

Chia-Kai Liang

<http://chiakailiang.org>

EXPERIENCES

- ◆ **Senior Staff Software Engineer**, Google Inc., Nov 2017 – present
- ◆ **Staff Software Engineer**, Google Inc., Aug 2015 – Oct 2017
 - Develop core computational photography features for mobile products and Android platforms
 - ◆ **Management:**
 - Lead the Android camera algorithm team to deliver high-quality features for Android platform and Google hardware products.
 - Collaborate with engineering and research teams across Google and hardware/SOC vendors to enable new features. Define the specification for several parts in the product.
 - ◆ **Engineering:**
 - Develop the core algorithms and architecture for mobile imaging features.
 - Characterize and optimize the camera pipeline performance.
 - Design and prototype the new feature and algorithms for future products.
 - ◆ **Product feature: *Face Distortion Correction***
 - Deliver the world-first, fully automatic, face-aware image distortion correction for Pixel 3. The solutions uses ML for portrait extraction, and computational geometry and optimization to find the optimal correction for each image with minimal distortions for all subjects.
 - The feature is critical for the wide-angle group selfie on Pixel 3, and is highly appreciated by many users and reviewers.
 - ◆ **Product feature: *Face Stabilization***
 - Deliver the real-time, WYSIWYG, face-centric video stabilization for Pixel 3. The solution combines efficient ML-based face landmark tracking, joint filtering and rolling shutter correction.
 - ◆ **Product feature: *Auto FPS***
 - Deliver the full pipeline to enable automatic FPS recording for Pixel 3. The system involves changes across the full camera stack: from 3A, sensor, HAL, framework, camera app, to the video encoder.
 - ◆ **Product feature: *Video Stabilization***
 - Deliver the real-time video stabilization project for Nexus 6p, Pixel, Pixel 2, and Pixel 3. The solution combines optical image stabilizer, machine-learning based motion filtering, and joint pipeline optimization.
 - The feature is critically acclaimed by press and reviewers and ranked #1 on the DxOMark benchmark in 2016, 2017, and 2018. The technique has been adapted into other Google projects and products.
 - ◆ **Product feature: *Video Denoising***
 - Deliver the real-time video denoising project for Pixel 2 and Pixel 3. The solution is a new and efficient non-linear recursive motion compensated temporal filtering and implemented with GPU-CPU joint processing.
 - This feature enables Pixel 2 to achieve the highest video noise and texture scores on the DxOMark benchmark in 2017 and 2018.
 - ◆ **Product feature: *Flare Detection and Removal***
 - Deliver the algorithm to automatically detect and remove the flare from the image for Google Pixel. The solution uses a Gaussian mixture model and a non-linear optimization framework to

estimate model parameters from a single photo. It is integrated into the HDR+ pipeline.

- ♦ **Architect, Computational Photography**, Lytro Inc., May 2013 – Aug 2015
- ♦ **Member of Technical Staff**, Lytro Inc., Nov 2010 – April 2013

Developed core algorithms for light field cameras, lead engineers for various product features, and conducted long-term researches on computational photography.

- ♦ **Product:** *Lytro ILLUM*, released at July 2014
The world-first prosumer level light field camera
 - ♦ **Management:**
Jointly led the team of 10 people to deliver the improved light field processing pipeline, including new saturation pixel handling, microlens vignetting correction, depth map estimation, and so forth.
Consolidated the schedule and coordinate with members and other teams for prioritization and bottleneck identification.
 - ♦ **Engineering:**
Participated in the design of lens specific to the light field camera.
Revised light field file format and user interaction model.
Defined and develop the core algorithms for new features.
 - ♦ Product feature: *High-Quality Virtual Camera Rendering*
Designed a new rendering algorithm to render high-quality images from light field with arbitrary camera parameters: viewpoint, f-number, focus distance, focus spread, and sensor tilt
Main components are focus-adaptive anti-aliasing, image-domain occlusion handling, depth/spatially-variant reconstruction/enhancement, and post-processing for artifact suppression.
 - ♦ Product feature: *Digital Lens Aberration Correction*
Corrected lens aberration of arbitrary orders during image reconstruction from light field.
Designed and estimate the 4D aberration correction model by ray-tracing.
Modeled the zoom- and focus- dependent lens aberration profiles with high-quality compression. Optimized the aberration correction process on CPU/GPU.
 - ♦ Product feature: *Real-Time Depth Assist*
Sparse depth map estimation and visualization at live-view.
Designed and implemented the gradient-based depth estimation algorithm.
Optimization to achieve 10+FPS on Qualcomm Snapdragon 800 by SIMD and multi-threading.
 - ♦ Product feature: *Flare Detection and Removal*
Automatically detected the flare corruption(s) in the light field and remove it.
Designed the prototype algorithm and work with the engineer for the product version.
- ♦ **Product:** *the Lytro light field camera*, released at 2012
The world-first consumer level light field camera.
Participate in the full development cycle of the product, including early prototyping, part selection, software light field/image processing pipeline design and optimization, manufacture test design/definition, and image quality evaluation/tuning.
 - ♦ Product feature: *Perspective Shift*
Developed the core algorithms for perspective-shift image creation, including occlusion detection and handling, spatially-variant image reconstruction, optimal parameter setting, depth score regression, etc.
Prototyped the player system and evaluate several different rendering approaches.
Define the file format and end-to-end dataflow (from camera to desktop to web/cloud).

