Information

Event Report: NTT Communication Science Laboratories Open House 2018

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Abstract

NTT Communication Science Laboratories Open House 2018 was held in Keihanna Science City, Kyoto, on May 31 and June 1, 2018. Over 1600 visitors enjoyed 6 talks and 29 exhibits, which included our latest research efforts in the fields of information and human sciences.

Keywords: information science, human science, artificial intelligence

1. Overview

NTT Communication Science Laboratories (CS Labs) aims to establish technologies that enable *heart to heart* communication between people and people, and between people and computers. We are thus working on a fundamental theory that approaches the essence of human beings and information, as well as on innovative technologies that will transform society.

NTT CS Labs Open House has been held annually with the aim of introducing the results of the CS Labs' basic research and innovative leading-edge research to both NTT Group employees and visitors from industries, universities, and research institutions who are engaged in research, development, business, and education.

This year, the Open House was held at the NTT Keihanna Building in Kyoto on May 31 and June 1, and over 1600 visitors attended it over the two days. We prepared many hands-on exhibits to allow visitors to intuitively understand our latest research results and to share a vision of the future where new products based on the research results are widely used. We also organized an invited talk. This article summarizes the event's research talks and exhibits.

2. Keynote speech

The event started with a speech by the Vice President and head of NTT CS Labs, Dr. Takeshi Yamada, entitled "Shift to new dimensions—Further initiatives to deepen Communication Science" (**Photo 1**).

Dr. Yamada mentioned the remarkable progress

Photo 1. Dr. Takeshi Yamada delivering keynote speech.

Photo 2.   Dr. Yasuhiro Takahashi giving research talk.

Photo 3.   Dr. Junji Watanabe giving research talk.

being achieved in deep learning, including recent developments in artificial intelligence (AI) technologies, and said that CS Labs must not only consist of a group of masters who use these leading technologies at a high level but also a group of researchers who are constantly taking on challenges that will open up new dimensions. He then introduced recent efforts in human and information science research at CS Labs. He discussed how to cope with risks and uncertainties accompanying these new initiatives by explaining the Exploration-Exploitation dilemma, which is well known in the field of AI research. The dilemma involves whether to do deeper research in a field we have already studied (i.e., Exploitation), or to explore a field about which we have less experience and do research widely (i.e., Exploration). He declared that every researcher at CS Labs who is responsible for long-term fundamental research will seek to discover and explore new, unknown expanses of knowledge boldly and resolutely.

3.   Research talks

Four research talks were given, as summarized below, which highlighted recent significant research results and high-profile research themes. Each presentation introduced some of the latest research results and provided some background and an overview of the research. All of the talks were very well received.
(1)   "The real worth of quantum computers with elementary operations—Analysis of computational power of gate-based quantum comput-

ers," by Dr. Yasuhiro Takahashi, Media Information Laboratory

Dr. Takahashi focused on a gate-based quantum computer, which has theoretical evidence of being more powerful than today's computers. There are many problems in realizing gate-based quantum computers equipped with a sufficient amount of computational resources, but he nevertheless introduced two of his recent results demonstrating that gate-based quantum computers are still powerful even under the more realistic condition where computational resources are limited (**Photo 2**).
(2)   "Role of haptics in improving wellbeing—Science and design of touch can enhance human flourishing," by Dr. Junji Watanabe, Human Information Science Laboratory

Dr. Watanabe introduced a recently launched study on wellbeing. Wellbeing is gathering attention because research on designing mind-enriching information technology has been pursued recently from a standpoint that is different from the one aiming to merely achieve greater efficiency. He introduced several topics including measuring and specifying factors of wellbeing and modifying cognitive and empathetic attitudes towards oneself and others with haptic experiences (**Photo 3**).
(3)   "Beyond combinatorial explosion—Enumeration and optimization with Binary Decision Diagrams," by Dr. Masaaki Nishino, Innovative Communication Laboratory

Dr. Nishino focused on a phenomenon called

Photo 4.   Dr. Masaaki Nishino giving research talk.

Photo 5.   Dr. Sadao Hiroya giving research talk.

a combinatorial explosion, in which the number of possible combinations increases exponentially with the number of elements, which we have often experienced in a grouping or travel routes search. He explained how the number of combinations created by the combinatorial explosion can be counted by algorithms based on the data structure called a binary decision diagram (**Photo 4**).

(4)   "Speech production and perception share common brain pathways—Investigation of the mechanisms of speech communication by speech conversion and brain imaging," by Dr. Sadao Hiroya, Human Information Science Laboratory

Dr. Hiroya introduced research on neural mechanisms underlying speech communication and showed the existence of the common pathways in the brain between speech production and perception, even though it has been considered that the pathways are different. He also discussed the difference between human brain mechanisms and speech recognition and synthesis techniques (**Photo 5**).

4.   Research exhibits

The Open House featured 29 exhibits displaying CS Labs' latest research results. We categorized them into the following four areas: "Science of Machine Learning," "Science of Communication and Computation," "Science of Media Information," and "Science of Humans."

Each exhibit was housed in a booth and employed techniques such as slides on a large-screen monitor or hands-on demonstrations, with researchers explaining the latest results directly to visitors (**Photos 6** and **7**). The following list, taken from the Open House website, summarizes the research exhibits in each category.

