre C.***, Haene C., Bouaziz S., Rhemann C., Debevec P., and Fanello S. Total Relighting: Learning to Relight Portraits for Background Replacement. ACM Transactions on Graphics (TOG), 40, 4 (August): 43 (SIGGRAPH 2021). [* denotes equal contributions]

LeGendre C., Ma W-C., Pandey R., Fanello S., Rhemann C., Dourgarian J., Busch J., and Debevec P. Learning Illumination from Diverse Portraits. ACM SIGGRAPH Asia Technical Communications 2020.

Meka A., Pandey R., Häne C., Orts-Escolano S., Barnum P., Davidson P., Erickson D., Zhang Y., Taylor J., Bouaziz S., **LeGendre C.**, Ma W-C., Overbeck R., Beeler

R., Debevec P., Izadi S., Theobalt C., Rhemann C., and Fanello S. Deep Relightable Textures: Volumetric Performance Capture with Neural Rendering. ACM SIGGRAPH 2020.

LeGendre C., Ma, W-C., Fyffe, G., Flynn, J., Charbonnel, L., Busch, J. and Debevec, P. 2019. DeepLight: Learning Illumination for Unconstrained Mobile Mixed Reality. CVPR 2019.

LeGendre C., Ma, W-C., Fyffe, G., Flynn, J., Charbonnel, L., Busch, J. and Debevec, P. 2019. DeepLight: Learning Illumination for Unconstrained Mobile Mixed Reality. SIGGRAPH 2019 Talks.

Zhao, Y., Huang Z., Li, T., Chen, W., **LeGendre C.**, Ren, X., Xing, J., Shapiro, A. and Li, H. Learning Perspective Undistortion of Portraits. ICCV 2019.

LeGendre C., Bladin, K., Kishore, B., Ren, X., Yu, X., and Debevec, P. 2018. Efficient Multispectral Facial Capture With Monochrome Cameras. In ACM SIGGRAPH 2018 Posters, ACM, SIGGRAPH 2018. [*3rd Place Winner, Graduate Category, ACM SIGGRAPH 2018 Student Research Competition*]

Huang Z., Li, T., Chen, W., Zhao, Y., Xing, J., **LeGendre C.**, Luo, L., Ma, C., and Li, H. 2018. Deep Volumetric Video From Very Sparse Multi-View Performance Capture. European Conference on Computer Vision (ECCV) 2018.

LeGendre C., Bladin, K., Kishore, B., Ren, X., Yu, X., and Debevec, P. 2018. Efficient Multispectral Facial Capture With Monochrome Cameras. In Proc. of IS&T Color Imaging Conference (CIC) 26, 2018. [*Best Student Paper Award*]

LeGendre C., Krissman, D., and Debevec, P. 2017. Improved Chromakey of Hair Strands via Orientation Filter Convolution. SIGGRAPH 2017 Posters. [*1st Place Winner, Graduate Category, ACM SIGGRAPH 2017 Student Research Competition*]

LeGendre C., Bastos, K., and Mordohai, P. 2017. High-Resolution Stereo Matching based on Sampled Photoconsistency Computation. British Machine Vision Conference 2017.

LeGendre C., Hyunh, L., Wang, S., and Debevec, P. 2017. Modeling Vellus Facial Hair from Asperity Scattering Silhouettes. SIGGRAPH 2017 Talks.

LeGendre C., Yu, X., and Debevec, P. 2017. Optimal LED Selection for Multispectral Lighting Reproduction. In Proc. of IS&T Electronic Imaging 2017 Material Appearance Conference. [*Best Student Paper Award*]

Holm, J., Maier, T., Debevec, P., **LeGendre C.**, Pines, J., Erland, J., Joblove, G., Dyer, S., Sloan, B., di Gennaro, J., and Sherlock, D. 2016. A Cinematographic Spectral Similarity Index. In Proc. of Annual Technical Conference & Exhibition, Society of Motion Picture and Television Engineers (SMPTE) 2016.

LeGendre C., Yu, X., Liu, D., Busch, J., Jones, A., Pattanaik, S., and Debevec, P. 2016. Practical Multispectral Lighting Reproduction. ACM Transactions on Graphics (TOG), 35, 4 (July): 32 (SIGGRAPH 2016).

