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ACADEMIC GOAL AND RESEARCH INTEREST

PhD in the field of multimedia processing and communication.

The current research interests are multimedia processing architecture design, light-field rendering, and image/video processing.

EDUCATION

Bachelor of Science, Electrical Engineering, National Taiwan University, 2004, (with honors)
Overall grade average: 90.27, overall GPA: 3.89 / 4.00, final rank: 14 / 154.

WORK AND TEACHING EXPERIENCES

- Teaching Assistant**
Video Signal Processing, Spring 2004, Signal and Systems, Fall 2004,
Video Signal Processing, Spring 2005, Solid-state Electronics, Spring 2005,
Stochastic Signals and Systems, Fall 2007, Signal and Systems, Spring 2008.
All in Electrical Engineering Dept., National Taiwan University.
- Internship** at Industrial Technology Research Institute (ITRI), 7/2004~9/2004.
Initial surveys on international DRM standards,
Development of an on-line multimedia store with DRM protection.
- Research Assistant** with Prof. Homer H. Chen.
- VLSI Design Engineer** at R&D Dept., AviSonic Inc. (part-time job), 7/2005~9/2007.
Development of hardware architecture of real-time video denoising.
Development of hardware architecture of real-time face detector.
Development of hardware architecture of digital image stabilizer and 3A blocks.
Performance evaluation and development of motion estimation architecture and algorithm.

PUBLICATIONS

Journal Papers

- P.-S. Tsai, **C.-K. Liang**, T.-H. Huang, and H. H. Chen, "Image enhancement for backlight-scaled TFT-LCD displays," *IEEE Trans CSVT*, accepted.
- C.-K. Liang**, T.-H. Lin, B.-Y. Wong, C. Liu, and H. H. Chen, "Programmable aperture photography: multiplexed light field acquisition," *ACM Trans Graphics (Proc. SIGGRAPH 2008)*, vol. 27, no. 3, pp. 55:1-55:10..
- C.-K. Liang**, L. Chang, and H. H. Homer, "Analysis and compensation of rolling shutter effect," *IEEE Trans Image Processing*, vol. 17, no. 8, pp. 1323-1330, Aug. 2008.
- H. H. Chen, **C.-K. Liang**, Y.-C. Peng, and H.-A. Chang, "Integration of digital stabilizer with video codec for digital video cameras," *IEEE Trans. CSVT*, vol. 17, no. 7, pp. 801-813, Jul. 2007. *2008 IEEE Circuits and Systems Society CSVT Best Paper Award*.
- Y.-E. Wu, **C.-K. Liang**, C.-T. Tsao, K.-S. Hsu, Y.-J. Lin, "Digital video content service-license usage management platform," *CCL Technical Journal*, no.110, pp. 44-52.

Conference Papers

- C.-C. Cheng, **C.-K. Liang**, Y.-C. Lai, H. H. Chen, and L.-G. Chen, "Analysis of belief propagation for

hardware realization," *SIPS 2008*, to appear.

7. T.-H. Huang, **C.-K. Liang**, S.-L. Yeh, and H. H. Chen, "JND-based enhancement of perceptibility for dim images", *ICIP'08*, to appear.
8. P.-S. Tsai, **C.-K. Liang**, and H. H. Chen, "Image quality enhancement for low backlight TFT-LCD displays," in *Proc. ICIP'07*, San Antonio, Texas, Sept. 16-19, 2007, vol. 3, pp.473-476.
9. **C.-K. Liang**, G. Liu, and H. H. Chen, "Light field acquisition using programmable aperture camera," in *Proc. ICIP'07*, San Antonio, Texas, Sept. 16-19, 2007, vol. 5, pp. 233-236.
10. Y.-H. Kao, **C.-K. Liang**, and H. H. Chen, "Depth detection of light field," in *Proc. ICASSP'07*, Honolulu, Hawaii, USA, Apr. 2007, vol. 1, pp. 893-896.
11. C.-C. Liu, **C.-K. Liang**, K.-S. Hsu, C.-P. Kuan, and H. H. Chen, "Digital rights management for DVB-H Mobile TV," in *Europe-China Conference on Intellectual Property in Digital Media*, Shanghai, China, Oct. 2006.
12. **C.-K. Liang**, C.-C. Liu and H. H. Chen, "A robust DRM system on the DVB Multimedia Home Platform," in *Proc. IEEE CCNC'06*, vol. 1, Las Vegas, Nevada, USA, Jan. 2006. pp. 605-609.
13. L.-W. Chang, **C.-K. Liang**, and H. H. Chen, "Analysis and correction of rolling shutter distortion for CMOS image sensor arrays," in *Proc. ISCOM'05*, Kaohsiung, Taiwan, Nov. 2005.
14. **C.-K. Liang**, Y.-C. Peng and H. H. Chen, "Rolling shutter distortion correction," in *SPIE Proc. VCIP'05*, vol. 5960, Beijing, China, July, 2005. pp. 1315-1322.
15. Y.-C. Peng, **C.-K. Liang**, H.-A. Chang, C.-J. Kao and H. H. Chen, "Integration of image stabilizer and video encoder for digital video cameras," in *Proc. ISCAS'05*, vol. 5, Kobe, Japan, May 2005, pp. 4871-4874.
16. **C.-K. Liang**, Y.-C. Peng, H.-A. Chang, C.-C. Su and H. H. Chen, "The effect of digital image stabilization on coding performance," in *Proc. ISIMP'04*, Hong Kong, China, Oct. 2004, pp. 402-405.

