Chia-Kai Liang

chiakailiang.org [Scholar]

EXPERIENCES

Director / Principal Software Engineer, Google LLC, Nov 2020 - present
Senior Staff Software Engineer, Google LLC, Nov 2017 – Oct 2020
Staff Software Engineer, Google LLC, Aug 2015 – Oct 2017

Management
Lead the Advanced Camera Algorithm Team of 170+ engineers on core image and video quality components, including algorithms, features, and tuning for 3A, ISP, and photo/video systems. Collaborate with multiple teams across Google and hardware vendors.

Engineering
Develop the core algorithms and architecture for mobile imaging features. Optimize the camera pipeline performance. Design and prototype new features for future products.

Core AE/AWB/ISP feature and production for Pixel 10
Drive the algorithm, tuning and testing/evaluation effort for core photo/video algorithm for exposure/color/texture/noise improvements.

Pro Res Zoom (since Pixel 10 / 2025)
The first mobile-optimized one-step consistency model for high-zoom (100x) image enhancements.

Pixel Panorama 2.0 (since Pixel 9 / 2024)
Fully re-designed panorama pipeline with ML-based artifact removal and night sight support.

Pixel Studio (since Pixel 9 / 2024)
The first Google app for expressive creation with cloud and on-device GenAI models.

Zoom Enhancement (since Pixel 8 / 2024)
The first on-device diffusion-based solution for high-zoom image restoration enabled by model specialization and GPU/TPU optimizations.

HDR+ (since Pixel 8 / 2023)
Improve and create new features based on HDR+ (50MP, Pro Mode, etc.). Extended dynamic range and depth-of-field in 2024. Streamlined the production and tuning flows.

Video Boost (since Pixel 8 / 2023)
A cloud-based video enhancement pipeline with advanced multi-frame fusion, ML deblurring, ML stabilization, and low-light enhancement solutions. Add 8K and 60fps support in 2024.

Flare Removal (since Pixel 8 / 2023)
Automatic detecting and removing the ghosting flare from the Sun and artificial light sources.

Fusion Zoom (since Pixel 7 / 2022)
Fusing images from different focal lengths with robustness to occlusion, DOF and focus/color variations.

Cinematic Video (since Pixel 7 / 2022)
End-to-end pipeline and algorithms for stereo calibration, depth estimation, and bokeh rendering.

AI Zoom (since Pixel 7 / 2022)
Steady high-zoom framing with motion and saliency-based tracking.

Hardware Video Denoising (since Pixel 6 / 2021)
The Tensor SOC includes the ASIC realization of our temporal denoising algorithm.

Hardware Tone Mapping and Dynamic Range Expansion (since Pixel 6 / 2021)
ASIC bilateral grid in the Tensor SOC with portrait brightening and adaptive lens shading correction.

Face Unblur (since Pixel 6 / 2021)
Adaptive second camera streaming and ML-based fusion to remove motion blur.

Video Blur Refinement (since Pixel 6 / 2021)
Motion blur reduction in low-light and blur synthesis for judder suppression with GPU/DSP.

ML-based Photo/Video Enhancements (since Pixel 6 / 2021)
Used offline ISP and sensor simulation to train an efficient ML model for low-light enhancement.

Portrait Mode (since Pixel 5 / 2020)
Advance it to support more products and improve the efficiency. High-accuracy depth model trained with NeRF and synthetic data. Monocular depth plus hair matting for the single-camera solution.

Live HDR+ (since Pixel 4 / 2019)
The new HDR viewfinder that enables WYSIWYG and new dual exposure slider controls. The solution integrates the CNN based tone mapping with the camera pipeline and the tuning process.

Super Res Zoom (since Pixel 3 / 2018)
The world-first multi-frame super-solution solution that perform practically on mobile phones. In this large cross-team effort, I led the very initial prototype and the core design of OIS communication.

Face Distortion Correction (since Pixel 3 / 2018)
The world-first face-aware image distortion correction. The real-time version is added to Pixel 4.

Video Stabilization (since Nexus 6P / 2015)
The solution combines optical image stabilizer, machine-learning based motion filtering, and joint pipeline optimization. The technique has been adapted into other Google projects.

