

Continuing to provide new value to society through our core technologies and unique ideas

We will create products and technologies that help transform customer workplaces and resolve social issues.

Providing new value for diverse workplaces

We have brought out ideas for innovative work styles since entering the business machine field in the 1950s. We are now broadening the scope of the value we create from regular offices to worksites in various industries and locations. By digitizing work in various places, we are helping customers work smarter. By providing new value to individuals, organizations and society, we can resolve social issues while generating new growth opportunities.

We are helping to change workplaces and society and continuing to provide value to customers by driving ahead with ongoing workplace innovations through our EMPOWERING DIGITAL WORKPLACES value proposition, in which individuals, teams, and organizations leverage digital technologies everywhere they do business. > [1](#)

Seeking to create value in new areas

We are leveraging two growth strategies to discover new ways to resolve social issues. The first is Growth Strategy #1 > [1](#), through which we are cultivating “applied printing” that drives printing technology further forward, and we are also pursuing other industrial innovations. The second is Growth Strategy #2 > [2](#), through which we are digitizing offices.

In printing technology, the focus of Growth Strategy #1, applications have expanded to encompass commercial printing, industrial printing, and healthcare. We are going beyond printing on paper to push ahead

with inkjet printhead applications for other media, notably for bioprinting and secondary battery printing.

Under Growth Strategy #2, we seek to support customer knowledge creation by innovating workplaces. We are doing this by using machine vision and other inputs as well as AI analysis and by optimally combining displays, controls, and other processes.

R&D structure and development process

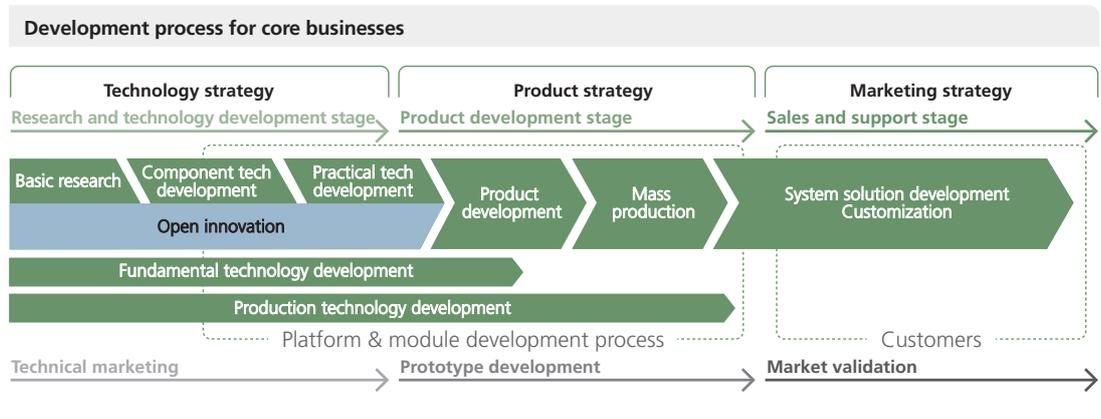
The Ricoh Group has R&D sites in Japan, the United States, India and China > [3](#). Each site explores market needs and conducts research and technology development attuned to regional characteristics while deepening cooperative connections among global sites. Our corporate map also includes RICOH Global Technology Centers and RICOH Customer Experience Centers, and we have launched value creating activities involving our customers through a framework for gathering feedback on market needs ascertained directly through customer support activities to enhance future product development.

Ricoh’s technology development process > [4](#) for core businesses is broken down into three stages—research and technology development, product development, and sales and support. We emphasize system solutions development and customized development to fuel more robust responses, from the development of key technologies based on technology strategy through efficient product development without relying on prototypes > [4](#), and then to customer needs.

