TOHOKU
UNIVERSITY

The 2nd International Symposium on AI Electronics

Organized by WISE Program for AI Electronics

Date 2021 Feb.15 Mon.

Venue Online

AIE
WISE Program
for AI Electronics

Technical Program

10:00 – 10:10

Opening Session

10:00 – 10:05

Welcome Address

Hideo Ohno

President, Tohoku University

10:05 – 10:10

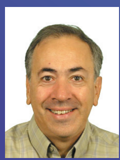
Opening remarks

Toshiro Kaneko

Program Coordinator,
WISE Program for AI Electronics,Tohoku University

10:10 – 11:00

Conversational AI becoming mainstream



Keynote

Alex Acero

Senior Director, Apple

P02

11:10 – 12:00

Human Perspective Scene Understanding via Multimodal Sensing

Keynote

Chiori Hori

Senior Principal Research Scientist,
Mitsubishi Electric Research Laboratories

P03

12:00 – 13:30

Lunch

13:30 – 14:00

Brainmorphic computing hardware paradigm for edge AI

Invited

Yoshihiko Horio

Professor, Research Institute of Electrical Communication,
Tohoku University

P04

14:00 – 14:30

Real-world Intelligent Systems and Energy-Efficient Accelerators

Invited

Masanori Hariyama

Professor, Graduate School of Information Sciences,
Tohoku University

P05

14:30 – 15:00

Searching for rare atomic nuclei via image analysis using machine learning

Invited

Junya Yoshida

Assistant Professor, Graduate School of Science, Tohoku University
Visiting Scientist, High Energy Nuclear Physics Laboratory, RIKEN

P06

15:15 – 15:55

Human resource development cost as an essential investment for establishing sustainable society

Keynote

Hiroshi Amano

Professor, Institute of Materials and Systems for Sustainability
Center for Integrated Research of Future Electronics,
Nagoya University

P07

16:00 – 16:50

Computer Vision: Geometry, Uncertainty and Deep Learning

Keynote

Roberto Cipolla

Professor of Information Engineering,
University of Cambridge

P08

Keynote

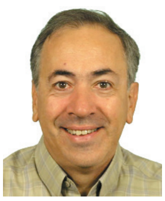
Conversational AI becoming mainstream

Alex Acero | Senior Director, Apple

ABSTRACT

After decades in the lab, artificial intelligence is becoming part of users' everyday lives. Neural networks run every time you unlock your iPhone with your face, or when you interact with Siri, the first mainstream intelligent assistant. This talk will introduce how advances in research were needed to improve the user experience.

BIOGRAPHY



Alex Acero

Alex Acero is Sr. Director at Apple leading speech recognition, speech synthesis, language understanding, and dialog for Siri, Apple' s personal assistant for iPhone, iPad, Apple Watch, Apple TV, Carplay, Macintosh, and HomePod. Prior to joining Apple in 2013, he spent 20 years at Microsoft Research managing teams in speech, audio, multimedia, computer vision, natural language processing, machine translation, machine learning, and information retrieval. His team at Microsoft Research built Bing Translator, contributed to Xbox Kinect, and pioneered the use of deep learning in large vocabulary speech recognition. From 1991-1993 he managed the speech team for Spain' s Telefonica. His first stint at Apple started in 1990. He is Affiliate Faculty at the University of Washington.

Dr. Acero is a Fellow of IEEE and ISCA. He received the 2017 Norbert Wiener Society Award, the 2013 Best Paper Award, and the 2006 Distinguished Lectureship from the IEEE Signal Processing Society. Alex received an engineering degree from the Polytechnic University of Madrid, a Masters from Rice University, and a PhD from Carnegie Mellon. Alex is author of the textbook "Spoken Language Processing" , over 250 technical papers and 150 US patents. Alex has served IEEE in many roles including the IEEE Board of Directors, the IEEE Foundation Board, and President of the IEEE Signal Processing Society.