Video Denoising (since Pixel 2 / 2017)
We developed an efficient temporal filtering with GPU-CPU joint processing with local motion estimation and recurrent processing.

Face-Centric Video Stabilization (since Pixel 3 / 2018)
The real-time, WYSIWYG, face-centric video stabilization solution with ML-based face landmark tracking, joint filtering and rolling shutter correction.

Encoder-Camera Optimization (since Pixel 4 / 2019)
Created the offline large-scale encoder performance analysis dataset and toolchain. Created the new on-device camera-encoder communication channels and the entropy adaptive filters for optimal quality.

Dual-Camera Transition (since Pixel 4 / 2019)

Design the calibration and algorithms to enable smooth transition between different cameras.

Auto FPS (since Pixel 3 / 2018)
The full pipeline to enable automatic FPS adjustments. The system involves changes across the full camera stack: from 3A, sensor, HAL, framework, camera app, to the video encoder.

Flare Detection and Removal (Pixel 1 / 2016)
The solution to detect and remove the flare for Pixel 1. It uses a Gaussian mixture model and a non-linear optimization framework to estimate flare parameters from a single photo.

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.

Management
Jointly led 10 engineers to deliver the light field processing pipeline, including new saturation pixel handling, microlens vignetting correction, depth map estimation, and so forth.

Engineering
Participated in the lens design specific to the light field camera. Revised file format and user interaction model. Designed core algorithms for new features. Participated in the full product cycle, including early prototyping, part selection, processing pipeline design and optimization, manufacture test design & definition, and image quality evaluation and tuning.

Product: Lytro ILLUM, released at July 2014. The world-first prosumer level light field camera.
Product: The Lytro light field camera, released at 2012 The world-first consumer level light field camera.

High-Quality Virtual Camera Rendering
Designed a new algorithm with arbitrary camera parameters. Main components are focus-adaptive anti-aliasing, occlusion handling, depth/spatially-variant reconstruction, and artifact suppression.

Digital Lens Aberration Correction
Corrected lens aberration of arbitrary orders from light field. Modeled the zoom- and focus- dependent 4D lens aberration profiles with ray-tracking and high-quality compression.

Real-Time Depth Assist
Sparse depth map estimation and visualization at live-view. Designed the gradient-based depth estimation algorithm. Achieved 10+FPS on Qualcomm Snapdragon 800 by SIMD and multi-threading.

Flare Detection and Removal
Detect and remove flare corruption(s) in the light field. Designed the prototype algorithm and led the development of the product version.

Perspective Shift
Developed algorithms including occlusion detection and handling, spatially-variant reconstruction, parameter optimization, depth score regression, etc. Defined the file format and end-to-end dataflow.

Living Filter
Designed the software architecture for Instagram-style light field filters that animate with user interaction. Two proposed filters were picked in the final release.

Core light field processing algorithm development
Demosaicing, photometric calibration, and depth estimation, white balance, filtering, sharpening, microlens defect detection, microlens array calibration, sensor characterization, etc.

Researches on computational photography
Analysis and modeling on light field filtering, reconstruction and sampling. High resolution 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 EE Dept., National Taiwan University (NTU), 2005 – 2006

Internship at Industrial Technology Research Institute (ITRI), July 2004 – Sept 2004

PUBLICATIONS

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

JOURNAL PAPERS

Efficient Hybrid Zoom Super-Resolution using Camera Fusion on Mobile Phones
X. Wu, W.-S. Lai, Y. Shih, C. Herrmann, M. Krainin, D. Sun, and C.-K. Liang
ACM TOG (Proc. SIGGRAPH Asia), 2023

Face Deblur using Dual Camera Fusion on Mobile Phones
W.-S. Lai, Y. Shih, L.-C. Chu, X. Wu, S.-F. Tsai, M. Krainin, D. Sun, and C.-K. Liang
ACM TOG (Proc. SIGGRAPH), 2022

Distortion-Free Wide-Angle Portraits on Camera Phones
Y. Shih, W.-S. Lai and C.-K. Liang
ACM TOG (Proc. SIGGRAPH), 2019

