

Embedded Systems Laboratory



Junji Kitamichi
Professor



Yoichi Tomioka
Associate Professor

The Embedded Systems Laboratory was established in July, 2013. In April, 2015, Prof. Tomioka joined in the Embedded Systems Laboratory. Embedded systems are products which computers are embedded, and the research region of the embedded systems is very wide, such as software, hardware, and middle-ware, from theory to application, calculation performance, power consumption, safety, and development methods. We are researching the following themes out of many research topics about embedded systems.

1. Safety Embedded System
 - (a) Formal Approach for Circuits Design and Systems Design
 - (b) Design Method of Safety Systems
2. Hardware acceleration of Heuristic Approaches for Combinatorial Optimization Problems
3. Image Processing and its Power-efficient Accelerator
 - (a) Video Analysis and Privacy Protection for Surveillance Camera
 - (b) Deep learning hardware
 - (c) Application of Image recognition to Lithography Hotspot Detection
 - (d) Image forensics

Members of the Embedded Systems Laboratory

Prof. Junji Kitamichi:

He received the B.S. and Ph.D degrees in information and computer sciences from Osaka University, Japan, in 1988 and 1999, respectively. In 1991, he joined the Department of Information and Computer Sciences at Osaka University, Japan, as a research associate. From 1999 to 2002, he was with Cybermedia Center at Osaka University, where he was assistant professor. In 2002, he joined School

Division of Computer Engineering

of Computer Science and Engineering, the University of Aizu, Japan. He was a professor at the University of Aizu from 2013. His research interests include formal methods for VLSI design, dynamically reconfigurable systems, formal design and verification of safety systems, heuristics and parallel algorithms for combinatorial optimization problems.

Prof. Yoichi Tomioka: He received his B.E., M.E., and D.E. degrees from Tokyo Institute of Technology, Tokyo, Japan, in 2005, 2006, and 2009, respectively. He was a research associate at Tokyo Institute of Technology till 2009. He was an assistant professor in the Division of Advanced Electrical and Electronics Engineering at Tokyo University of Agriculture and Technology till 2015. Since 2015, he has been an associate professor in School of Computer Science and Engineering at the University of Aizu. His research interests include image processing, hardware acceleration, high performance computing, electrical design automation, and combinatorial algorithms.

Students : B3: Sho Endo, Shun Okazaki, Yuki Okada, Reon Kobayashi, Seigo Kon, Yoshiki Tanabe, Tomoyuki Ara, Rintaro Mikawa

B4: Masayuki Tokutake, Ken Watanabe, Shiori Tanikawa, Shuhei Suzuki, Hiroki Ishii, Issei Onodera, Sachi Takahashi, Yoshiaki Ejiri

M1: Sho Ikeda, Dai Funayama, Shu Takenoshita, Yusuke Sekiguchi

M2: Hiroki Saito

Refereed academic journal

- [ytomioka-208-033-01:2017] Yoichi Tomioka Shota Saito and Hitoshi Kitazawa. A Theoretical Framework for Estimating False Acceptance Rate of PRNU-based Camera Identification. *IEEE Trans. on Information Forensics and Security*, 12(9):2026–2035, September 2017.

Refereed proceedings of an academic conference

- [kitamiti-208-033-01:2017] Junji Kitamichi Sho Ikeda, Yoichi Tomioka. Parallel Computing of Neural Network Algorithm for Fixed Channel Assignment Problem in Cellular Radio Networks with CUDA. In *The 2017 International Symposium on Nonlinear Theory and Its Applications*, pages C2L–E, 2017.

In recent years, graphics processing units (GPUs) have been used for faster numerical calculation because they have many cores and can calculate via parallel computing. In this paper, we propose a CUDA C program that aims to accelerate the extended maximum neural network algorithm for the fixed channel assignment problem (FCAP) in cellular radio networks using a general-purpose GPU (GPGPU). We evaluate the developed program using the existing benchmark problem in the FCAP. Results show that the processing speed of the developed program is 2.4 times to 15.1 times faster than in the case of using only a CPU.

Unrefereed proceedings of an academic conference

- [kitamiti-208-033-02:2017] Junji Kitamichi Sachi Takahashi. A Proposal of Genetic Algorithm using a Local Search as Mutation for a Fixed Channel Assignment Problem in a Cellular Radio Communication. In *The 80th National Convension of IPSJ*, pages 2K–03, 2017.

- [kitamiti-208-033-03:2017] Junji Kitamichi Dai Funayama. Modeling a Safety Embedded System Considering External Factors using LTSA. In *2017 Tohoku-Section Joint Convention of Institutes of Electrical and Information Engineers*, page 2B17, 2017.

- [ytomioka-208-033-02:2017] Shuhei Suzuki and Yoichi Tomioka. Efficient Generation of Lithography Hotspot Detector based on Transfer Learning. In

Summary of Achievement

IEICE Technical Report (VLD2017-106), volume 115, pages 103–108, February 2018.

(in Japanese)

[ytomioka-208-033-03:2017] Yukihide Kohira Masayuki Tokutake, Yoichi Tomioka and Hiroshi Saito. Cloud Area Estimation using Convolutional Neural Networks. In *Proc. of Tohoku Branch Workshop of the Meteorological Society of Japan*, December 2017.