Refer to these pages

[1](#) Growth Strategy #1 P.13

[2](#) Growth Strategy #2 P.13



Refer to our website

- [1 Technology](http://www.ricoh.com/technology/) www.ricoh.com/technology/
- [2 Global R&D](http://www.ricoh.com/technology/rd/global.html) www.ricoh.com/technology/rd/global.html
- [3 Technology development](http://www.ricoh.com/technology/rd/development.html) www.ricoh.com/technology/rd/development.html
- [4 Development process innovation](http://www.ricoh.com/technology/rd/manufacture.html) www.ricoh.com/technology/rd/manufacture.html

Engaging in open innovation

We are drawing on open innovation with universities, research institutions, and enterprises to accelerate efforts to help resolve social issues and streamline the development of advanced technologies.

We are applying our inkjet, machine vision, image processing, and other technologies in diverse initiatives. They include the Japanese government supported Funding Program for World-Leading Innovative R&D on Science and Technology and joint R&D with universities and independent administrative corporations. We are reinforcing relationships with start-up enterprises to accelerate the creation of new businesses.

Open innovation case study

Super telephoto stereo camera > 3

We are undertaking joint research and development with the University of Tokyo into advanced automated flight control systems as part of a project of Japan's New Energy and Industrial Technology Development Organization that focuses on practical applications for advanced aircraft systems. We are also engaging in R&D for Horizon 2020 VISION (the Validation of Integrated Safety-enhanced Intelligent flight cONtrol), a Europe-Japan collaborative research project.

Biomagnetic measurement system (magneto-spinography system) > 4

We look to commercialize this system with Tokyo Medical and Dental University and the Kanazawa Institute of Technology.

Micro granulation > 5

We aim to foster innovations in pharmaceuticals production by collaborating with the University of Shizuoka and by participating in the Pharma Valley Project of the Pharma Valley Center of the Shizuoka Organization for Creation of Industries.

In November 2017, we concluded a comprehensive collaborative research accord with Chiba University to pursue wide-ranging innovations. We look to take part in an innovation business that leading Japanese research institution RIKEN plans to set up.

In April 2019, we launched RICOH ACCELERATOR 2019 as a business cocreation program that supports startups. We conduct comprehensive business contests for selected internal and external teams. At the same time, we support activities by providing environments for the open usage of resources, and seek to help create new businesses through the efforts of participants and exchanges between people.

In March 2016, we established a fund to support the creation of technology ventures and foster future industries. The fund had assisted 13 companies through June 2019.

R&D investments and intellectual property initiatives

The Ricoh Group consistently earmarks 5% to 6% of consolidated sales for R&D to ensure a steady stream of innovation. In the year ended March 31, 2019, R&D expenses reached ¥111.0 billion, or about 5.5% of sales. Of this amount, 13.3%, or ¥14.8 billion, went into basic research.

Intellectual property > 5, the fruit of our R&D efforts, is vital to our competitiveness. We therefore encourage efforts that yield valuable intellectual property and seek to acquire and use intellectual property that protects and grows our businesses.

We have accordingly continued to secure highly effective patents in Japan and overseas. As of March 31, 2019, the number of registered patents overseas exceeded the number in Japan in the year ended March 31, 2015. We are conducting a review of maintained patent rights by assessing future market and business conditions and determining whether to abandon any unnecessary patent rights.

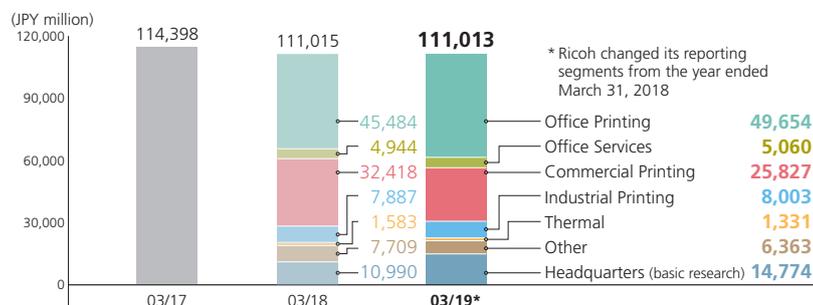
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3 Super telephoto stereo camera P.44