Keynote

Human Perspective Scene Understanding via Multimodal Sensing

Chiori Hori | Senior Principal Research Scientist, Mitsubishi Electric Research Laboratories

ABSTRACT

The recent artificial intelligence (AI) boom and intelligent use of data acquired from various sensors has certainly accelerated the development of technologies needed to realize advanced human-like capabilities in machines. AI technologies have come a long way in accurately perceiving visual scenes and understanding speech —- even achieving super-human performance on certain tasks, e.g., speech recognition for overlapped utterances spoken by multilingual speakers. However, one important piece of technology is still missing: natural and context-aware human-machine interaction, where machines understand their surrounding scene from the human perspective and they are able to share their understanding with humans using natural language. Currently, there are no mechanisms for machines to have a conversation about a surrounding event or experience with humans using natural language. To bridge this communications gap, we have developed and built a new AI system, called Scene-Aware Interaction, enables machines to translate their perception and understanding of a scene and respond to it using natural language to interact more effectively with humans.

BIOGRAPHY

Chiori Hori

Dr. Chiori Hori is a Senior Principal Research Scientist at Mitsubishi Electric Research Laboratories (MERL) in Boston since 2015. Her work is focused on multimodal scene-aware interaction technologies toward human-robot communications. She spent 8 years at NICT prior to MERL after researching at CMU and NTT Communication Science Laboratories. She led the project for the world' s first open-domain QA system which enabled real-time over-a-million word vocabulary continuous speech recognition at NTT in 2004. She was the director of the Spoken Language Communication Laboratory of NICT and built a WFST-based speech recognition system which has been ranked first place in the competition of speech recognition performance on English TED speech at IWSLT in three consecutive years since 2012. The NICT speech recognition system has also been utilized for commercial products such as spoken dialog systems of NTT DOCOMO and speech translation systems of KDDI AU on smartphones. She received several awards including the Paper Award from IEICE in 2003, the 24th TELECOM System Technology Award by the Telecommunications Advancement Foundation in 2009, the International Cooperation Award from ITU-AJ in 2012, DOCOMO Mobile Science Award for Social Science Sector from Mobile Communication Fund in 2012 and the 58th Maejima Hisoka Award, Tsushinbunka Association, 2013. She has served on the editorial board of "Computer Speech and Language" and is a technical committee member of "Speech and Language Processing Group" of IEEE Signal Processing Society. She received BS and MS degrees from Yamagata University and Ph.D. degrees from Tokyo Institute of Technologies, respectively.

Invited

Brainmorphic computing hardware paradigm for edge AI

Yoshihiko Horio | Professor, Research Institute of Electrical Communication, Tohoku University

ABSTRACT

In order to realize near future edge AI, which provides personal and private services, ultra-compact and ultra-low power unobtrusive peri-personal space edge hardware is required. For such edge devices, adaptations to the user and environment with real-time continuous on-line learning, immediate responses, and non-volatile memory are mandatory. Therefore, to implement the space and power efficient peri-personal leaning edge AI devices, we need a novel non-von Neumann-type computational principle, architecture, and device. One of promising candidates is a brainmorphic computational paradigm with brain-specific computational schemes such as consciousness/sub-consciousness, prediction, inference, memory, attention, and self. In this talk, I introduce the brainmorphic computing paradigm and its hardware architecture. The brainmorphic computing hardware system should process information imitating the anatomical and physiological mechanisms of the brain by naturally using physical and dynamical characteristics of the constituent devices, especially through nonlinear analog circuits and devices. The latest knowledge from brain science, especially, on high-order brain specific functions emerged from high-dimensional complex neuro-dynamics, are reflected in the design of brainmorphic hardware. In addition, the bodily and environmental constraints are considered and utilized as embodiment in this hardware paradigm. Our efforts on physical implementation of the brainmorphic computing hardware are illustrated; for example, spin-torque orbit devices for neuronal and synaptic dynamics, and a chaotic neural network reservoir for computation through high-dimensional complex dynamics.

BIOGRAPHY

Yoshihiko Horio

Yoshihiko Horio currently is a professor at Research Institute of Electrical Communication, Tohoku University. He received the B.E., M.E., and Ph.D. degrees in electrical engineering from Keio University, Yokohama, Japan, in 1982, 1984, and 1987, respectively. From 1987 to 2015, he was with Tokyo Denki University where he was a professor from 2000. He is a Honorary Professor of Tokyo Denki University from 2020. From April 1992 to March 1994, he was a Visiting Professor at Center for Telecommunications Research, Columbia University, New York, U.S.A. From 1999 to 2002, he was a vice president of Epoch Technologies, LLC, U.S.A. He was a President of NOLTA Society, the Institute of Electronics, Information and Communication Engineers (IEICE). He received the Lifetime Achievement Award, NOLTA Society, IEICE in 2016. He is currently Fellow, IEICE, Director of Japanese Neural Network Society, and Editor-in-Chief of Nonlinear Theory and Its Applications, IEICE journal. His current research interest includes neuromorphic and brainmorphic hardware systems, VLSI information processing systems based on complex physical dynamics, and high-order brain-inspired VLSI systems with consciousness, self, and embodiment.

