Hitachi's Next-generation Large-scale Disk Array Subsystem — the World's First to Adopt Virtualization Technologies in the Disk Array Itself

In recent years, information systems combine various vendors and several different types of storage, making storage management and operation increasingly complicated. In response to the growing demand for easier and more efficient storage management solutions, Hitachi now offers the world's first disk array subsystem to adopt virtualization technologies in the disk array itself.

From left to right: Engineering Manager Akinobu Shimada of Products Planning Department, Strategic Business Planning; Engineering Manager Hisao Homma, Disk Array Software Development Department 1; Engineering Manager Norio Hamada, Disk Array Hardware Development Department; Engineering Manager Hiroyuki Morimoto, Systems Design Verification Department, Storage Systems Development, Disk Array Systems Division, Hitachi, Ltd.

Background to Development

In recent years, information systems have come to include various vendors and several different types of storage, in order to handle rapidly increasing volumes of data and the unique characteristics of applications, and this has made storage management and operation extremely complicated. In this type of storage environment, there has been a growing demand for easier and more efficient storage management solutions.

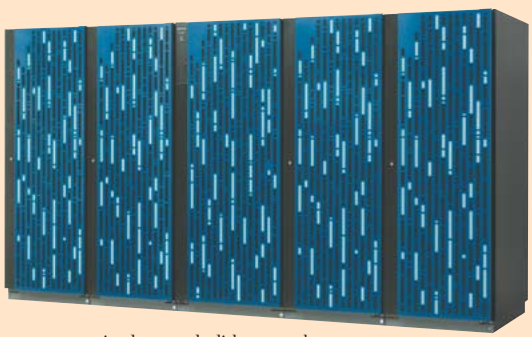
To respond to these demands, Hitachi has developed the next-generation large-scale disk array subsystem, which uses virtualization technologies in the disk array. It virtually integrates multiple storage resources while maintaining high performance and reliability, enabling centralized management and dramatically increasing the efficiency of storage management and operations. Hitachi's next-generation large-scale disk array subsystem can also be used as a platform for DLCM (data life cycle management), optimizing the allocation of data in storage resources with different scale and performance connected to Hitachi's next-generation large-scale disk array subsystem, effectively using existing investments while increasing the usage efficiency of the storage system as a whole. At the same time, it can transfer data safely and easily between storage systems—even those of other manufacturers—during system operations, without the need for an intermediate server.

Main Features of the Next-generation Large-scale Disk Array Subsystem

In addition to the features offered by conventional large-scale storage systems, this subsystem features three revolutionary functions. First, the "Universal Volume Manager" integrates various types of external storage resources into a single storage system, thus supporting "virtualization" of management. This is the first time in the world that such virtualization has been achieved in a disk array system.

The "Virtual Partition Manager," also unprecedented anywhere in the world, supports "virtual private storage functions" that enable a single physical storage unit to be used as multiple storage units through logical partitioning, thus providing dedicated storage areas for each server. The remote copier function adopts a "Universal Replicator"—a new and original approach that increases recovery capabilities in the event of a disaster. This function creates a remote copy that is not susceptible to the effects of changes in the input output workload or link band width, and also enables the use of remote copies between several operating locations.

In terms of hardware, Hitachi has made further improvements to the functions and reliability cultivated through past models, achieving more than twice the scalability available in the past.



Hitachi's next-generation large-scale disk array subsystem

Advantages of the Product, and Future Developments

The new functions outlined above reduce the burden of management and operation while maintaining harmony between machines, even in system environments that incorporate a wide range of different hardware. This highly expandable product enables a variety of applications in keeping with your business goals and environment, opening up many new possibilities for the future. This product will contribute to reducing TCO (total cost of ownership) and increasing ROI (return on investment), bringing you one step closer to truly harmonious computing.

Particularly with regard to virtualization, a variety of methods have been examined in the past, but this solution, which overcomes the fixed ideas of the past, has become the focus of much attention in the industry. We believe that this positive response is an indication of the future potential of this product.

These results are only the first step, however, as we will continue to improve and expand the system's functions in the future. At the same time, in addition to improving performance and reliability, we will devote our efforts to the development of even more advanced products that embody the key words "Value Plus Alpha," and which support the ubiquitous information society.