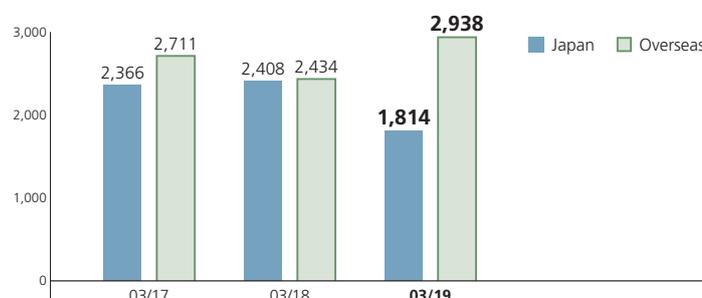
4 Biomagnetic measurement system (magneto-spinography system) P.37, 44

5 Micro granulation P.42

Changes in R&D investment



Number of registered patents worldwide



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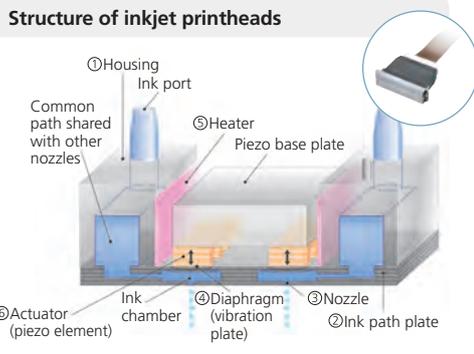
5 Initiatives in intellectual property www.ricoh.com/technology/rd/ip

Growth Strategy #1: Broaden the potential of printing technology and create new value

We have broadened the application of technologies that originated in office printing to encompass commercial and industrial printing, as well as “applied printing.”

The expansion of inkjet technology > 1

The Ricoh Group has key inkjet technologies that work together to deliver top-quality results. Inkjet printheads ensure that droplets of a desired size are applied uniformly and properly to print media. Ink supplies reproduce image quality as applications require. Printing system controls precisely. Our inkjet technologies for various media provide new value in fields such as apparel, food, medicine, and industry.



This stainless steel housing delivers outstanding safety through its excellent rigidity and resistance to corrosion and contamination.

Printing for clothing, food, and housing

Advances in inkjet printheads and inks have enabled the application of inkjet printing technologies with an array of media, from paper to food labels and packaging, packaging, textiles, T-shirts, construction materials, furniture, automobiles, and decoration on food and other items.

The RICOH Ri 100 garment printer > 2 can print high-definition images on T-shirts and other garments, ensuring comfort and wash fastness. For printing labels used on bottles and packaging, this model employs high-viscosity UV curable inks that cure quickly and resist friction and deliver fine droplets for high-quality on-demand printing.



Expresses the texture when printing on such building materials as glass, metal, and wood

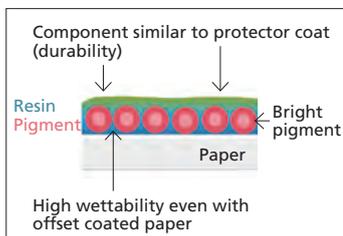


Printing directly on wallpaper and canvas

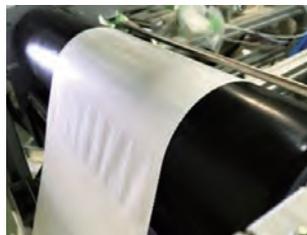
Display printing

Offset coated paper ink and new dryer

The RICOH Pro VC70000 > 2 is a high-speed continuous feed inkjet printing system with a dramatically extended gamut and advanced drying capabilities, and employs inks for production on an array of stocks and eliminates the need for undercoats or protector coats. A new dryer incorporating small heat rollers virtually eliminates cockling with dense images and lightweight papers.



Cross section of printed paper



Cocking correction with heat rollers

Handy printer

The portable RICOH Handy Printer weighs just 315 g. It can print by being swiped over a wide range of media otherwise inaccessible to most printers. Such media includes cardboard, labels, envelopes, postcards, wood, and cloth.

