Robert LiKamWa

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Research Interests

Low power computer vision systems on mobile devices.
Energy management; Mobile computing; Context-awareness;
Operating systems; System-on-chip architecture;

Education

Ph.D., under Dr. Lin Zhong, Electrical & Computer Engineering, Rice University — *in progress*
M.S., under Dr. Lin Zhong, Electrical & Computer Engineering, Rice University — May 2012
B.S.E.E. (cum laude), Electrical & Computer Engineering, Cum Laude, Rice University — May 2010
Minor, Computational and Applied Math, Rice University — May 2010

Graduate Honors/Awards

- 2nd Place ACM Student Research Competition (Pitch + Poster + Presentation) @ MobiCom (9/2014)
- Best Presenter Award at Ph.D. Forum @ MobiSys (6/2014)
- Best Paper Award at MobiSys (6/2013)
- Best Paper Award at PhoneSense @ SenSys (11/2011)
- Best Ph.D. Forum Presentation at S3 Workshop @ MobiCom (9/2011)
- Texas Instruments Graduate Fellowship (8/2010-present)

Selected Conference & Workshop Papers

"Starfish: Efficient concurrency support for computer vision applications"
  Robert LiKamWa, Lin Zhong
  MobiSys '15: Proc. of the 13th annual int'l conf. on mobile systems, applications, and services

"Draining our Glass: An energy and heat characterization of Google Glass"
  Robert LiKamWa, Zhen Wang, Aaron Carroll, Felix Xiaozhu Lin, Lin Zhong
  APSys '14: Proc. of 5th Asia-Pacific workshop on systems

"Energy proportional image sensors for continuous mobile vision" *(Best Paper Award)*
  Robert LiKamWa, Bodhi Priyantha, Matthai Philipose, Lin Zhong, Paramvir Bahl
  MobiSys '13a: Proc. of the 11th annual int'l conf. on mobile systems, applications, and services

"Reflex: using low-power processors in smartphones without knowing them"
  Felix Xiaozhu Lin, Zhen Wang, Robert LiKamWa, Lin Zhong
  ASPLOS '12: Proc. of the 17th int'l conf. on arch. support for programming languages and op. systems

"MoodScope: Building a mood sensor from smartphone usage patterns"
  Robert LiKamWa, Yunxin Liu, Nicholas D. Lane, Lin Zhong
  MobiSys '13b: Proc. of the 11th annual int'l conf. on mobile systems, applications, and services

Other Papers & Posters

Invited Paper: "Efficient image processing for continuous mobile vision"
   Robert LiKamWa, Yunhui Hou, Peter Washington, Lin Zhong
   SID Display Week, Imaging Technologies and Applications

"Efficient image processing for continuous mobile vision" *(Best Presentation Award)*
   Robert LiKamWa
   MobiSys PhD Forum '14: Proc. of the MobiSys 2014 PhD Forum Workshop

Poster: "Retrofitting Computer Vision Libraries for Concurrent Support on Mobile Devices"
   Robert LiKamWa, Lin Zhong
   MobiCom '14: Proc. of the 20th annual int'l conf. on mobile computing and networking

"Styrofoam: A tightly packed coding scheme for camera-based visible light communication"
   David Ramirez, Robert LiKamWa, Jason Holloway
   VLCS @ MobiCom '14: Proc. of the 1st ACM workshop. on Visible Light Communication Systems

"Can your smartphone infer your mood?" *(Best Paper Award)*
   Robert LiKamWa, Yunxin Liu, Nicholas D. Lane, Lin Zhong
   PhoneSense '11: Proc. of the second int'l workshop on sensing applications on mobile phones

Demo: "SUAVE: Sensor-based User-Aware Viewing Enhancement for mobile device displays"
   Robert LiKamWa, Lin Zhong
   UIST '11: Adjunct Proc. of the 24th annual ACM symp. on user interface software and technology

Ph.D. Dissertation: Rethinking the Sensing Pipeline for Continuous Mobile Vision

Vision Library Support for Efficient Concurrency
Rice University with Lin Zhong

The future of continuous mobile vision envisions multiple computer vision-based applications concurrently running without user engagement. However, running a multitude of applications calling resource-hungry vision algorithms will strain a wearable device with limited resources. We design Starfish, a split-process software system that enables applications to share redundant computations, reducing the overhead of computer vision function calls. Starfish splits the vision library from an application into a separate process and securely and efficiently caches library function calls, improving the performance and efficiency of concurrent vision tasks.
Full Paper at MobiSys 2015

Image Sensor Control for Energy-Proportional Capture
Microsoft Research Redmond with Matthai Philipose, Bodhi Priyantha, Victor Bahl
Rice University with Lin Zhong

A major hurdle to frequently performing mobile computer vision tasks is the high power consumption of image sensing. We experimentally and analytically characterize the energy consumption of CMOS image sensors. With this knowledge, we create system-level driver-controlled power optimizations for capturing images and video relevant to machine vision tasks.
Best Paper at MobiSys 2013

Vision Sensor Hardware Architecture for Deep Analog Processing
Rice University with Yunhui Hou, Yuan Gao (undergrad), Mia Polansky (undergrad), Dr. Lin Zhong