Handheld Multi-Frame Super-Resolution
B. Wronski, I. Garcia-Dorado, M. Ernst, D. Kelly, M. Krainin, C.-K. Liang, M. Levoy, and P. Milanfar
ACM TOG (Proc. SIGGRAPH), 2019

Improving Light Field Camera Sample Design with Irregularity and Aberration
L.-Y. Wei, C.-K. Liang, G. Myhre, C. Pitts, and K. Akeley
ACM TOG (Proc. SIGGRAPH), 2015

A Light Transport Framework for Lenslet Light Field Cameras
C.-K. Liang and R. Ramamoorthi
ACM TOG, 2015

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

Content-Aware Display Adaptation and Interactive Editing for Stereoscopic Images
C.-H. Chang, C.-K. Liang, and Y.-Y. Chuang
IEEE Trans. Multimedia, 2011

Hardware-Efficient Belief Propagation
C.-K. Liang, C.-C. Cheng, Y.-C. Lai, H. H. Chen, and L.-G. Chen
IEEE Trans. CSVT, 2011

Light Field Analysis for Modeling Image Formation
C.-K. Liang, Y.-C. Shih, and H. H. Chen
IEEE Trans. Image Processing, 2011

TouchTone: Interactive Tonal Adjustment Using Point-and-Swipe
C.-K. Liang, W.-C. Chen, and N. Gelfand
Computer Graphics Forum, 2010

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

Programmable Aperture Photography: Multiplexed Light Field Acquisition
C.-K. Liang, T.-H. Lin, B.-Y. Wong, C. Liu, and H. H. Chen
ACM TOG (Proc. SIGGRAPH), 2008

Analysis and Compensation of Rolling Shutter Effect
C.-K. Liang, L. Chang, and H. H. Chen
IEEE Trans. Image Processing, 2008

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

SensorFlow: Sensor and Image Fused Video Stabilization
J. Yu, T. Zhang, F. Shi, L. He and C.-K. Liang, *WACV 2025*

Deep Online Fused Video Stabilization
Z. Shi, F. Shi, W.-S. Lai, C.-K. Liang, and Y. Liang, *WACV 2022*

Steadiface: Real-Time Face-Centric Stabilization on Mobile Phones Top 10% Papers
F. Shi, S.-F. Tsai, Y. Wang, C.-K. Liang, *Proc. ICIP, 2019*

Real-time Video Denoising on Mobile Devices
J. Ehmann, L.-C. Chu, S.-F. Tsai, and C.-K. Liang, *Proc. ICIP, 2018*

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*

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*

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*

Learning Landmarks by Exploiting Social Media
C.-K. Liang, Y.-T. Hsieh, T.-J. Chuang, Y. Wang, M.-F. Weng, and Y.-Y. Chuang, *Proc. 16th MMM, 2010*

Panoramic Imaging System for Camera Phones
K. Pulli, C.-K. Liang, M. Tico, X. Wang, and Y. Xiong, *Proc. ICCE, 2010*

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*

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*

JND-Based Enhancement of Perceptibility for Dim Images
T.-H. Huang, C.-K. Liang, S.-L. Yeh, and H. H. Chen, *Proc. ICIP, 2008*

Image Quality Enhancement for Low Backlight TFT-LCD Displays
P.-S. Tsai, C.-K. Liang, and H. H. Chen, *Proc. ICIP, 2007*

Light Field Acquisition using Programmable Aperture Camera
C.-K. Liang, G. Liu, and H. H. Chen, *Proc. ICIP, 2007*

Rolling Shutter Distortion Correction
C.-K. Liang, Y.-C. Peng and H. H. Chen, *SPIE Proc. VCIP, 2005*

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)

US 12167134B2: Video Stabilization

US 12010440: Optical Image Stabilization Movement to Create a Super-resolution Image of a Scene

US 11856295: Multi-camera Video Stabilization

US 11683586: Video Stabilization

US 11227146: Stabilizing Video by Accounting for a Location of a Feature in a Stabilized View of a Frame