This model employs a sensor to detect hand motion speed and the surface condition of print media and uses a new discharge technology harnessing an algorithm to predict printer movements and accurately jet the ink. We miniaturized parts and optimized the layout in keeping with compact dimensions. This high-definition printer can output barcodes and QR codes and delivers instant results with quick-dry ink.



Refer to our website

- 1 The expansion of Ricoh's inkjet technology www.ricoh.com/technology/inkjet/
- 2 Features of RICOH Pro VC70000 www.ricoh.com/technology/tech/084_ink_for_offset_coated_paper
www.ricoh.com/technology/tech/085_new_drying_technology
- 3 Direct to Garment Printer RICOH Ri 100 www.ricoh.com/products/garment-printers/ri-100/

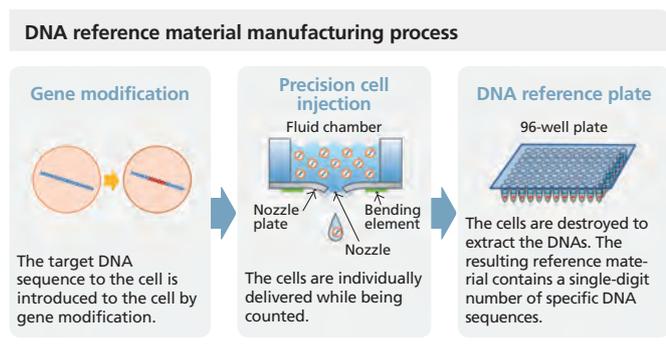
Applied printing

● Healthcare

Reference DNA plate >4

In genetic testing, we developed a manufacturing technology for reference DNA plates, a reference material for controlling individual DNA molecules to accurately confirm issues with testing processes, equipment, and reagents.

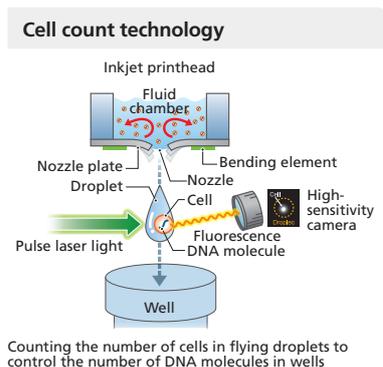
This plate is a benchmark for measurements in which the components of ingredients are clearly specified, and can be used in controlling precision for genetic testing equipment and reagents.



Developing and applying bioprinting technology

We develop bioprinting technology that employs a unique inkjet technique to accurately discharge live cells.

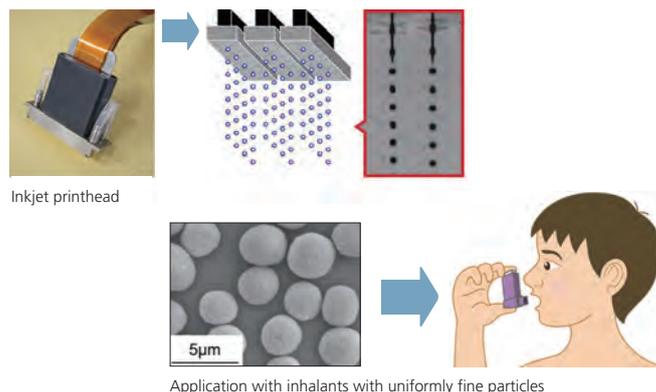
Reference DNA plate manufacturing process requires fixed numbers of cells to enter each well. Ricoh thus developed an inkjet printhead to eject cells for bioprinting. This simple configuration eliminates the flow path and makes it possible to form droplets with small solution amounts. We additionally developed a new technology to count cells in droplets by synchronously irradiating pulsed lasers with droplet ejection and observing fluorescence from cells. It is therefore possible to strictly control cell numbers.