Sensor readout is a key bottleneck to vision energy efficiency. We design a novel sensor that performs early analog processing to reduce the sensor readout. We discover that vision workloads map well to analog hardware, due to robustness to noise and repetitiveness of execution. We then provide an architecture that allows deep analog vision processing with fixed complexity. Through cyclic reuse of modules in a column-based topology, we limit the design complexity of the chip while provisioning for iterative execution before readout. As opposed to prior vision sensors and neuromorphic processors discussed in Related Work, deep processing allows us to target readout as the fundamental boundary to sensor and system efficiency.
Submitted Full Paper to ISCA 2016

Transparent Compiler/Runtime for Heterogeneous CPU Architecture (co-author)
Rice University with Felix Xiaozhu Lin (lead), Zhen Wang & Lin Zhong

Reflex is our suite of compiler and runtime support tools for efficient smartphone sensing. A distributed heterogeneous architecture promises energy-efficiency to sensing applications, but programming software on such an architecture is difficult. Reflex not only manages deployment and execution of code for heterogeneous resources, but also creates a software shared memory among distributed code.
Full Paper at ASPLOS 2012

Energy and Heat Characterization of Wearable Systems
Rice University with Zhen Wang, Aaron Carroll, Felix Xiaozhu Lin, Lin Zhong

The Google Glass small form factor hampers its potential: (1) battery size, and therefore lifetime, is limited by a need for the device to be lightweight, and (2) high-power processing leads to significant heat, which should be limited due to the compact form factor and proximity to the user's skin. We study the power and thermal characteristics of Glass as an exemplar optical head-mounted device. We share insights and implications to limit power draw with the goal of increasing the safety and utility of head-mounted devices.
Workshop Paper at APSys 2014

Master's Thesis: Building a Mood Sensor from Smartphone Usage Patterns

Mood Inference over Smartphone Usage Patterns
Microsoft Research Asia with Yunxin Liu , Nic Lane
Rice University with Lin Zhong

Our MoodSense system infers a user's mood based on information already available in today's smartphones, including website visitations, app usage, and communication via SMS, e-mail, and phone calls. The service enhances context-awareness by providing clues about mobile users' mental states.
Best Workshop Paper at PhoneSense 2011 (co-located with SenSys), Full Paper at MobiSys 2013

Patent Applications

Energy-proportional image sensor (Microsoft)

Robert LiKamWa, Nissanka A. Bodhi Priyantha, Matthai Philipose, Lin Zhong, Paramvir Bahl

2013/2/19; US; 13/770,031

> Energy saving mechanisms of image sensor circuitry (e.g., in a camera). Image quality data, such as provided by an application, is processed to make energy consumption of image sensor circuitry more proportional to output image quality by controlling power saving mechanisms of the image sensor circuitry.

Wireless electronic pegboard setup for quantification of dexterity (Shriner's Hospital; Rice University)

Steven E. Irby, Dillon P. Eng, Rachel Jackson, Allison C. Scully, Jessica Scully, Robert LiKamWa, Marcia K. O'Malley, Z. Maria Oden, Gloria R. Gogola, Avery L. Cate

2012/4/13; US; 13/446,610

> An electronic pegboard setup for assessing patient dexterity. In certain embodiments, the pegboard setup may be wireless and may employ pegs equipped with sensors that that allow tracking of the motion of the peg in three-dimensions and over time, providing quantitative motion path data to assess patient dexterity.

Hand muscle measurement device

Shuai Xu, Gloria R. Gogola, Graham Sattler, Sridhar Madala, Robert LiKamWa

2010/10/8; US; 13/500,607

> The present disclosure relates to an integrated system for measuring hand strength and dexterity. Specifically, the integrated system allows for measuring of hand muscle strength through the pinch-grip test, of intrinsic hand muscle strength, and testing of performance in various dexterity tests.

Teaching Assistance

- ELEC 101: Introduction to ECE
- ELEC 241: Fundamentals of Electrical Engineering I
- ELEC 242: Fundamentals of Electrical Engineering II
- COMP 425/ELEC 425: Computer Architecture
- COMP 424/ELEC 424: Mobile and Embedded Systems
- ELEC 494: Senior Design

Mentoring

Undergraduate Students:
- Yuan "Julian" Gao (Mobile Vision Research)
- Juliana Gomez (Mood Research)
- Edward "Teddy" Hickman (Mobile Vision Research)
- Avery McFarlan (Mood Research)
- Mia Polansky (Mobile Vision Research)
- Abdul Hadi Tabani (Mobile Vision Research)
- Peter Washington (Mood Research, Mobile Vision Research)

Professional Service

- 2015: MobiSys '16 Poster/Demo/Video Regional Chair (North America)
- 2015: MobiCASE '15 Technical Program Committee
- 2015: MobiSys '15 Publicity Chair
- 2015: IPSN '15 Shadow Technical Program Committee
- 2014: MobiCASE '14 Publicity Chair
- 2011-2014: Rice Center for Engineering Leadership Graduate Committee Chair

References

M.S./Ph.D. Advisor
- Lin Zhong (Rice University, Electrical & Computer Engineering/Computer Science

Internship Mentors
- Victor Bahl (Microsoft Research Redmond)
- Matthai Philipose (Microsoft Research Redmond)
- Yunxin Liu (Microsoft Research Asia)
- Nicholas Lane (Microsoft Research Asia)
- Manish Goel (Samsung Research America - Mobile Processor Innovation Lab - SoC Team)