Coordinate numerous engineer teams for delivery on-time.

- ◆ **Product feature: *Living Filter***
Designed the software architecture for Instagram-style light field filters that animate with user interaction. Two proposed filters, virtual glass and depth-aware mosaicking, were picked in the final release.
- ◆ **Core light field processing algorithm development**
Light field processing: demosaicing, photometric calibration, and depth estimation.
Image processing: white balance, filtering, sharpening, color/tone enhancement, etc.
Algorithms for manufacture testing: microlens defect detection, microlens array geometry calibration, light field camera resolution estimation, sensor characterization, etc.
Performance optimization using multi-threading, SSE, and GPU.
- ◆ **Researches on computational photography**
Analysis and modeling on light field filtering and reconstruction (one journal paper)
Analysis and optimization of light field sampling (one journal paper).
High resolution light field reconstruction algorithm based on depth dependent deconvolution.
Predictive and standard compatible light field compression.
- ◆ **Processing pipeline architecture and API (cooperative work)**
Optimized the architecture for the CPU-based pipeline.
Designed and implemented the new GPU/CPU hybrid, asynchronous, pipeline system for automatic light field tiling and scheduling.
- ◆ **Military Service**, National Army of Taiwan, Oct 2009 – Sept 2010
- ◆ **Visiting Researcher/Postdoctoral Fellowship**, NTU CM Lab, Sept 2009 – Oct 2009
Developed content-aware stereoscopic image/video processing algorithms. Published one journal paper and one top conference paper.
- ◆ **Research Intern/ Visitor**, Nokia research center and Stanford graphics lab, Feb 2009 – July 2009
Camera 2.0 project. Developed the built-in panorama application for Nokia cell-phones. Designed a touch-based interactive image editing system. Published one journal and two conference papers.
- ◆ **VLSI Design Engineer**, AviSonic Inc, July 2005 – Sept 2007 (part-time)
Developed hardware architecture of real-time video denoising, face detector, digital image stabilizer and 3A blocks (with SystemC and Verilog). Evaluated the motion estimation ASIC architecture.
- ◆ **Research Assistant** of Prof. Homer H. Chen, NTU, 2005-2008
- ◆ **Teaching Assistant** at the Department of Electrical Engineering, National Taiwan University (NTU)
- ◆ **Internship** at Industrial Technology Research Institute (ITRI), July 2004 – Sept 2004

PUBLICATIONS AND PATENTS

DISSERTATION

Analysis, Acquisition, and Processing of Light Field for Computational Photography, defended at Dec. 3 2008

BOOK CHAPTER

High-Quality Light Field Acquisition and Processing

C.-K. Liang and H. H. Chen, *Computational Photography: Methods and Applications*

INTERNATIONAL JOURNAL PAPERS

1. Improving Light Field Camera Sample Design with Irregularity and Aberration
L.-Y. Wei, C.-K. Liang, G. Myhre, C. Pitts, and K. Akeley