Micro granulation >5

We are using our inkjet technology to develop techniques for creating micro particles of uniform size. One potential benefit of applying this technology to inhalants and other medicines is that they could reach targeted parts of the body and suppress side effects.

An inkjet printhead jets out very fine droplets at a high frequency, with Fine Droplet Drying technology drying very quickly, making it possible to generate uniformly micron-sized particles.

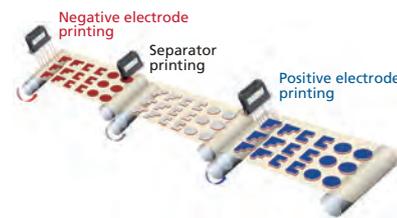


● Manufacturing innovation

Secondary battery digital printing manufacturing

In January 2019, we announced the world's first inkjet technique-based technology to manufacture lithium-ion secondary batteries in desired shapes.

We materialized the production of low-viscosity, high-density electrode material ink that can be ejected from inkjet printheads. We created ink from most electrode materials and separator materials used in lithium-ion secondary batteries. These battery materials are digitally printed on target location using inkjet technology, simplifying processes and enabling multi-product manufacturing. This approach minimizes electrode material waste, as materials are printed only on necessary parts.



Pushing the boundaries of inkjet technology to open new worlds

Our website showcases the broad applications of our inkjet technologies. It also presents our core technologies, as well as our history in this field, and details of our innovations.



www.ricoh.com/technology/inkjet/

Refer to our website

4 The manufacturing of reference DNA plates www.ricoh.com/technology/institute/research/tech_dna_reference_plate

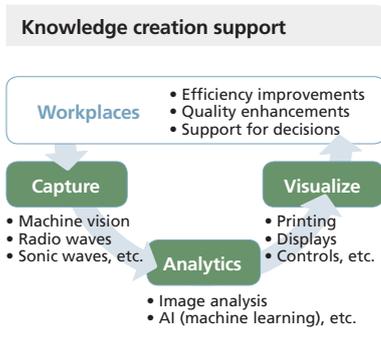
5 Micro granulation www.ricoh.com/technology/institute/research/tech_fine_droplet_drying

Growth Strategy #2: Creating knowledge to drive innovation in offices, on frontlines, and in society at large

Since its foundation, the Ricoh Group has provided value to customers in various fields. We currently support knowledge creation for more than 1.4 million customers. We are developing technologies that help create new value for customers by digitally linking offices, frontlines, and society at large.

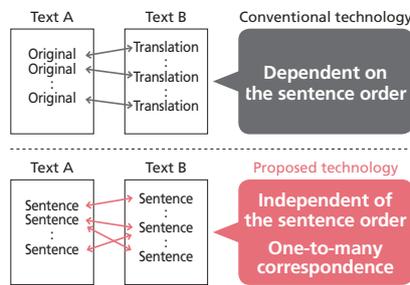
Supporting knowledge creation in diverse workplaces and energizing society

Workplaces vary among different businesses and fields and are expanding everywhere. With globalization, people in different locations and time zones are connecting digitally and are constantly exchanging information. The Ricoh Group views such interactions as sources of knowledge creation. The Internet of Things organically links inputs from edge devices, processing through AI, and optimized visualization. We are drawing on the Internet of Things and other technologies so we can innovate and energize society.



AI-based clause checking tool > 2

One option in our RICOH Contract Workflow Service is an AI-based clause check tool that uses Deep Alignment. This proprietary technology incorporates Ricoh's natural language processing to automatically align two documents to associate sentences and paragraphs with similar content with each other. Synthesizing the meanings of phrases through Deep Alignment makes it possible to precisely associate meaning. Deep Alignment can be applied to



one-to-many associations, where one sentence with multiple meanings is associated with multiple different sentences, or even to tasks where association counterparts are missing.

