From Information Transmission to Mutual Understanding: Paradigm Shift in the Age of Data

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Abstract

The paradigm shift from information transmission to communication is taking place amid technological advancements in artificial intelligence (AI) and their attendant expectations. Against this background, I introduce NTT's AI-related research and development strategy and the research currently being pursued by NTT Communication Science Laboratories. I also examine the role played by communication science and present a vision of its future.

Keywords: communication, artificial intelligence, human-computer interaction

1. NTT's AI technology "corevo™"

In recent years, interest in artificial intelligence (AI) has risen sharply. AI is wrapped up in excessive expectations and disenchanted criticism. However, at the very least, new AI-related discoveries and technologies are undoubtedly transforming systems of the world. To make the right investments in the future, we must properly understand the technological foundation of AI and its latent possibilities.

At NTT, the NTT Group's AI technology is given the brand name corevo™. The name incorporates the idea of collaborating with a variety of players to bring about a revolution. However, corevo does not emulate human intelligence or thinking. Instead, it encompasses AI technologies that seek to overcome social issues and strengthen industrial competitiveness by supporting human activities and complementing and drawing out human abilities.

To develop the AI-related elemental technologies that make up corevo, NTT is leveraging its strength as a communication carrier to conduct AI research in four directions [1] (**Fig. 1**). NTT has developed groups of diverse technologies in each of the four AI directions: Agent-AI, which seeks to understand the intentions and emotions of people active at work and play and to lend assistance for contact centers and for support of the elderly; Heart-Touching-AI, which supports improvement in sports and mental wellness by enhancing the human essence; Ambient-AI, which governs intelligent sensors as the brain of IoT (Internet of Things) that lie at the core of operations such as healthcare and traffic control; and Network-AI, which supports ultra-distributed real-time processing of massive systems, for example total optimization on a global scale (**Fig. 2**). AI does not refer to several specific technologies. Instead, it should be viewed as the name of functions or services realized by combining a variety of technologies related to human beings and communication.

2. Market economics of intelligence

Undoubtedly, what led to the start of immense power being wielded by AI as a practical technology is the gathering and utilization of big data. To be sure, there are fields in which it is difficult to gather and utilize big data such as in the discovery and analysis of rare illnesses in medicine. There are also AI technologies that can demonstrate their effectiveness without big data. However, major technological tools that leverage big data, as exemplified by deep learning, are becoming critical elements of AI.