Patent

17. M.-Y. Wu, **C.-K. Liang**, C.-C. You, and B. Sung, "Method for enhanced removing noise of digital image and apparatus Thereof," Taiwan, USA, and Japan pending.
18. M.-Y. Wu, **C.-K. Liang**, and B. Sung, "Face detection system and method," Taiwan and USA pending.
19. H. H. Chen, **C.-K. Liang**, D. Yeh, and B. Sung, "Digital image stabilization method," Taiwan and USA pending.
20. M.-Y Wu, B. Sung, C.-C. Yu, and **C.-K Liang**, "Method and apparatus thereof for enhancing digital image," Taiwan and USA pending.
21. **C.-K. Liang**, H. H. Chen, D. Yeh, and H. Wang, "Camera using programmable aperture," Taiwan and USA pending.
22. H. H. Chen, **C.-K. Liang** and C.-C. Liu, "Methods and apparatus for digital rights management of digital video broadcasting system," USA 20070189530, Taiwan I-281825.

HONORS

1. 2008 IEEE Circuits and Systems Society CSVT Best Paper Award
2. 2007 5th Ennovation Contest First Prize (US \$3000)
3. 2005 MiTac Technology Scholarship from MiTac Technology Corporation
4. 2005 Class A Scholarship, Graduate Institute of Communication Engineering, National Taiwan University
5. 2004 Class A Scholarship, Graduate Institute of Communication Engineering, National Taiwan University
6. Presidential Award of the 2003 1st semester in EE dept., National Taiwan University
7. Presidential Award of the 2001 1st semester in EE dept., National Taiwan University

ACADEMIC RESEARCH EXPERIENCES

1. **Landmark Identification using Social Networks** (8/2007~present), supervised by Prof. Yung-Yu Chuang
We are developing a big system to processing the landmark images in many different aspects. First, we use the geo-tags from Flickr to build a hierarchical *tag forest* for all geographic tags. Given the forest, given a new image with a geo-tag, we can directly put all the related geographic tags. Second, we use Wikipedia to learn a classifier to classify the geographic tags (e.g., city, landscape, market). This gives users more information in exploring the image collections. Third, we are attempting to use the visual information of the image, such as color, texture, and

local features, to directly identify the location of the query image without geo-tag. This should enable much more applications.

2. **Light Field Acquisition and Analysis** (8/2005~present)

We are building a device which can capture the 4-D light field with minimal modifications to the original mechanisms. The main idea is *multiplexing the light field through the lens using the programmable aperture*. In this way we can capture full-resolution light field with high efficiency. We have built a prototype using a conventional DSLR and simple mechanisms.

We also discover many interesting way to interpret the light transport in a signal processing framework. One specific work of our research is a novel depth detection algorithm. The algorithm only extracts the possible depth planes, but it can benefit many applications, such as digital refocusing and all-in-focus rendering.

3. **Image Enhancement for Low Backlight LCD Displays** (supervision, 8/2006~6/2007) (As a supervisor)

An efficient algorithm is proposed to enhance the image quality for the low backlight displays. This is achieved by incorporating brightness compensation and local contrast enhancement depending on the given backlight level. The algorithm uses the global statistics of the image to find a best mapping function to compensate for the brightness loss and local sharpness information to enhance the local contrast. This simple algorithm is designed to be hardware feasible.

4. **Digital Rights Management System on DVB System** (8/2004~6/2006)

This system is developed for the DVB standards, and the goal is to protect the digital contents without feedback channel. The system is implemented on MHP-STB. MPEG-21 REL is chosen to describe digital rights. DRM Xlet programs are written, which encrypts, watermarks, and saves the received digital content. REL and DRM programs are broadcasted with the digital content. The system utilizes smartcard to protect the important data.

5. **Rolling Shutter Distortion Compensation** (10/2004~10/2005)

We proposed an algorithm to remove the rolling shutter effect that commonly occurs in digital cameras with CMOS sensor array. The mathematical model to the distortion is developed. The velocity of the camera or the scene is reconstructed by global motion estimation. The offset of each scanline (pixel) is then determined and compensated.

6. **Digital Image Stabilization and its Integration with Video Codec** (03/2004~06/2005)

A digital image stabilizer for digital video camera is developed. The camera motion is calculated by global motion estimation and then the hand shake effect is filtered out. We observed that both the digital image stabilizer and video encoder perform motion estimation, and thus we combined them into one system by sharing the motion information. Without any fast algorithm applied to the motion estimator, the computational cost is reduced by a factor of two.

7. **H.264 Parser and Decoder** (9/2003~6/2004)

To provide a concise program for training new members in the lab, a H.264 bitstream parser in C++ is written. The entropy coding is content adaptive in H.264, and so the data can not be parsed without decoding. As the result, the parser became a fully decoder in the end of the project. This speed of this decoder is the same as the reference software before any optimization but much easier to understand and modify.

