Chia-Kai Liang

http://chiakailiang.org

EXPERIENCES

- **Staff Software Engineer,** Google, Aug 2015 – present

  Develop core computational photography features for mobile products and Android platforms

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

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

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

    - **Management**:
      Jointly lead 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
      Consolidate the schedule and coordinate with members and other teams for prioritization and bottleneck identification

    - **Engineering**:
      Participate in the design of lens specific to the light field camera
      Revise light field file format and user interaction model
      Define and develop the core algorithms for new features

    - Product feature: *High-Quality Virtual Camera Rendering*
      Design 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*
      Correct lens aberration of arbitrary orders during image reconstruction from light field
      Design and estimate the 4D aberration correction model by ray-tracing
      Model the zoom- and focus- dependent lens aberration profiles with high-quality compression
      Optimize the aberration correction process on CPU/GPU

    - Product feature: *Real-Time Depth Assist*
      Sparse depth map estimation and visualization at live-view
      Design and implement 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 detect the flare corruption(s) in the light field and remove it
      Design 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*
  Develop the core algorithms for perspective-shift image creation, including occlusion detection and handling, spatially-variant image reconstruction, optimal parameter setting, depth score regression, etc
  Prototype 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*
  Design 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
  Performance optimization for all shipping filters

- **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)**
  Optimize the architecture for the CPU-based pipeline
  Design and implement 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
  Develop content-aware stereoscopic image/video processing algorithms
  Publish 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
  Develop the built-in panorama application for Nokia cell-phones
  Design a touch-based interactive image editing system
  Publish 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, real-time face detector, digital image stabilizer and 3A blocks (with SystemC and Verilog)
  Evaluate and develop motion estimation ASIC architecture

- **Research Assistant** of Prof. Homer H. Chen, NTU, 2005-2008
  Conduct researches on light field rendering, low-level computer vision and image processing, and hardware architecture for multimedia applications
  Publish six journal papers and numerous conference papers

- **Teaching Assistant** at the Department of Electrical Engineering, National Taiwan University (NTU)
  Video Signal Processing (Spring 2004, Spring2005), Signal and Systems (Fall 2004, Spring 2008)
  Solid-state Electronics (Spring 2005), Stochastic Signals and Systems (Fall 2007)
- **Internship** at Industrial Technology Research Institute (ITRI), July 2004 – Sept 2004
  Develop an on-line multimedia store with DRM protection

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
H. H. Chen, C.-K. Liang, Y.-C. Peng, and H.-A. Chang
IEEE Trans. CSVT, 2007
2008 IEEE Circuits and Systems Society CSVT Best Paper Award

SELECTED CONFERENCE PAPERS

1. 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

2. 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

3. 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

4. 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

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

6. 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

7. 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

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

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

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

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

12. 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. Robust Layered Light-Field Rendering
C.-K. Liang and C. Pitts, US 9444991, 2016/09/13

2. Calibration of Light-Field Camera Geometry via Robust Fitting
C.-K. Liang and Z. Wang, US 9420276, 2016/08/16

3. 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

4. Plenoptic Camera Resolution
G. Myhre, C.-K. Liang, C. Pitts, C. Craddock, and Y.-R. Ng, US 9392153, 2016/07/12

5. Compensating for Sensor Saturation and Microlens Modulation during Light-Field Image Pro-

cessing
K. B. Akeley, B. Cabral, C. Pitts, C.-K. Liang, B. Willburn, T. J. Knight, and Y.-R. Ng, US 9386288, 2016/07/05

6. 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

7. Capturing and Relighting Images using Multiple Devices
Y.-R. Ng, C.-K. Liang, K. B. Akeley, and B. Willburn, US 9001226, 2015/04/07

8. 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

9. Depth Determination for Light Field Images
C.-K. Liang, C. Pitts, K. B. Akeley, and A. Song, US 8988317, 2015/03/24

10. 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

11. 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

12. 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

13. 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

14. Access to Control of Multiple Editing Effects
W-C. Chen, N. Gelfand, and C.-K. Liang, US 8780134 B2, 2014/07/15

15. 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

16. Photometric Calibration Method and Device
C.-K. Liang, H. H. Chen, B.-Y. Wong, and G. Liu, US 8406563 B2, 2013/03/26

17. 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

18. 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

19. Low-Backlight Image Visibility Enhancement Method and System
P.-S Tsai, H. H. Chen, and C.-K. Liang, US 8026935, 2011/09/27

20. 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
Average GPA: 4.00

2000 – 2004 Bachelor of Science – National Taiwan University

Major: Electrical Engineering (with honors), average/core-course GPA: 3.89/3.97

INVITED TALKS

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

Technical Program Committee: ICCP 2016, CCD/PROCAMS 2015, IEEE ICME 2010-2015, ICIP 2014, ECCV Workshop on Light Fields for Computer Vision 2014, and ACCV 2012

Reviewer: ACM TOG, ACM SIGGRAPH 2009-10, 2014-15, ACM SIGGRAPH Asia 2008-09, 2012, IEEE Multimedia Magazine, IEEE Signal Processing Magazine, IEEE TPAMI, IEEE TIP, IEEE TCSVT, IEEE TMM, IEEE JSTSP, IJCV, CVIU, Optics Express, Optik, PG 2016, ICCV 2015, CVPR 2015-16, ECCV 2014, PG 2013, Image and Vision Computing, JMIV, EGSR 2009, ACM Multimedia 2009, PCS 2007, IEEE ICIP 2007, 2009-16, MobiMedia 2006, JCIE, NSC proposals 2006, PCS 2006, and ISCAS 2005

REFERENCES

Available upon request