Invited

Real-world Intelligent Systems and Energy-Efficient Accelerators

Masanori Hariyama | Professor, Graduate School of Information Sciences, Tohoku University

ABSTRACT

In order to realize intelligent systems working in real world environment, we advance researches from two type of approaches. One is to develop intelligent algorithms/systems, and another is to develop high-performance and low-power accelerators for the intelligent algorithms, since intelligent algorithms requires a huge computational amount that exceeds the computational capability of conventional computers. In this presentation, we introduce our development examples of intelligent systems such as medical information system, IoT-based system to quantify child development, Material informatics, etc. Moreover, we introduce custom supercomputers for intelligent systems such as AI-based natural language processing, quantum annealing simulations to solve combinatorial optimization problems, etc.

BIOGRAPHY

Masanori Hariyama

Masanori Hariyama received the B.E. degree in electronic engineering, the M.S. degree in information sciences, and the Ph.D. degree in information sciences from Tohoku University, Sendai, Japan, in 1992, 1994, and 1997, respectively. He is currently a Professor with the Graduate School of Information Sciences in Tohoku University. His research interests include real-world applications such as robotics and medical information systems, big-data analysis such as human-behavior analysis, high-performance computing such as quantum computing simulation.

Invited

Searching for rare atomic nuclei via image analysis using machine learning

Junya Yoshida | Assistant Professor, Graduate School of Science, Tohoku University
Visiting Scientist, High Energy Nuclear Physics Laboratory, RIKEN

ABSTRACT

We are studying rare atomic nuclei called "hypernuclei" that consist of protons, neutrons, and other types of particles. They can be produced with beams from high-intensity particle accelerators, but quite rarely. Although they are unstable with a lifetime of a billionth of a second, they are important for understanding interactions among the particles which make up atomic nuclei and a dense stellar object called a neutron star. To search for a special type of hypernuclei ("double hypernuclei"), we have used dedicated photographic sheets, irradiating them with beams and recording "events" of production and decay of double hypernuclei. Optical micrographs of the recorded image with sub-micrometer spatial resolution allows us to identify double hypernuclei. We have found a few instances of uniquely identified double hypernuclei, but the observed number is limited due to their small production probability, huge background, and loads of visual inspection. It is expected that deep mining of the images in the irradiated photographic sheets shall reveal a thousand of double hypernuclear events. To achieve the deep mining, we introduced machine learning for image analysis. One of the major challenges is image synthesis to compensate for the lack of training data. We developed a method to produce training data with physics simulations and a GAN. Another challenge is on evaluating the performance of machine learning models. We used several kinds of typical events recorded in the photographic sheets to evaluate the performance of the developed models. We will discuss the progress and outlook of our development.

BIOGRAPHY

Junya Yoshida

Junya Yoshida is an assistant professor in the Graduate School of Science at Tohoku University and a visiting scientist in the High Energy Nuclear Physics Laboratory at RIKEN. He is currently stationed at RIKEN. His current research interests are on experimental nuclear physics using nuclear emulsions and machine learning. His main research activities are on exotic nuclei with strange-quarks, so-called hypernuclei. He contributed to the first observation of a candidate of a Xi hypernucleus, and he received the 22nd Outstanding Paper Award of the Physical Society of Japan as a co-author of the paper reporting the observation. He is also interested in the application of the nuclear emulsion technique to other fields. Particularly, he is currently developing detectors to measure precisely thermal or cold neutron beams for non-destructive inspections. He obtained a Ph.D. degree from the Department of Physics at Nagoya University in 2013. Following the doctoral study, he worked as a postdoc researcher at Gifu University from 2013 to 17 and the Advanced Science Research Center at Japan Atomic Energy Agency from 2017 to 20.

