Embracing Information Science and Technology—Decoding, Exploring, and Designing the World

Eisaku Maeda

Abstract

The era in which human beings are confronted with machines (computers or artificial intelligence) as disparate elements is coming to an end. From here on, we will embrace information science and technology as part of ourselves. This will necessitate the ability to decode, explore, and design the entire world, including us human beings. While bearing in mind the drastic changes in the information environment that we have experienced in the first fifteen years of the twenty-first century, we must think about what should make up the basic research that will form the compass of the future as we envision the year 2030, fifteen years from now.

Keywords: basic research, innovation, information science

1. Introduction

The recent era is one in which human beings have *faced off* against "machines" (computers or artificial intelligence), so to speak. This era is coming to an end. From this point on, we will embrace information science and technology as part of ourselves. This means that we will need to be able to decode, explore, and design everything in the entire world, including us human beings. Consequently, we must think about what the basic research will be that will form the compass of the future as we envision the year 2030, fifteen years from now, while still keeping in mind the drastic changes in the information environment that we have so far experienced in the twenty-first century. Thanks to the development of information science and technology, the real world in which we embrace information science and technology and are in turn embraced by it, is changing greatly in the following three ways.

1.1 From measuring to understanding

The first turning point is a transition from an era in which physical quantities in the real world are measured by sensors to an era in which diverse information flows through two types of space-time environments—the real world and the virtual world—and are decoded. Sound-recording microphones will be replaced by microchips that decode the audio environment. Such a development will be equivalent to the evolution of human beings' audiovisual processing system, which includes the sensory organs such as the ears and eyes and the frontal lobe of the cerebral cortex. The growing intelligence of sensor devices that continue to evolve in the real world can be said to be the origin of the aforementioned turning point. A similar evolution is happening in the virtual world. This development will necessitate new security technologies.

1.2 From analysis to exploration

Second, we will transition from an era of analysis, in which massive amounts of data are gathered and analyzed using statistical techniques, to an era of exploration, in which the conclusions necessary for control or decision-making can be immediately acquired.

There are two major features to exploration in the age of big data. The first is that an exploratory result will be presented with a probability value attached.

The second is the possibility of fast yet inexpensive exploration. This will be the key to the new age. With the arrival of big data, an empirical element is being added to the academic discipline that is information science. These two features can be likened to the key of improving productivity through assay (screening) in the experimental sciences and manufacturing science.

1.3 From implementation to design

The third aspect is the move from an age of implementation in which information processing technologies in the form of machines are actuated in the real world, to an age in which design is optimized for the overall system that connects both the real world and the virtual world into a cyber-physical system. Because the enterprise to design the overall world is itself a decoding application, recursive methods will expand our understanding of the world outward in a spiral. The research we are tackling right now can be placed in the flow of decoding, exploring, and designing the world.

2. Communication science as the compass for the future

The research topics being tackled by NTT Communication Science Laboratories today can be placed in the flow of decoding, exploring, and designing the world. If we classify the technologies introduced in these Feature Articles into these three categories, we can consider the technologies introduced in "Biological Measures that Reflect Auditory Perception" [1] and "Deep Learning Based Distant-talking Speech Processing in Real-world Sound Environments" [2] to be technologies for decoding the real world. We can consider the technology described in "Combinatorial Optimization Using Binary Decision Diagrams" [3] to be technology for searching in the real world, and those in the articles "Generative Modeling of Voice Fundamental Frequency Contours for Prosody Analysis, Synthesis, and Conversion" [4] and "Yu bi Yomu: A New Text Display System Using Tracing Behavior" [5] to be technologies for designing the real world. Another technology for designing the real world is described in "'Hen-Gen-Tou (Deformation Lamps)'—Amazing Illumination to Make Static Objects Dynamic" [6].