COURSE PROJECTS

1. Game Programming: **A First-Person-Shooting Game** (9/2007~1/2008) Partner: Chihyuan Chung

We develop a complete game engine, including BSP rendering and collision and AI for the FPS game. We use the PhyX physical engine and the OpenAL 3D audio engine to make the game more vivid.

2. Digital Image Synthesis: **Wine Rendering** (9/2006~1/2007)

Partner: Chihyuan Chung Advisor: Prof. Yung-Yu Chuang

We render a glass of wine with haze on the glass surface. The applied techniques are multiple scattering volumetric rendering, photon mapping, and haze modeling and rendering.

3. Digital Visual Effect: **Image-based Material Editing** (2/2006~7/2006)

Partner: Chihyuan Chung Advisor: Prof. Yung-Yu Chuang

We implement a SIGGRAPH'06 paper and improve the performance. All manipulations are responded in near real-time. A better texture mapping method is applied.

4. DSP in VLSI Design: **Block-based Global Motion Estimation** (2/2005~7/2005)

Partner: Der-Chun Cherng, Chi-Ling Wu, Chin-Hsiang Chang Advisor: Prof. Shao-Yi Chien

A circuit for block-based motion estimation is developed. With popular add-tree SAD accelerators and motion

vector cluster, a global motion which minimizes error is obtained in real time. The operation frequency is 50MHz.

5. Computer Graphics: **Water Animation** (9/2004~2/2005)
Partner: Ping-Hao Wu Advisor: Prof. Ming Ouhyoung
We implemented a complex dynamic flow system. A discrete 3-dimentional Navier-Stokes equations solver and a ray tracer are developed.
6. Microprocessor Lab: **Microprocessor CD-Player** (9/2004~2/2004)
We use an 8051 microprocessor to control a CD-ROM reader. I write low-level assembly code to control IDE interface.
7. Analog Integrated Circuit: **Sample-and-hold Circuit Design for 8-bit ADC** (9/2003~2/2004)
Partner: Tai Dai Advisor: Prof. Behzad Razavi
One OP-Amp is designed for the 8-bit sample-and-hold circuit working in 300MHz. The SNR in the simulation is 84dB. This circuit is designed under 0.35 TSMC process and our performance reaches the theoretic limit and is the best in the course.
8. Integrated Circuit Design Lab: **Tetris Chip** (3/2003~6/2003) Advisor: Prof. Tzi-Dar Chiueh
We designed an ASIC to run Tetris. The chip includes main logic modules and LCD controller. The whole chip is designed in gate-level.
9. Special Project: **Clock and Data Recovery Circuit Design** (3/2003~6/2003)
Partner: Chih-Chi Cheng Advisor: Prof. Chorng-Kuang Wang
CDR circuit is used to estimate the transmission rate from binary data. The phase error is integrated by charge pump and then input to VCO. This circuit works at 8GHz and uses no inductance. We use TSMC .18 model.

SKILLS

Hardware description language: Verilog, CUDA.

High-level languages: C, C++, .NET framework, Java, PHP, MySQL, html.

C++ libraries: QT, SystemC, FFTW, OpenGL (GLUT), OpenAL, OpenCV.

Simulation software: HSPICE, Matlab.

Hardware interface control: VGA, RS-232, PS/2, SCSI/IDE.

LANGULAGE

Chinese and English

RELEVANT COURSES

Graduate:

Digital Image Processing (95),	Digital Communication I (99),
Analog Integrated Circuit (97),	Digital Speech Processing (90),
Queuing Theory (95),	Algorithms (93),
Cryptography (96),	Computer Graphics (80),
Digital Signal Processing in VLSI Design (96)	Digital Signal Processing (90),
Digital Visual Effect (98)	Digital Image Synthesis (99),
Computer Communication Network (94)	Game Programming (95)
Advanced Topics in Multimedia Analysis and Indexing (99)	

bold: highest score in the course.

Undergraduate:

Signals and Systems	Computer Architecture	Microprocessor Lab
Engineering Mathematics	Principles of Communication	SoC Design Lab
Electronics 1, 2, 3	Electro-Optics	Integrated Circuit Lab
Integrated Circuit Design	Computer Networks	Multimedia Lab
	8 Special Projects.	Digital Circuit Lab

ACADEMIC SERVICES

Reviewer of IEEE Trans. CSVT, ISCAS 2005, PCS 2006, JCIE, NCS proposals 2006, MobiMedia 2006, ICIP 2007, PCS 2007, and SIGGRAPH Asia 2008.

Chief of the learning department, NTUEE academic association, 9/2002~8/2003.

REFERENCES

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Yung-Yu Chuang, Ph.D. Department of Computer Science, National Taiwan University	886-2-23625336 ext. 527 cyy@csie.ntu.edu.tw
Shao-Yi Chien, Ph.D. Department of Electrical Engineering, National Taiwan University	886-2-33663668 sychien@cc.ee.ntu.edu.tw