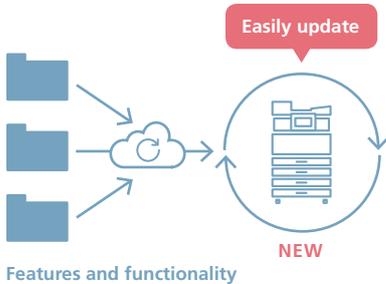
Office Office communication and AI transforming workstyle

Companies need to seek ways to become more competitive as people's perceptions about the value of work change. The Ricoh Group is drawing on visual communication and AI technologies to offer productivity, economic viability, and work practice solutions.

RICOH Always Current Technology > 1

Since 2019, we have installed RICOH Always Current Technology on new MFP and printer models to keep their device software up to date.

This setup enables customers to access the latest features and functionality available on the latest models whenever they purchase systems, including newly developed functions. They can also add functions that match industry requirements to enhance workflows, while security features also remain up to date.



Frontlines and society Materializing safe and secure frontlines and societies by drawing on diverse inputs and outputs

The Ricoh Group combines information inputting, processing, and visualization technologies to visualize situations in various frontlines and societies and enhance added value.

Leveraging acoustic communications > 3

Disruptions or delays with information services through cellular phones, Wi-Fi™, and other public communications tools could occur following disasters. Situations in the field could make television or radio broadcasts unsuitable for bulletins. So, we developed a technology to acoustically transmit multilingual text and audio information to smartphones and other personal devices through



existing broadcasting equipment. This setup employs an audible watermark below 10 kHz and sends identifiers associated with a range of messages. User apps can display and output audio of disaster information in Japanese, English, Chinese, or Korean and show related information anywhere at any time.

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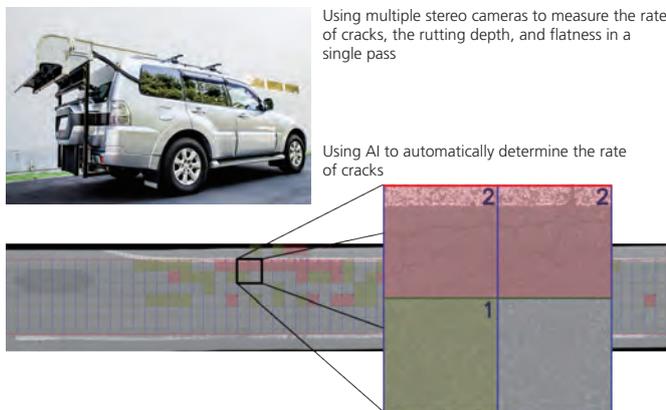
- 1 RICOH Always Current Technology www.ricoh.com/products/printers-and-copiers/always-current-technology/
- 2 Natural language processing for document solutions www.ricoh.com/technology/institute/research/tech_deep_alignment
- 3 Transmitting Information using Acoustic communication www.ricoh.com/technology/tech/086_acoustic_communication

Our technology is one way in which we are helping overcome growing social issues posed by the aging of roads, tunnels, and other infrastructure. Systematically maintaining such structures will enhance social safety and security.

Road surface monitoring system >4

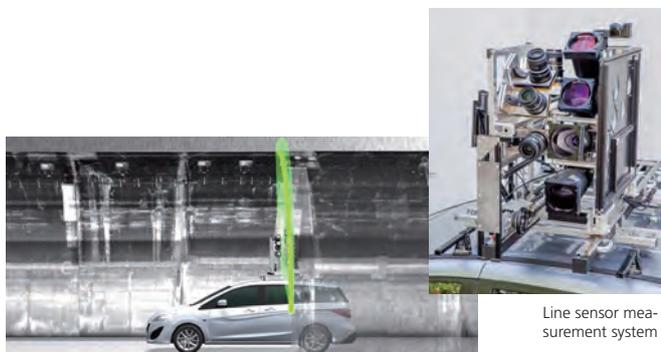
We developed a vehicle-mounted system with stereo cameras to evaluate road surfaces. In September 2018, our setup became the first employing stereo cameras to pass a performance confirmation of Japan's Public Works Research Center. We commercialized the Ricoh Road Surface Monitoring Service in August 2019. Because it can be mounted on ordinary automobiles, it can be used on residential roads on which it would be hard to measure changes with large specialist vehicles.