- ACM Trans. Graphics (Proc. SIGGRAPH)*, 2015
2. A Light Transport Framework for Lenslet Light Field Cameras
C.-K. Liang and R. Ramamoorthi
ACM Trans. Graphics, 2015
 3. Single Image Realism Assessment and Recoloring by Color Compatibility
B.-Y. Wong, K.-T. Shih, C.-K. Liang, and H. H. Chen
IEEE Trans. Multimedia, 2012
 4. Content-Aware Display Adaptation and Interactive Editing for Stereoscopic Images
C.-H. Chang, C.-K. Liang, and Y.-Y. Chuang
IEEE Trans. Multimedia, 2011
 5. Hardware-Efficient Belief Propagation
C.-K. Liang, C.-C. Cheng, Y.-C. Lai, H. H. Chen, and L.-G. Chen
IEEE Trans. CSVT, 2011
 6. Light Field Analysis for Modeling Image Formation
C.-K. Liang, Y.-C. Shih, and H. H. Chen
IEEE Trans. Image Processing, 2011
 7. TouchTone: Interactive Tonal Adjustment Using Point-and-Swipe
C.-K. Liang, W.-C. Chen, and N. Gelfand
Computer Graphics Forum, 2010
 8. Image Enhancement for Backlight-Scaled TFT-LCD Displays
P.-S. Tsai, C.-K. Liang, T.-H. Huang, and H. H. Chen
IEEE Trans. CSVT, 2009
 9. Programmable Aperture Photography: Multiplexed Light Field Acquisition
C.-K. Liang, T.-H. Lin, B.-Y. Wong, C. Liu, and H. H. Chen
ACM Trans. Graph. (Proc. SIGGRAPH), 2008
 10. Analysis and Compensation of Rolling Shutter Effect
C.-K. Liang, L. Chang, and H. H. Chen
IEEE Trans. Image Processing, 2008
 11. Integration of Digital Stabilizer with Video Codec for Digital Video Cameras
2008 IEEE Circuits and Systems Society CSVT Best Paper Award
H. H. Chen, C.-K. Liang, Y.-C. Peng, and H.-A. Chang
IEEE Trans. CSVT, 2007

SELECTED CONFERENCE PAPERS

1. Real-time Video Denoising on Mobile Devices
J. Ehmann, L.-C. Chu, S.-F. Tsai, and C.-K. Liang, *Proc. ICIP*, 2018
2. 3D Cinematography Principles and Their Applications to Stereoscopic Media Processing
C.-W. Liu, T.-H. Huang, M.-H. Chang, K.-Y. Lee, C.-K. Liang, and Y.-Y. Chuang
ACM Multimedia, 2011
3. Efficient Message Reduction Algorithm for Stereo Matching using Belief Propagation
Y.-C. Lai, C.-C. Cheng, C.-K. Liang, and L.-G. Chen, *Proc. ICIP*, 2010
4. Architecture Design of Stereo Matching using Belief Propagation
C.-C. Cheng, C.-T. Li, C.-K. Liang, Y.-C. Lai, and L.-G. Chen, *Proc. ISCAS*, 2010
5. Learning Landmarks by Exploiting Social Media

C.-K. Liang, Y.-T. Hsieh, T.-J. Chuang, Y. Wang, M.-F. Weng, and Y.-Y. Chuang
Lecture Notes in Computer Science 5916 (Proc. 16th MMM), 2010

6. Panoramic Imaging System for Camera Phones
K. Pulli, C.-K. Liang, M. Tico, X. Wang, and Y. Xiong, *Proc. ICCE*, 2010
7. Realism Assessment of Color Compatibility using a Single Image
B.-Y. Wong, C.-K. Liang, T.-H. Lin, and H. H. Chen, *Proc. ICIP*, 2009
8. Hardware-Efficient Belief Propagation *Doctoral Spotlight*
C.-K. Liang, C.-C. Cheng, Y.-C. Lai, H. H. Chen, and L.-G. Chen, *Proc. CVPR*, 2009
9. JND-Based Enhancement of Perceptibility for Dim Images
T.-H. Huang, C.-K. Liang, S.-L. Yeh, and H. H. Chen, *Proc. ICIP*, 2008
10. Image Quality Enhancement for Low Backlight TFT-LCD Displays
P.-S. Tsai, C.-K. Liang, and H. H. Chen, in *Proc. ICIP*, 2007
11. Light Field Acquisition using Programmable Aperture Camera
C.-K. Liang, G. Liu, and H. H. Chen, *Proc. ICIP*, 2007
12. Rolling Shutter Distortion Correction
C.-K. Liang, Y.-C. Peng and H. H. Chen, *SPIE Proc. VCIP*, 2005
13. Integration of Image Stabilizer and Video Encoder for Digital Video Cameras
Y.-C. Peng, C.-K. Liang, H.-A. Chang, C.-J. Kao and H. H. Chen, *Proc. ISCAS*, 2005