Through the process of information circulation,

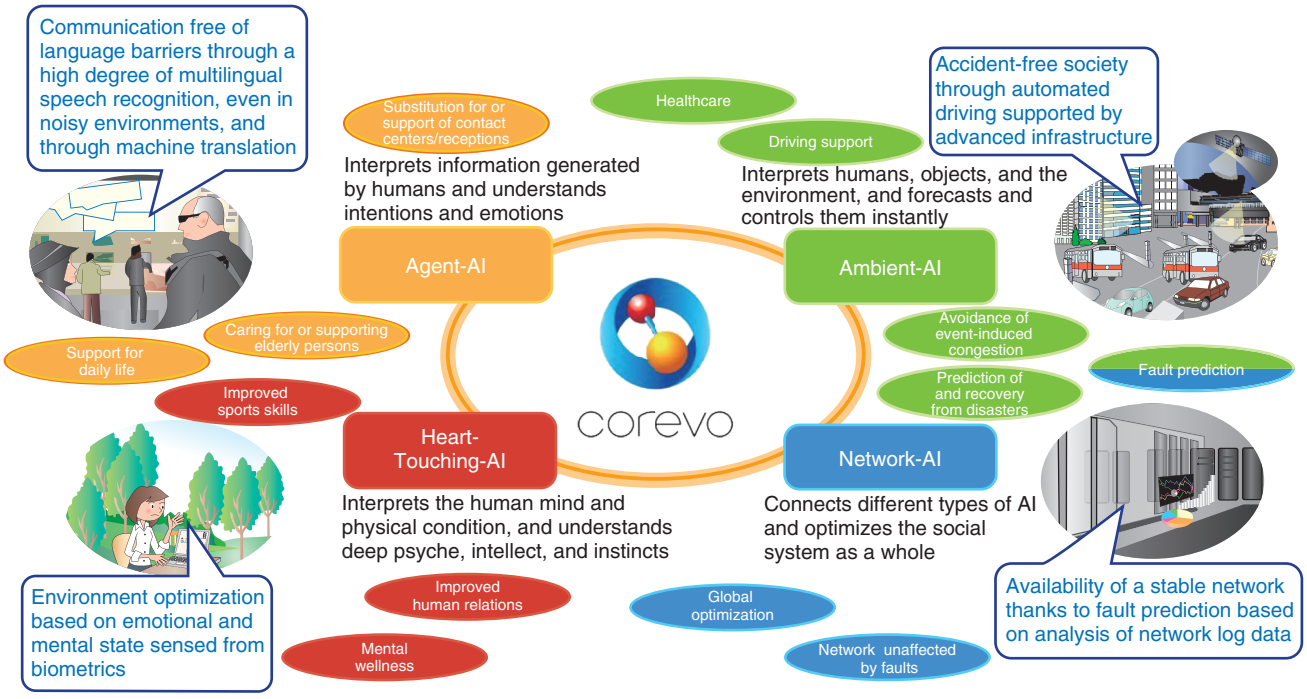
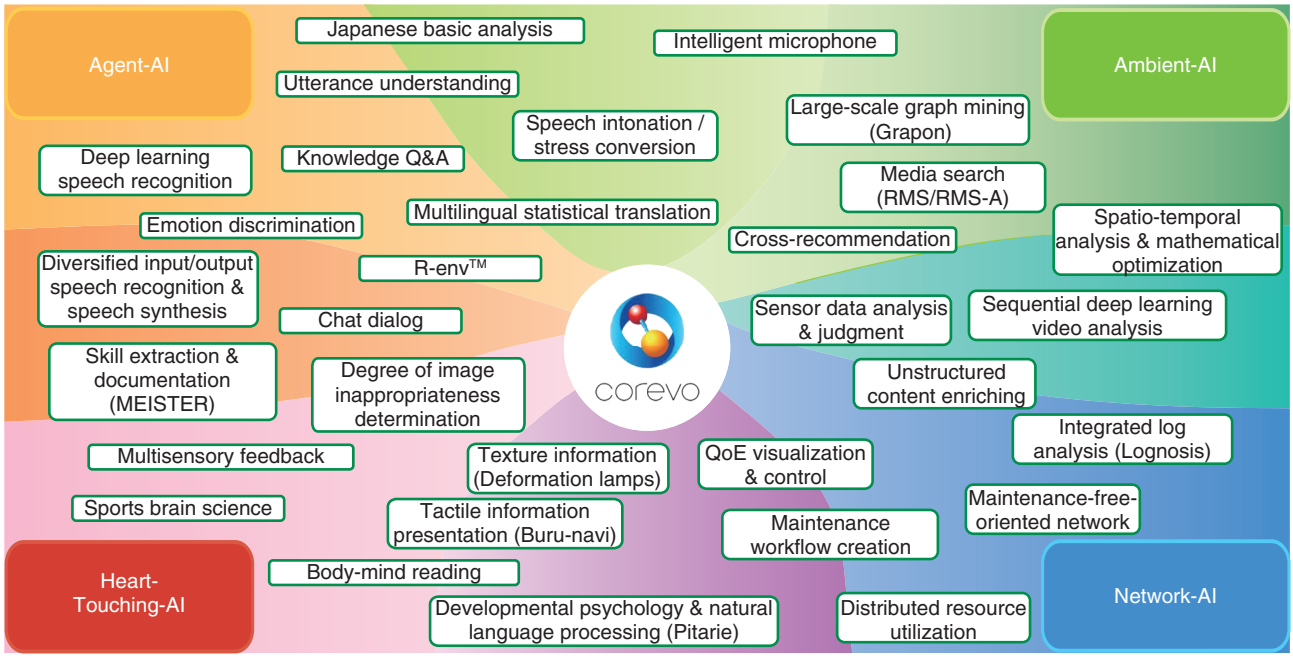


Fig. 1. Four types of AI that make up corevo™.



RMS: robust media search
QoE: quality of experience

Fig. 2. Constitutive technologies and modules of corevo™.