Stereo cameras: Obtaining depth (three-dimensional) information on objects ahead by using the parallax of two cameras aligned left and right.



Tunnel monitoring system >5

We developed a photographing system for mounting on a standard motor car that can measure the conditions of a tunnel while driving at normal traffic speeds. A line sensor-type measurement system employing a unique extended depth-of-field camera captures images clearly, even in dimly lit tunnels. It is possible to optimally illuminate the tunnel wall with line lights. This compact configuration means that only the measurement system can easily be detached, making it easy to transport to other locations.



Imaging the entire length of tunnels just by traveling along them

Line sensor measurement system

Super telephoto stereo camera >6

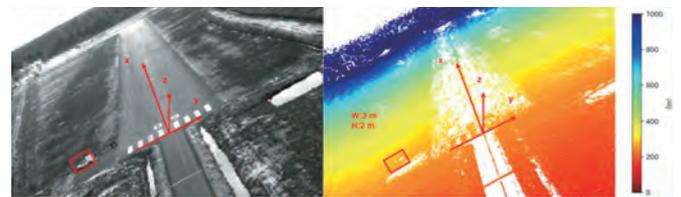
We developed the world's first super telephoto stereo camera that can measure objects up to 1,000 meters away in real time and perform real-time stereo ranging processing in 4K resolution.

We ensured accurate distance measurement by optimizing our proprietary optical design and calibration technology. We optimized our image processing technology to swiftly deliver 4K stereo image processing output in real time and at high speed.

Potential applications include allowing fast-traveling aircraft to estimate their own positions and detect obstacles or monitoring distant objects of unknown sizes in real time.



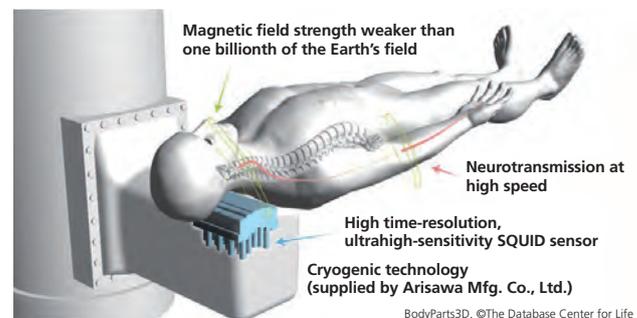
Super telephoto stereo camera mounted on unmanned aircraft



Biomagnetic measurement system (magnetospinography system) >7

The human body's magnetic field from spinal cord activity is only around one billionth that of Earth's, while neural conduction is around 60 meters per second. High-performance magnetic shields, highly sensitive sensors and advanced signal processing technology are needed to measure nerve activity. The Kanazawa Institute of Technology developed a SQUID (for superconducting quantum interference device) that can measure weak signals in several dozen microseconds. The Ricoh Group created a system to process the detected signals and display the spinal activity information over morphological images. Tokyo Medical and Dental University undertook research to establish diagnostic techniques.

We developed hardware, software, and diagnostic techniques to successfully measure magnetic fields of the lumbar spinal nerves in addition to the cervical spinal cords. We were also able to measure neuromagnetic fields in peripheral nerves, notably for the palm and brachial plexus. Clinical applications are expanding, and we are progressing well toward commercialization.



Magnetospinography system

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4 Road surface inspection system www.ricoh.com/technology/institute/research/tech_road_surface_monitoring

5 Tunnel monitoring system www.ricoh.com/technology/tech/087_tunnel_monitoring

6 Super telephoto stereo camera www.ricoh.com/technology/tech/083_super_telephoto_stereo_camera

7 Visualization of neural activity of the spine (magnetospinography system) www.ricoh.com/technology/institute/research/tech_neuro_trans
www.ricoh.com/release/2019/0724_1