LeGendre C., Yu, X., and Debevec, P. 2016. Optimal LED Selection for Multispectral Lighting Reproduction. In ACM SIGGRAPH 2016 Posters, ACM, SIGGRAPH 2016.

LeGendre C., Yu, X., and Debevec, P. 2016. Efficient Multispectral Reflectance Function Capture for Image-Based Relighting. In Proc. of IS&T Color Imaging Conference (CIC) 24, 2016.

REVIEWER	ACM SIGGRAPH 2017, 2020, 2021, 2022 ACM SIGGRAPH Asia 2020, 2022 ACM Transactions on Graphics (TOG) 2017, 2021, 2022 IEEE Transactions on Computer Graphics and Visualization 2020 IS&T Color Imaging Conference 2017, 2018, 2019, 2022.
TEACHING ASSISTANTSHIP	CSCI 576 - Multimedia Systems Design (TA, Spring 2018, USC) CSCI 420 - Computer Graphics (TA, Fall 2017, USC)
HONORS AND AWARDS	Annenberg Ph.D. Fellowship, University of Southern California (2015 - 2019). First Runner Up, ACM SIGGRAPH Thesis Fast Forward (2019). First Place, Graduate, ACM SIGGRAPH Student Research Competition (2017). Best Student Paper, IS&T Color Imaging Conference (2018). Best Student Paper, IS&T Electronic Imaging Conference (2017). Runner-up, Best Student Paper, IS&T Color Imaging Conference (2016). USC Stevens Center for Innovation Commercialization Award (2017, 2018).
INVITED TALKS AND LECTURES	“Jointly Optimizing Color Rendition and In-Camera Backgrounds in an RGB Virtual Production Stage.” USC Entertainment and Technology Center, Innovation Conference, August 2022. “Relighting Portraits Using Machine Learning.” UW Reality Lab, Feb 2022. “Lighting Virtual Objects using Machine Learning.” MPI Perceiving Systems Group, May 2021. “Learning to Estimate Environmental Lighting.” Brown University, February 2021. “Learning to Estimate Environmental Lighting.” CVPR Tutorial on Disentangled 3D Representations for Relightable Performance Capture of Humans, June 2020. “DeepLight: Learning Illumination for Unconstrained Mobile Mixed Reality.” USC Entertainment and Technology Center, Innovation Conference, August 2019. “DeepLight: Learning Illumination for Unconstrained Mobile Mixed Reality.” IEEE AIVR Workshop on Capturing and Rendering Digital Humans for AR/VR. December 2019. “Lighting Real and Virtual Humans.” USC CSCI 576 Multimedia Systems Design, guest lecture with Professor Parag Havaladar. October 2017 and April 2018. “Global Illumination in Rendering.” USC CSCI 420 Computer Graphics, guest lecture with Professor Hao Li. October 2017. “Multispectral Lighting and Relighting.” Imperial College, London, UK, Realistic Graphics and Imaging Group. September 2017. “Practical Multispectral Lighting Reproduction.” Digital Domain, Los Angeles, CA. July 2016.

PATENTS G. Balooch, **C. LeGendre**, W. Jung, R. Jung, W. Sloan, P. Patel, and A. Loudermilk. Systems and Methods for Measuring Spectra of Skin and Other Objects and Materials and Making Predictions Based Thereon. US Patent 9,924,778.

P. Debevec, **C. LeGendre**, and S. Pattanaik. Multispectral Lighting Reproduction. US Patent 10,375,264.

C. LeGendre, I. Neulander, and P. Debevec. Lighting for Inserted Content. US Patent 10,922,878.

C. LeGendre, R.K. Ananda, R. Tao, W. Meeussen. Machine Learning Inference on Gravity Aligned Imagery. US Patent 11,069,075.

C. LeGendre, L. Charbonnel, C. Tong, K.N.J. Tsotsos, W-C. Ma, P. Debevec. Compute Amortization Heuristics for Lighting Estimation for Augmented Reality. US Patent 11,288,844.

PROGRAMMING C++, OpenCV, Python, Tensorflow.

SOFTWARE Nuke, Maya, Arnold Renderer, Adobe Creative Suite.

LANGUAGE English (native), French (proficient).

VISUAL EFFECTS Blade Runner 2049 (2017)

CREDITS Logan (2017)
Valerian and the City of a Thousand Planets (2017)