ISSUED PATENTS (SEVERAL OTHERS PENDING)

1. Compression of light field images,
K. Akeley, B. Bevense, C. Pitt, T. J. Knigh, C. W. Craddock, C.-K. Liang, 10038909, US 2018/07/31
2. Capturing light-field images with uneven and/or incomplete angular sampling
C. Pitts, C.-K. Liang, K. B. Akeley, US 10033986, 2018/07/24
3. Automatic Lens Flare Detection and Correction for Light-field Images,
J. Kuang, C.-K. Liang, US 9979909, 2018/05/22
4. Video Stabilization for Mobile Devices
C.-K. Liang, X. Tu, L.-C. Chu, and J. Wei, US 9888179, 2018/02/06
5. Depth-based Image Blurring
C.-K. Liang, K. Oberheuer, K. B. Akeley, G. Girod, K. Karnad, and F. A. Benevids Jr., US 9858649,
2018/01/02
6. Predictive Light Field Compression
C.-K. Liang, US 9712820, 2017/07/18
7. Light-Field Aberration Correction
C.-K. Liang, C. Pitts, C. Craddock, G. Myhre, US 9628684, 2017/04/18
8. Depth-Assigned Content for Depth-Enhanced Pictures
Y.-R. Ng, E. Cheng, C.-K. Liang, K. Fatahalian, D. J. Evans, K. Wampler, K. Berman, K. B. Akeley,
US 9607424, 2017/03/28
9. Robust Layered Light-Field Rendering
C.-K. Liang and C. Pitts, US 9444991, 2016/09/13
10. Calibration of Light-Field Camera Geometry via Robust Fitting
C.-K. Liang and Z. Wang, US 9420276, 2016/08/16

11. Compression of Light Field Images
K. Akeley, B. Bevensee, C. Pitts, T. J. Knight, C. Craddock, and C.-K. Liang, US 9414087, 2016/08/09
12. Plenoptic Camera Resolution
G. Myhre, C.-K. Liang, C. Pitts, C. Craddock, and Y.-R. Ng, US 9392153, 2016/07/12
13. Compensating for Sensor Saturation and Microlens Modulation during Light-Field Image Processing
K. B. Akeley, B. Cabral, C. Pitts, C.-K. Liang, B. Willburn, T. J. Knight, and Y.-R. Ng, US 9386288, 2016/07/05
14. Microlens Array Architecture for Avoiding Ghosting in Projected Images
C. Pitts, T. J. Knight, C.-K. Liang, and Y.-R. Ng, US 9172853, 2015/10/27
15. Capturing and Relighting Images using Multiple Devices
Y.-R. Ng, C.-K. Liang, K. B. Akeley, and B. Willburn, US 9001226, 2015/04/07
16. Parallax and/or Three-Dimensional Effects for Thumbnail Image Displays
C.-K. Liang, M. Knott, M. Marculescu, J. Wilson, and Y.-R. Ng, US 8997021 B2, 2015/03/31
17. Depth Determination for Light Field Images
C.-K. Liang, C. Pitts, K. B. Akeley, and A. Song, US 8988317, 2015/03/24
18. Generating Dolly Zoom Effect using Light Field Image Data
C. Pitts, T. J. Knight, C.-K. Liang, and Y.-R. Ng, US 8971625, 2015/03/03
19. Compensating for Sensor Saturation and Microlens Modulation during Light-Field Image Processing
K. B. Akeley, B. Cabral, C. Pitts, C.-K. Liang, B. Wilburn, T. J. Knight, and Y.-R. Ng, US 8948545, 2015/02/03
20. Compensating for Variation in Microlens Position during Light-Field Image Processing
C. Pitts, T. J. Knight, C.-K. Liang, and Y. -R. Ng, US 8831377, 2014/09/09
21. Extended Depth of Field and Variable Center of Perspective in Light-Field Processing
C. Pitts, T. J. Knight, C.-K. Liang, and Y. -R. Ng, US 8811769, 2014/08/09
22. Access to Control of Multiple Editing Effects
W.-C. Chen, N. Gelfand, and C.-K. Liang, US 8780134 B2, 2014/07/15
23. Stereo-Matching Processor using Belief Propagation
L.-G. Chen, C.-T. Li, C.-C. Cheng, C.-K. Liang, Y.-C. Lai, L.-H. Huang, US 8761491 B2, 2014/06/24
24. Photometric Calibration Method and Device
C.-K. Liang, H. H. Chen, B.-Y. Wong, and G. Liu, US 8406563 B2, 2013/03/26
25. Method of Realism Assessment of an Image Composite
B.-Y. Wong, H. H. Chen, C.-K. Liang, T.-H. Lin, US 8373721, 2013/02/12
26. Method and Apparatus of Tile-Based Belief Propagation
L.-G. Chen, C.-C. Cheng, C.-K. Liang, Y.-C. Lai, H. H. Chen, and L.-H. Huang, US 8249369, 2012/08/21
27. Low-Backlight Image Visibility Enhancement Method and System
P.-S Tsai, H. H. Chen, and C.-K. Liang, US 8026935, 2011/09/27
28. Digital Image Stabilization Method
H. H. Chen, C.-K. Liang, D. Yeh, and B. Sung, US 7956898, 2011/06/07