Hitachi's Enterprise Blade System Supports Ubiquitous Information Society

In the context of the ubiquitous information society, in which information is essential to a wide range of activities from business to personal life, IT platforms are required to offer high stability and reliability, and at the same time reduce the burden of operation and management. In order to respond to these issues, Hitachi has developed an Enterprise Blade System that achieves high-level product links and integration.

Project Manager Atsushi Nakajima (left) and Project Manager Takeshi Yoshida (right) both of Server Development Operation, Enterprise Server Division

What is Hitachi's Enterprise Blade System?

In the ubiquitous information society, companies, individuals, and public institutions will be connected dynamically and freed from the restrictions of time and space, so that these connections will expand dramatically. In this society, anybody will be able to share information safely, securely, and comfortably anytime and anywhere, and these mutual connections will support the creation of unprecedented and innovative value.

The IT platforms that support this society must offer the flexibility, scalability, and reliability to keep up with a rapidly changing environment. Hitachi believes that it is important to work with the customers to achieve the innovative value that customers demand, but creating IT platforms that keep up with and respond to changes. The Enterprise Blade System is Hitachi's solution for this IT platform.

Hitachi's Enterprise Blade System is a system product based on an entirely new concept created to achieve the "high-level product links and integration" that Hitachi has been working to develop. In the past, common systems were comprised of servers, storage functions, networks, and middleware to manage all three. The Enterprise Blade System integrates all of these functions, creating an unified service platform. In this system, based on Hitachi's experience and past performance, the products that make up the system respond quickly and flexibly to the changes in the business environment based on the customer's operation policies, as though creating a beautiful harmony.

The Blade Server, which represents the core of the Enterprise Blade System, can accommodate two server blades in the same server chassis: one with an Intel* Xeon* processor, and one with an Intel Itanium* 2 processor. We have introduced the world's first technology that enables SMP (symmetric multiprocessor) system connection between server blades which allows to connect up to four Intel Itanium 2 processor server blades forming an eight-way SMP server. In this way, it is possible to construct the customer's ideal system at a minimal cost, using "scaling out" technology for front-end applications, and "scaling up" in back-end applications. This SMP function between server blades was a particular focus of attention during the development phase. As a result, it has also drawn the attention of many customers since the product's release.

* See "Trademarks" on page 86.

Hitachi's enterprise blade system

Product Features and Future Goals

Because the hardware and software required for IT platforms have been brought together, operations such as hardware settings, configuration management, and monitoring of operation status are handled centrally by the dedicated system management software. This system can respond flexibly and easily to sudden system performance requirements, such as changes in the business environment and expanded core operations, with simple software settings. Automated operations based on business policies serve to reduce the costs and labor required by the customer in operation and management.

Of course, because high-performance hardware is essential as a base for such a system, we have incorporated many of the technologies cultivated by Hitachi in the development of mainframes and open servers. The storage and network components also combine the core technologies of the Hitachi Group, ensuring high reliability and availability throughout the entire system.

Development of the current system required new measures to enable the high-density installations to concentrate hardware in a limited space, but in the future, we will continue to reduce the size and increase the performance of the system, in order to achieve greater utility and greater autonomy in this next-generation IT platform.

A Great Leap Forward in Hitachi's Digital Media World by Utilizing Core Technology of Digital Consumer Electronics

—The Appeal of Hitachi's New High-definition FPD Television Series: Images Brimming with a Feeling of Depth—

All around the world, broadcasting media is being digitized and becoming "high definition." In line with this trend, all television broadcasting in Japan will become digital by 2011. Since the launch of terrestrial digital broadcasting, with the aim of realizing our concept of "flat-panel TVs with high definition in all sizes," Hitachi has taken the lead in the Japanese market. In the autumn of 2004, our flat-panel TV lineup "Hitachi New High-Definition FPD Television series" was commercialized, leading to further evolution of "Hitachi's Digital Media World" for supporting a "high-definition-image life." Moreover, to meet the needs of the global market, we are introducing models for receiving digital broadcasting—launched in 2004 in North America and planned for the spring of 2005 in the EU.

