TECHNOLOGY STRATEGY

Recognizing major structural changes in society stemming from digital transformation and technological innovation, OKI conducts R&D aimed at realizing its growth strategy. While inheriting the technical strengths cultivated in our electronics and mechatronics businesses, we seek to resolve social issues identified in the United Nations' SDGs. Here, we envisage the ideal future images of priority areas, then engage in backcasting in order to select technological fields that we should reinforce. We are also leveraging the OKI Innovation Management System (Yume Pro) to develop concepts from the perspective of customer value while conducting research in a flexible and speedy manner.

From "Connecting" to "Circulating"

Under Mid-term Business Plan 2019 (fiscal year 2017–2019), we have pursued R&D with focuses on "smart sensing" and "humane mechatronics" in order to increase the value of "connecting" in the physical and digital edge domains. We use these technologies to connect various devices to networks and conduct high-level sensing of people's lifestyles and social conditions, and deploy edge technologies to help realize top-quality services. In future society, the function of "connecting" will become a matter of course, and people will always live in an online environment in which the physical world is enveloped by digital technologies. In this context, OKI is monitoring social changes brought about by the conversion of information into knowledge and the concept of "circulating" to deliver growth. For example, information gets "circulated" between companies and consumers and becomes knowledge, enabling services to become more convenient. Meanwhile, multiple companies engage in a "circular" process to grow their businesses by connecting both ends of a linear value chain with information and knowledge. These changes can be seen in our circular economy including resources and environmental viewpoints.

Based on this new view of society, we have identified technologies—centered on high-real-time AI, cultivated through our involvement in edge computing—that we should reinforce in order to "circulate" information and knowledge to achieve growth. Specifically, we are focusing on four domains: sensing, networks, robotics, and user experience. By linking these technologies and incorporating the "circulation" of knowledge—gained through co-creation with customers and partners—into the research process, we will realize our growth strategies and help build safer and more convenient social infrastructures.

Sensing

Our smart sensing technologies, cultivated through our experience in sound, light, radio-waves, and vision, have been developed from detection and measurement to cognitive technologies due to AI evolutions. To achieve further progress in this digital-edge domain, we are working to enhance our sensor hardware, apply AI to maximize flexibility, and integrate sensor fusion and mobility to expand functionality.

Networks

OKI has been conducting R&D and social implementations in such areas as optical fiber communication, wireless sensor network technologies, and V2X communication. Today, many devices have become part of the "connected" world, heralding the beginning of collaboration between these distributed devices and the linking of new distributed information mechanisms, such as blockchains. Our aim is to strengthen technologies in the network domain to ensure that information is circulated between devices more safely, efficiently, and conveniently.

Robotics

Safe robots, such as service robots and collaborative robots, can move in close proximity to people and have come to be used in a wide range of applications. While to advances in modularization stemming from market expansion, it is becoming easier to combine existing functions to develop new ones as necessary. Bringing its expertise in sensing and network technologies to this domain, OKI will foster the spread of highly practical robotics technologies that have a high-level combination of AI autonomy and human flexibility.

User Experience

OKI has sought to improve human-machine interaction technologies in the edge domain. By developing these technologies and creating a natural circulation of information between humans and machines, we will continue creating devices that give people a sense of security and the optimum support.

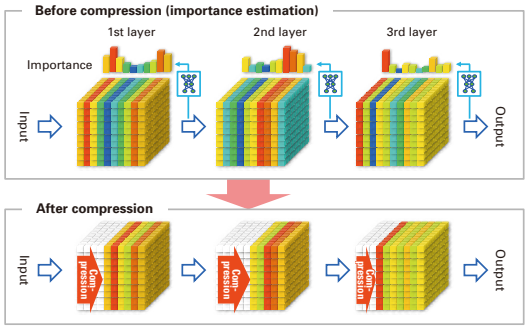
R&D Case Study

Using AI to Enhance Edge Domains

OKI is promoting R&D on AI-based edge computing technology by integrating advanced AI functions into highly reliable edge devices. The functions required for edge computing are diverse, however, we believe it is important to develop advanced AI technologies with high inference accuracy and to incorporate such technologies into edge devices with limited computing power then to achieve automatic service mediation through collaboration between edge devices.