[ytomioka-208-033-04:2017] Yusuke Sekiguchi and Yoichi Tomioka. Threshold Optimization of Quantized HOG for Reliable Human Detection. In *Tohoku-Section Joint Convention of Institutes of Electrical and Information Engineers*, August 2017.

[ytomioka-208-033-05:2017] Shu Takenoshita and Yoichi Tomioka. Scaling Factor Estimation Using Three Peak Frequencies Related to Periodic Interpolation Artifacts. In *Tohoku-Section Joint Convention of Institutes of Electrical and Information Engineers*, August 2017.

Research grants from scientific research funds and public organizations

[ytomioka-208-033-06:2017] Yoichi Tomioka. Japanese Young Researcher Research Grant from Nakajima Foundation, 2017.

Academic society activities

[kitamiti-208-033-04:2017] Kitamichi J., 2017.

Member

[kitamiti-208-033-05:2017] Kitamichi J., 2017.

Member

[ytomioka-208-033-07:2017] Yoichi Tomioka, 2017.

TPC member of SASIMI (Synthesis And System Integration of Mixed Information technologies)

Advisor for undergraduate research and graduate research

- [kitamiti-208-033-06:2017] Hiroki Saito. Development of a Real Time Operating System for a Processor with a Fault Detection Function and its Evaluation, Graduate school, 2017.
- [kitamiti-208-033-07:2017] Hiroki Ishii. Acceleration for Minimum p-Quasi Clique Cover Problem using Intel AVX and OpenMP, University of Aizu, 2017.
- [kitamiti-208-033-08:2017] Issei Onodera. Development of RTOS TOPPERS/ASP for a MIPS32 Processor System, University of Aizu, 2017.
- [kitamiti-208-033-09:2017] Sachi Takahashi. Improvement of Solution Accuracy for FCA using GA with Gradient Descent Method as Mutation, University of Aizu, 2017.
- [kitamiti-208-033-10:2017] Yoshiaki Ejiri. Implementation of Human Detection algorithm using parallel programming with XMOS, University of Aizu, 2017.
- [ytomioka-208-033-08:2017] Masayuki Tokutake. Convolutional Neural Network based Cloud Detection from Sky Images, Undergraduate school, March 2018.
- [ytomioka-208-033-09:2017] Shiori Tanikawa. Evaluation of Human Region Extraction using Fully Convolutional Networks for Privacy Protection, Undergraduate school, March 2018.
- [ytomioka-208-033-10:2017] Shuhei Suzuki. A Construction Method of Lithography Hotspot Detector based on Transfer Learning, Undergraduate school, March 2018.
- [ytomioka-208-033-11:2017] Ken Watanabe. Circulated Systolic Array Processor for Binary Convolutional Neural Networks, Undergraduate school, March 2018.

Others

- [ytomioka-208-033-12:2017] Yoichi Tomioka and Stanislav Sedukhin. Design and Analysis of a Brain-inspired CNN Accelerator, 2017.
RIEC Brain Architecture Workshop (invited talk)

Summary of Achievement

[ytomioka-208-033-13:2017] Yoichi Tomioka Shota Saito and Hitoshi Kitazawa. A Theoretical Framework for Estimating False Acceptance Rate of PRNU-based Camera Identification, 2017.

the Seventh Symposium on Biometrics, Recognition and Authentication

[ytomioka-208-033-14:2017] Yoichi Tomioka Shota Saito and Hitoshi Kitazawa. A Theoretical Framework for Estimating False Acceptance Rate of PRNU-based Camera Identification, 2017.

the Seventh Symposium on Biometrics, Recognition and Authentication (invited talk)

[ytomioka-208-033-15:2017] Yoichi Tomioka Shota Saito and Hitoshi Kitazawa. A Theoretical Framework for Estimating False Acceptance Rate of PRNU-based Camera Identification, 2017.

the Seventh Symposium on Biometrics, Recognition and Authentication (invited presentation)

Contributions related to syllabus preparation

[ytomioka-208-033-16:2017] ITA18 Sensing and Control Engineering

Preparation of course examination to measure comprehension

[ytomioka-208-033-17:2017] Member who prepares entrance examination questions

[ytomioka-208-033-18:2017] Member who selects entrance examination questions

[ytomioka-208-033-19:2017] Member who grades entrance examination

Advisor of a student club or circle

[ytomioka-208-033-20:2017] Robo Mouse

Did you participate in Faculty Development? (Yes or No) If yes, please describe what you did.

Summary of Achievement

[ytomioka-208-033-21:2017] Arrangement of FD lecture

**Did you participate in Public Lectures, and/or Open Campus?
(Yes or No) If yes, please describe what you did.**

[ytomioka-208-033-22:2017] Openlab (Summer session), Video Processing System for Safty and Security

[ytomioka-208-033-23:2017] Openlab (Autumn session), Video Processing System for Safty and Security

[ytomioka-208-033-24:2017] Fukushima Nishi Highschool, Basic to State-of-the-arts Image Analysis

[ytomioka-208-033-25:2017] Iwaki Sakuragaoka high school, Basic to State-of-the-arts Image Analysis