From left to right: Hidenao Kubota and Haruki Takada, Senior Engineers, FPD Design Division of Image Media Headquarters, Digital Media Division, Ubiquitous Platform Systems; Noboru Fujita, Senior Engineer, Product Sales Planning Division of Marketing Headquarters; Hirohiko Mizuguchi, Senior Engineer, Image Media Development Division of Development Center

Hitachi's Digital Media World: High Definition that Evokes Emotions

Following Hitachi's launch of the world's first 32-inch plasma TV in March 2001, the market for large flat-panel TVs grew rapidly. As a result, it is forecast that the total number of large flat-panel TVs (i.e. over 26-inch displays) around the world will reach 10 million in 2005. Moreover, among these TVs, the proportion of "high-vision" (i.e. high definition) ones is continuing to increase. To enjoy high-vision broadcasts in full, it is necessary to enhance the surrounding devices as well as the TV itself.

Hitachi is offering various high-vision-compliant devices—such as HDD (hard disk drive)/DVD (digital versatile disk)-fitted AVCs (audio-visual controllers), high-vision video recorders, and LCD projectors—as part of Hitachi's "Digital Media World." In Japan, these high-vision products are being marketed under the catch phrase "Wooo World." While expressing the meanings "Wonder," "World Standard," and "Worthwhile," the exclamation "Wooo" also conveys emotion and surprise when spoken out loud. Wooo products seek to bring striking images into our daily lives and continuously improve their ease of use.

High-definition images are produced by the collective use of advanced technologies for panels, engines, HDDs and so on. By utilizing the strength of Hitachi Group's affiliated companies for developing key devices, we have been the fastest to incorporate the latest technologies in our products and launch them ahead of rival companies.

In the autumn of 2004 in Japan, Hitachi's "New High-Definition FPD (flat panel display) Television" series—which recreates feelings of "depth" and "sharpness"—was launched. This lineup comes in two LCD-panel sizes and four plasma-panel sizes. In the case of the model fitted with an HDD for recording and playback of high-definition—namely, "high-vision"—images without any deterioration in picture quality, various new functions are added and ease of use is improved. For example, "slow playback," namely, sound data is read at 0.8 slower than usual, applies voice-tracking technology to minimize differences in sound pitch and thereby make it easier to aurally comprehend the voices coming from the TV.

As regards the "New High-Definition FPD Television" series aimed at the Japanese market, the AVC (audio-visual control) (or tuner) is a separate type (i.e. separated from the TV monitor). This means that a wide variety of monitor sizes and AVCs with different functions can be chosen from a rich lineup of TV monitors and AVC stations and freely combined. As for the wiring on the monitor side, only one cable connects with the AVC, so connection is simple and the surroundings around the TV are kept neat and tidy. What's more, since the monitor is thin, it can freely fit a room layout by mounting it on a wall or above pieces of furniture. As well as being a home theater bringing realistic sensations to life, the lineup has a smart design frame that brings about a touch of class to an interior like a casual living room.

Recreating a Feeling of "Depth" by New Digital High-definition Processing Technology

With new digital-image-processing technology developed for generating high-grade, high-vision images with realistic sensations in real time, images with a realistic "feeling of depth" are created. By adding a newly developed, high-precision image-recognition chip, DIPP+ (digital image pixel processor+), to the DIPP (digital image pixel processor) chip used up until now and using them in combination, even higher definition images have become possible. With this feature, image characteristics are analyzed and recognized by means of signal-processing technology applying brightness-histogram processing, image contrast is improved according to the analysis results, and lively images are reproduced.

Device lineup for high-vision

Furthermore, histogram measurement and analysis of brightness variation across each pixel in an image (edge level) is performed, and by dynamically controlling the vertical and horizontal "enhance level" by "edge enhance" technology, image noise is effectively suppressed, while keeping appropriate graininess at all times, and images giving a feeling of "depth" are produced.