US 11190689: Multi-Camera Video Stabilization

US 11132800: Real Time Perspective Correction on Faces

US 11102413: Camera Area Locking

US 11064119: Video Stabilization

US 10897608: Capturing Light-Field Images with Uneven and/or Incomplete Angular Sampling

US 10812717: Stabilizing Video by Accounting for a Location of a Feature in a Stabilized View of a Frame

US 10552947: Depth-based Image Blurring

US 10547790: Camera Area Locking

US 10531082: Predictive Light-Field Compression

US 10462370: Video Stabilization

US 10205896: Automatic Lens Flare Detection and Correction for Light-field Images

US 10200613: Video Stabilization for Mobile Devices

US 10171738: Stabilizing Video to Reduce Camera and Face Movement

US 10129524: Depth-Assigned Content for Depth-Enhanced Virtual Reality Images

US 10038909: Compression of Light Field Images

US 10033986: Capturing Light-Field Images with Uneven and/or Incomplete Angular Sampling

US 9979909: Automatic Lens Flare Detection and Correction for Light-field Images

US 9888179: Video Stabilization for Mobile Devices

US 9858649: Depth-based Image Blurring

US 9712820: Predictive Light Field Compression

US 9628684: Light-Field Aberration Correction

US 9607424: Depth-Assigned Content for Depth-Enhanced Pictures

US 9444991: Robust Layered Light-Field Rendering

US 9420276: Calibration of Light-Field Camera Geometry via Robust Fitting

US 9414087: Compression of Light Field Images

US 9392153: Plenoptic Camera Resolution

US 9386288: Compensating for Sensor Saturation and Microlens Modulation during Light-Field Image Processing

US 9172853: Microlens Array Architecture for Avoiding Ghosting in Projected Images

US 9001226: Capturing and Relighting Images using Multiple Devices

US 8997021: Parallax and/or Three-Dimensional Effects for Thumbnail Image Displays

US 8988317: Depth Determination for Light Field Images

US 8971625: Generating Dolly Zoom Effect using Light Field Image Data

US 8948545: Compensating for Sensor Saturation and Microlens Modulation during Light-Field Image Processing

US 8831377: Compensating for Variation in Microlens Position during Light-Field Image Processing

US 8811769: Extended Depth of Field and Variable Center of Perspective in Light-Field Processing

US 8780134: Access to Control of Multiple Editing Effects

US 8761491 B2: Stereo-Matching Processor using Belief Propagation

US 8406563: Photometric Calibration Method and Device

US 8373721: Method of Realism Assessment of an Image Composite

US 8249369: Method and Apparatus of Tile-Based Belief Propagation

US 8026835: Low-Backlight Image Visibility Enhancement Method and System

US 7956898: Digital Image Stabilization Method

EDUCATION

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

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

INVITED TALKS AND PUBLICATIONS

Mobile Computational Photography at Google, NTHU, NCTU, and NTU, 2021

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

2001/03 NTU EE Dept. Presidential Award (top 5%)

CITIZENSHIP

Taiwan and US citizens

ACADEMIC SERVICES

Associate Editor, 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, 2019, ECCV Workshop on Light Fields for Computer Vision 2014, and ACCV 2012.

Reviewer
ACM TOG, ACM SIGGRAPH 2009-10, 14-16, 20, 22, 24, ACM SIGGRAPH Asia 2008-09, 12, 22, IEEE Signal Processing Magazine, IEEE TIP, IEEE Multimedia Magazine, IEEE TCSVT, IEEE TMM, IEEE TPAMI, IEEE JSTSP, IEEE TCI, Nature Scientific Report, IJCV, CVIU, ICCV 2015/17/19/21/23, CVPR 2015-25, AAAI 2020, WACV 2021-25, Optics Express, Optik, PG 2016, ECCV 2014/24, PG 2013, Image and Vision Computing, JMIV, EGSR 2009, ACM Multimedia 2009, IEEE ICIP 2007, 2009-24, ICASSP 2016-18, 22, PCS 2007, MobiMedia 2006, JCIE, NSC proposals 2006, PCS 2006, and ISCAS 2005.

REFERENCES

Available upon request.