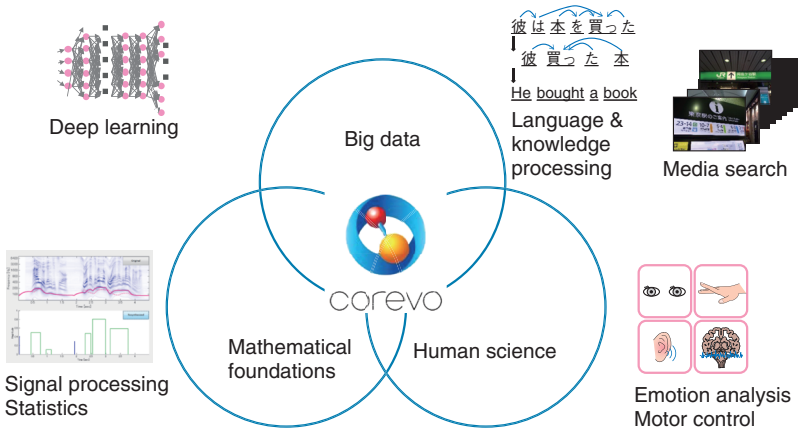


Fig. 3. Technological foundation of AI.

which involves obtaining data from just about anything (people, objects, environments) in the real world and decoding, searching (exploring), and designing (implementing) elements in the world, the results are fed back to the real world [2]. Models of intelligence will be created from all sorts of data related to people, including their written words, actions, speech, images, voices, vital statistics, and muscle and brain activity. Through this process, intelligence in a variety of forms is broken down and componentized. Sooner or later, an era in which these components are treated as products in the market economy will surely arrive. At that time, the product cost of intelligence as components will be influenced by the cost of gathering and analyzing big data.

3. Exploring the essence of communication

Research on communication involving human beings is becoming ever more important. This includes research that forms the foundation of communication transmission and information, for example, research on voice communication to make VoLTE (voice over Long Term Evolution) a practical reality [3] and research on extracting necessary knowledge from vast amounts of information [4]. Other areas include research on machine intelligence that handles information in place of humans [5], research on how human beings transmit and receive information between two parties [6], research on diverse communication styles among people [7], and research on mechanisms to support people [8].

Research on AI in the broad sense is composed of technologies that act as substitutes for human intelligence and technologies that enhance human intelligence. The three major areas for advancing research in these technologies are big data, mathematical foundations, and human sciences (**Fig. 3**). AI technologies in diverse forms, from practical voice recognition and machine translation to sensing technologies that can decode human emotions and actions, are being incorporated into real life. In the midst of this trend, the time has come to reconsider the essence of *communication*. The environment surrounding human beings is greatly changing despite fixed constraints; the flow of physical time is constant, and the lifespan of human beings as organisms remains largely unchanged. I wish to sketch out a design plan of the future that broadly and deeply explores the essence of communication between person and person, and person and machine.

References

[1] Feature Articles: "Artificial Intelligence Research Activities in NTT Group," NTT Technical Review, Vol. 14, No. 5, 2016. https://www.ntt-review.jp/archive/2016/201605.html
[2] E. Maeda, "Embracing Information Science and Technology—Decoding, Exploring, and Designing the World," NTT Technical Review, Vol. 13, No. 11, 2015. https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201511fa1.html
[3] Y. Kamamoto, T. Moriya, and N. Harada, "Transmission of High-quality Sound via Networks Using Speech/Audio Codecs," NTT Technical Review, Vol. 14, No. 11, 2016. https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201611fa2.html
[4] M. Blondel, A. Fujino, and N. Ueda, "Learning from a Large Number of Feature Combinations," NTT Technical Review, Vol. 14, No. 11, 2016. https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201611fa3.html

[5] H. Sugiyama, R. Higashinaka, and T. Meguro, "Towards User-friendly Conversational Systems," NTT Technical Review, Vol. 14, No. 11, 2016.
https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201611fa4.html
[6] Y. Okumura, T. Kobayashi, and Y. Oshima-Takane, "Child Language Development: The Differences between Japanese and English," NTT Technical Review, Vol. 14, No. 11, 2016.
https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201611fa5.html
[7] T. Kimura, K. Takahashi, D. Mikami, and M. Kashino, "Elucidating the Brain Processing Mechanisms of Athletes Using Virtual Reality Technology," NTT Technical Review, Vol. 14, No. 11, 2016.
https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201611fa6.html
[8] N. Yamashita, "How Tracking Technologies Improve Family Communication," NTT Technical Review, Vol. 14, No. 11, 2016.
https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201611fa7.html

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