The information environment that permeates our lives has dramatically changed since the beginning of the twenty-first century, and the intensity of the transformation is continuing to grow. Even in the field of basic research, we are now in an era in which we must choose the challenges to tackle and we must contribute to introducing new technologies to the market with a sense of urgency of the times. As NTT seeks to create new markets by exploiting *Co-Innovation* through collaboration with companies in other industries, it can be said that, in fact, the expectation placed on the value of basic research and its fruits is becoming even greater. Each of the fruits born from basic research is a valuable seed of innovation. They are waiting for the arrival of the right time to blossom [7, 8].

Just when and where are technologies with the potential for innovation born? Understanding and exploiting this insight quickly is the key to winning the competition to create services, even in the field of research and development. The mission of private basic research is to diligently refine technologies that blossom a few years or a decade from now as we respond to the demands of the times. It is also to resolutely continue the intellectual challenge of creating a new world that others have not arrived at yet by creating new knowledge and patiently verifying it to build it up [9]. The research achievements of NTT Communication Science Laboratories are posted on our website as the occasion arises. We also introduce our efforts at the open house held in June every year [10].

References

[1] S. Furukawa, S. Yamagishi, H-I Liao, M. Yoneya, S. Otsuka, and M. Kashino, "Biological Measures that Reflect Auditory Perception," NTT Technical Review, Vol. 13, No. 11, 2015. https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201511fa3.html

[2] S. Araki, M. Fujimoto, T. Yoshioka, M. Delcroix, M. Espi, and T. Nakatani, "Deep Learning Based Distant-talking Speech Processing in Real-world Sound Environments," NTT Technical Review, Vol. 13, No. 11, 2015. https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201511fa4.html

[3] M. Nishino, N. Yasuda, T. Hirao, S. Minato, and M. Nagata, "Combinatorial Optimization Using Binary Decision Diagrams," NTT Technical Review, Vol. 13, No. 11, 2015. https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201511fa6.html

[4] H. Kameoka, "Generative Modeling of Voice Fundamental Frequency Contours for Prosody Analysis, Synthesis, and Conversion," NTT Technical Review, Vol. 13, No. 11, 2015. https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201511fa2.html

[5] K. Maruya and J. Watanabe, "Yu bi Yomu: A New Text Display System Using Tracing Behavior," NTT Technical Review, Vol. 13, No. 11, 2015. https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201511fa5.html

[6] NTT press release issued on Feb. 17, 2015. http://www.ntt.co.jp/news2015/1502e/150217a.html

[7] E. Maeda, “The Evolution of Basic Research,” NTT Technical Review, Vol. 12, No. 11, 2014.
https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201411fa1.html
[8] E. Maeda, “Basic research—Defining our age and the future - The origin of ideas and the seeds of innovation,” Director’s address of NTT Communication Science Laboratories Open House 2014, Kyoto, Japan, June 2014.
http://www.kecl.ntt.co.jp/openhouse/2014/talk/director/index_en.html
[9] E. Maeda, “The Enchantment of Turning toward Academics,” IEICE Information and System Society Journal, Vol. 19, No. 2, pp. 21–22, 2014 (in Japanese).
[10] Website of NTT Communication Science Laboratories Open House 2015.
http://www.kecl.ntt.co.jp/openhouse/2015/index_en.html

Eisaku Maeda
Vice President, Head of NTT Communication Science Laboratories.
He received a B.E. and M.E. in biological science and a Ph.D. in mathematical engineering from the University of Tokyo in 1984, 1986, and 1993. He joined NTT in 1986. He was a guest researcher at the University of Cambridge, UK, in 1996–1997. He was awarded IPSJ’s 45th anniversary best paper on the next 50 years of information science and technology for his paper “Resurgence of Fairies and Goblins—A Proposal for the New Vision of “Ambient Intelligence.” His research interests are statistical machine learning, intelligence integration, and bioinformatics. He is a fellow of IEICE (Institute of Electronics, Information and Communication Engineers of Japan) and a senior member of IEEE (Institute of Electrical and Electronics Engineers) and IPSJ (Information Processing Society of Japan).