EDUCATION

2004 – 2009 Doctor of Philosophy – National Taiwan University
Advisor: Homer H. Chen

2000 – 2004 Bachelor of Science – National Taiwan University
Major: Electrical Engineering (with honors)

INVITED TALKS AND PUBLICATIONS

Google Research Blog, 2017

SIGGRAPH Silicon Valley Chapter, Santa Clara, CA, USA, 2014

CITI, Sinica, Taipei, Taiwan, 2010

EE Dept., National Tsing Hua University, Hsinchu, Taiwan, 2009

HP Labs, Palo Alto, CA, USA, 2009

Institute of Information Science, Academia Sinica, Taipei, Taiwan, 2008

Adobe Advanced Technology Labs, Seattle, WA, USA, 2008

Microsoft Research, Redmond, WA, USA, 2008

HONORS

2009 IICM Best PhD Dissertation Award

2009 NTU GICE Best PhD Dissertation Award

2009 Honorary Member of the Phi Tau Phi Scholastic Honor Society

2009 IPPR Best PhD Dissertation Award

2009 IEEE Computer Society Conference CVPR Doctoral Spotlight (US \$600)

2008 Travel Grant from Foundation for Advancement of Outstanding Scholarship (US \$2000)

2008 IEEE Circuits and Systems Society CSVT Best Paper Award (US \$2000 for 4 authors)

2007 5th Ennovation Contest First Prize (US \$3000)

2005 MiTac Technology Scholarship (US \$350 each month for two years)

2004, 2005 Class A Scholarship, Graduate Institute of Communication Engineering, NTU

Presidential Award of the 2003 1st semester in EE dept., NTU (top 5%)

Presidential Award of the 2001 1st semester in EE dept., NTU (top 5%)

CITIZENSHIP

Taiwan citizen and green card holder.

ACADEMIC SERVICES

Associate Editors, IEEE Transactions on Image Processing 2018/03 - present.

Technical Program Committee:

CVPR Workshop on Light Fields for Computer Vision 2017, ICCP 2016-18, CCD/PROCAMS 2015, IEEE ICME 2010-2018, ICIP 2014, ECCV Workshop on Light Fields for Computer Vision 2014, and ACCV 2012.

Reviewer:

ACM TOG, ACM SIGGRAPH 2009-10, 2014-16, ACM SIGGRAPH Asia 2008-09, 2012, IEEE Signal Processing Magazine, IEEE TIP, IEEE Multimedia Magazine, IEEE TCSVT, IEEE TMM, IEEE TPAMI, IEEE JSTSP, IJCV, CVIU, ICCV 2015, 2017, CVPR 2015-19, Optics Express, Optik, PG 2016, ECCV 2014, PG 2013, Image and Vision Computing, JMIV, EGSR 2009, ACM Multimedia 2009, PCS 2007, IEEE ICIP 2007, 2009-18, ICASSP 2016-18, MobiMedia 2006, JCIE, NSC proposals 2006, PCS 2006, and ISCAS 2005.

REFERENCES

Available upon request.