In the sensing domain, we are working on object detection and tracking technology across a very wide spectrum. With conventional detection technology, it is difficult to accurately detect tiny objects or objects partially hidden in images. Deploying advanced deep learning modeling technology to overcome these challenges, we are currently conducting R&D on a new AI model that uses high-resolution cameras (4K/8K, for example) to detect and track numerous objects up to several kilometers away. These advanced AI models are very computationally intensive. Nevertheless, we are also engaged in R&D on new model compression technologies, achieved by learning ways to minimize accuracy degradation. We announced the results of our work at an international conference*1 held in the United Kingdom in September 2019. In the network domain, we are working on technologies to enhance cooperation and collaboration between AI-embedded edge devices. By synchronizing factory production and logistics AI schedules, for example, we are developing a technology for cooperating with traffic control AI to prevent trucks from getting involved in traffic jams. This technology works together intelligently between multiple AI devices to achieve wide-area optimization. In addition to machine learning, we aim to realize it by combining multiple technologies, such as multi-agent technology, game theory, and AI cooperation.

Thanks to these works, OKI has been commissioned to participate in R&D projects*2 by the National Research and Development Agency New Energy and Industrial Technology Development Organization (NEDO). Our aim is to accelerate development and facilitate application of technologies to focal business areas.



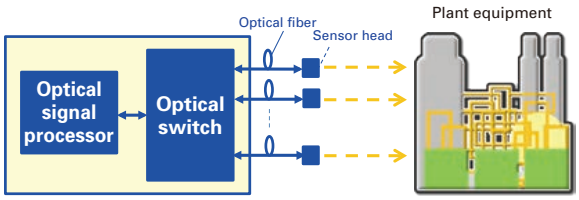
AI model compression technology

Expanding Optical Signal Processing Technology for Wider Application Fields

OKI is applying its advanced optical signal processing technologies, developed over many years in the optical communications field, to wide range of optical sensing technologies. We have already commercialized an optical fiber temperature/distortion sensor that works more than 100 times faster than existing sensors. An original optical signal processing circuit was newly developed to detect weak reflected light in the optical fiber. We are also developing an optical fiber sensor for detecting vibrations along the optical fiber. We are conducting experimental verification tests to identify abnormal situations based on the obtained vibration data along the optical fiber.

This optical signal processing technology can also be applied to laser Doppler vibrometers, which can measure the vibration and speed of an object intact by using a laser light. In addition to lowering the cost of equipment by using optical components readily available in optical communication applications, OKI's original sensor system has highly innovative features that will permit significant cost reductions. For example, connecting and separating the optical signal processing unit and sensor heads with optical fibers enable acquiring multiple vibration data of various equipment in a factory by using a single sensor unit.

In addition, we are applying our original optical device technology to develop terahertz sensors, which have attracted attention in recent years for detecting explosives and dangerous drugs. A major issue with terahertz sensors is the efficiency of light sources and receivers. The combination of OKI's periodically poled lithium niobate (PPLN) device, which has the world's highest-level wavelength conversion efficiency, and an inexpensive optical communication laser diode may realize highly efficient terahertz light source.



Simultaneous multipoint vibration measurement using laser Doppler vibrometer

*1 The British Machine Vision Conference (BMVC2019), https://bmvc2019.org/

*2 National Research and Development Agency New Energy and Industrial Technology Development Organization (NEDO) projects:

- "Project for Innovative AI Chips and Next-Generation Computing Technology Development" (Theme: "R&D on ultrawide-sensing AI edge technologies using soft tensor processors")
- "Cross-ministerial Strategic Innovation Promotion Program (SIP) Phase 2/Cyberspace Platform Technology Utilizing Big Data and AI" "Improvement of efficiency and flexibility of value chain through inter-AI cooperation")