Keynote

Human resource development cost as an essential investment forestablishing sustainable society

Hiroshi Amano | Professor, Institute of Materials and Systems for Sustainability
Center for Integrated Research of Future Electronics, Nagoya University

ABSTRACT

Our DII Collaborative Graduate Program for Accelerating Innovation in Future Electronics (DII program) has been ongoing since 2018. The DII programs aim to foster a cluster of talent who can accomplish product innovation within 10 years, which previously required 30 years or longer. This program is designed to nurture three types of human resources who will play different roles in continually creating product innovation in future electronics. Believing that cooperation and collaboration between these different types of personnel toward a common goal is the key to accelerating innovation, we call this partnership the DII Collaboration, which is based on the names of the three types of personnel.

Deployers : Conceptualize and plan the creation of social values through innovative products.

Innovators : Anticipate the final product from seeds, resolve technical challenges in the development of the product, and bring the process to completion.

Investigators : Ingeniously clarify social issues and propose a solution based on their deep insight.

A key feature of this program is the involvement of mentors from industry: not only from manufacturing-based companies, but also from entrepreneurial support companies and national research institutes. The degree offered by the DII program is independent of the conventional Ph.D. program. The DII program provides an unrivaled opportunity for enthusiastic students who want to apply their knowledge to realize innovation, and the entire staff of the DII program is proud to provide this program to young students.

BIOGRAPHY

Hiroshi Amano

Hiroshi Amano received his BE, ME and DE degree in 1983, 1985 and 1989, respectively, from Nagoya University. From 1988 to 1992, he was a research associate at Nagoya University. In 1992, he moved to Meijo University, where he was an assistant professor, associate professor from 1998 till 2002, and professor from 2002 till 2010. He moved to Nagoya University, where he was a professor of Graduate School of Engineering from 2011 till 2015. On Oct. 1, 2015, he became a director of Center for Integrated Research of Future Electronics, Institute of Materials and Systems for Sustainability, Nagoya University. He has also been the director of the Akasaki Research Center, Nagoya University since 2011.

During his doctoral program at the Nagoya University Graduate School of Engineering, he was able to realize high-quality epitaxially grown GaN film with metal-organic vapor phase epitaxy, p-type GaN film doped with Mg while conducting research with Professor Akasaki. For the first time in history, he established the technology necessary for the production of blue LEDs, thus performing a great achievement the development of the high-luminosity blue LED.

He is currently developing energy-saving technologies for the fabrication of efficient high-power/high-frequency semiconductor devices at Nagoya University. Prof. Amano shared the Nobel Prize in Physics 2014 with Prof. Isamu Akasaki and Prof. Shuji Nakamura "for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources".

Keynote

Computer Vision: Geometry, Uncertainty and Deep Learning

Roberto Cipolla | Professor of Information Engineering, University of Cambridge

ABSTRACT

The last decade has seen a revolution in the theory and application of computer vision and machine learning. I will begin with a brief review of some of the fundamentals with a few examples of the reconstruction, registration and recognition of three-dimensional objects and their translation into novel commercial applications. I will then introduce some recent results from real-time deep learning systems that exploit geometry and compute model uncertainty. Understanding what a model does not know is a critical part of safe machine learning systems. New tools, such as Bayesian deep learning, provide a framework for understanding uncertainty in deep learning models, aiding interpretability and safety of such systems. Additionally, knowledge of geometry is an important consideration in designing effective algorithms. In particular, we will explore the use of geometry to help design networks that can be trained with unlabeled data for stereo and for human body pose and shape recovery.

BIOGRAPHY

Roberto Cipolla

Professor Cipolla has been a Professor of Information Engineering at the University of Cambridge since 2000. Previously he worked as a Toshiba Fellow and engineer at the Toshiba Corporation Research and Development Centre in Kawasaki, Japan, and was awarded a D.Phil. (Computer Vision) from the University of Oxford in 1991. Roberto' s research interests are in computer vision and robotics and include the recovery of motion and 3D shape of visible surfaces from image sequences; object detection and recognition; novel man-machine interfaces using hand, face and body gestures; real-time visual tracking for localisation and robot guidance; applications of computer vision in mobile phones, visual inspection and image-retrieval and video search.

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