4.1   Science of Machine Learning
- Finding similar voice recordings in big data—Graph index-based audio similarity search
- Learning feature combinations from multiple tasks—MOFM: low-rank regression for learning common factors
- Where do they come from? Where are they going?—"Data assimilation and navigation learning for crowd"
- Datafying cities—Event analysis by environmental sensing and machine learning
- Memory efficient deep learning for mobile devices—Quantized neural networks for model compression
- Optics makes machine learning much faster—Photonic reservoir computing for high-speed machine learning
- Interpreting deep learning from network structure—Detecting communities in trained layered neural networks

4.2   Science of Communication and Computation
- Can I borrow your quantum memory?—High-speed quantum computations with uninitialized qubits
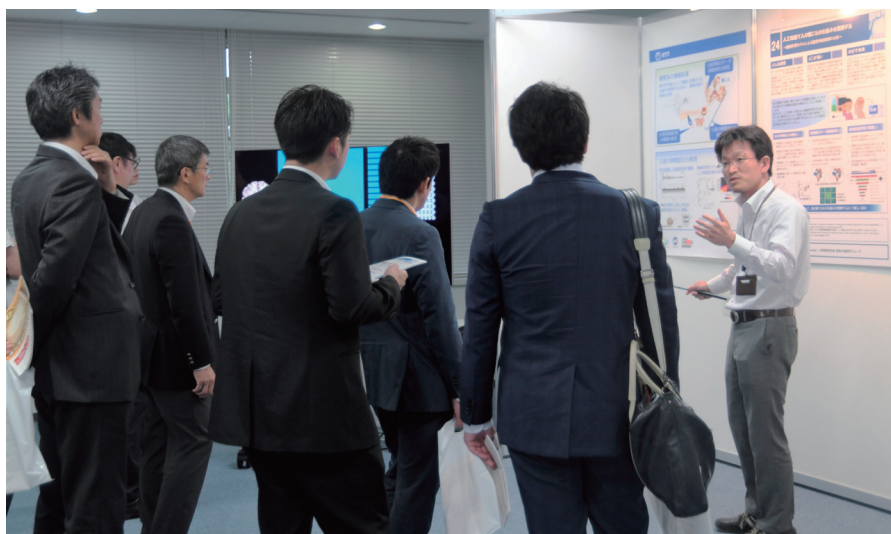
Photo 6.   The latest research results were exhibited.

Photo 7.   Researchers explaining a demonstration.

- Designing fault-tolerant networks—Maximizing network reliability via binary decision diagrams
- Can computer translate considering context?—Context understanding tests for neural machine translation
- Early vocabulary development in late talkers—Collecting and analyzing data from pediatric medical fields
- Chatting with robots broadens your knowledge—Integration of chat and QA based on two-robot coordination
- Anytime, anywhere, we can speak like a native!—Speech rhythm conversion by mobile application

- Sharing enthusiasm between remote sites—Applause coding for bi-lateral immersive sharing

4.3 Science of Media Information
- Illumination-based color saturation control—Spectral operation using color enhancement factors
- Pay attention to the speaker you want to listen to—Computational selective hearing based on deep learning
- Solving two-choice questions makes AI clever—Deep pairwise comparison model for ASR hypothesis selection
- Estimating objects' visuals only from audio—Cross-media scene analysis
- Cast shadows add dimensions—Projection mapping giving depth illusion to real objects
- Converting impression and intelligibility of speech—Speech attribute conversion using deep generative models
- Creating favorite images with selective decisions—Hierarchical image analysis and synthesis with DTLC-GAN

4.4 Science of Humans
- Predicting attention to the ears by the eyes—Auditory spatial attention revealed as pupillary response
- Measuring, understanding, and empowering wellbeing—Cross-disciplinary research toward "eudaimonic wellbeing"
- Understanding human hearing with AI—Analyzing auditory neural mechanisms with machine learning
- How do excellent batters hit the ball?—Cognitive processes revealed by body movements in batting
- How do excellent batters look at the ball?—Cognitive processes revealed by eye movements in batting
- The sooner you decide, the better you can localize—Visual motion processing in the perception and action
- Let's FEEL shape and action by a force—Can we receive environmental information by Buru-Navi4?
- Feeling bumps on a flat sheet—Magnetic haptic printing technology

5. Invited talk

This year's event also featured an invited talk by Dr. Hiroshi Nakagawa, group director, Artificial Intelligence in Society Research Group, RIKEN Center for Advanced Intelligence Project. The title of his talk was "AI, ethics and social impact." He explained ethics guidelines for developing AI systems proposed in domestic and international organizations, personal data protection in big data utilization, and the proper way to have a relationship with AI. He also discussed the hot topic of whether AI will take away all our jobs. He pointed out that natural language processing will be one of the most important research fields for future AI technologies and explained the importance of redefining what our jobs are by ourselves from a higher viewpoint.

6. Concluding remarks

Just like last year, many visitors came to NTT CS Labs Open House 2018 [1, 2] and engaged in lively discussions on the research talks and exhibits and provided many valuable opinions on the presented results. In closing, we would like to offer our sincere thanks to all of the visitors and participants who attended this event.

References

[1] Website of NTT Communication Science Laboratories Open House 2018 (in Japanese).
http://www.kecl.ntt.co.jp/openhouse/2018/index.html
[2] Website of NTT Communication Science Laboratories Open House 2018 (in English).
http://www.kecl.ntt.co.jp/openhouse/2018/index_en.html

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