Towards Plasma Panels with Higher Brightness and Longer Life, and LCD Panels with Wider Viewing Angle and Faster Response

Developed at Fujitsu Hitachi Plasma Display Ltd., advanced ALIS (alternating lighting of surfaces) technology increases the discharge space by 10% and utilizes a wider fluorescent coated area. It also improves the fluorescent luminous efficiency, and attains the world's highest intensity of 1,200 cd/m^2 for a 42-inch panel or 1,100 cd/m^2 for a 32-inch panel. Since brightness is increased, but power consumption is not, substantial power savings are made. Furthermore, the surface of the panel is fitted with a newly developed, dynamic MBP (multi-bandpass) color filter that improves purity of red, green, and blue as well as daylight contrast by about 10%. As a result of these features, even in a bright room, deep velvety black images giving a feeling of depth can be enjoyed. What's more, the operational panel lifetime across the whole model range exceeds 60,000 hours.

Applied in a high-vision LCD panel produced by Hitachi Displays, Ltd., AS-IPS (advanced super in-plane switching) technology produces a real high-vision spectral ratio of 16:9. The AS-IPS panel—in which the liquid-molecules turns horizontally—has a wide viewing angle that removes the difficulty of viewing at certain angles. Combined with a wide-viewing filter, this wide viewing angle (176 degrees from left/right and above/below) secures equivalent low variation in contrast as a cathode-ray-tube TV. Moreover, "high-speed" liquid-crystal materials and "overdrive" technology are applied to produce a high-speed response of 15 m/s—fast enough to reproduce clear images of fast moving scenes.

Future Developments

From now onwards, we believe that as networking—which started with the internet—continues to become more widespread, the television will become a "home terminal" that accumulates information from its surroundings and, at the same time, will be able to handle digital broadcasting from around the world. Under these circumstances, aiming at giving our customers deep feelings of sensation and inspiration through our new high-definition digital TV lineup, Hitachi's research centers and affiliated Hitachi Group companies will continue to work together in developing new, world-leading technologies.

A Lineup of High-definition HDD/DVD Recorders with Large Capacity for Long-term Storage of High-vision Images with No Loss of Quality

With the start of digital terrestrial broadcasting, the day when almost all television broadcasts are "high vision" is just around the corner. As regards the DVD recorder, hybrid types with a built-in HDD are becoming mainstream. In particular, to enable recording of high-vision broadcasts without loss of quality, the need for a recorder with a high-capacity HDD is becoming more acute. Responding to this need, Hitachi, Ltd. has developed a series of HDD/DVD recorders for high-vision recording. Fitted with digital tuners for terrestrial, BS (broadcasting satellite), and 110-degree CS (communication satellite) broadcasts and launched in Japan in October 2004, this series consists of three models with different HDD capacities: model DV-DH400T (400 Gbytes), model DV-DH250T (250 Gbytes), and DV-DH160T (160 Gbytes).

(From left) Hironori Komi, Researcher, Video System Development Department, Storage System Development Center, Ubiquitous Platform Systems R&D Laboratory; Mika Nishiyama, Engineer, Storage Media Development Department, Development Center, Digital Media Division; Hideyuki Usami, Business Manager, Audio Visual Sales Department, Consumer Sales Headquarters

Appeal of the HDD/DVD Recorder Series

Made by Hitachi Global Storage Technologies, Inc., the high-capacity HDD fitted in the DV-DH400T, DV-DH250T, and DV-DH160T (which became commercially available from October 2004) enables so-called "long-time recording" (i.e. many hours of recorded video images) of high-vision images of high-bit-rate content. In the case of DV-DH400T, in long-term-image-recording mode, a maximum of 555 hours of long-term video recording is possible, and 40-h recording is possible at digital high-vision picture quality. Moreover, DV-DH400T's is fitted with simple functions that make operation easy; for example, its "*Mirukamo* (may view)" function—independently developed by Hitachi—enables simple recording of lots of favorite programs on the large-capacity HDD, and its "disk-navigation function" enables simple retrieval and playback of these programs.

The DVD (digital versatile disc) driver is a super multi-DVD type (made by Hitachi-LG Data Storage, Inc.) that combines a choice of DVD media tailored to applications and can playback either +RW (rewritable) or +R (recordable) DVDs. Furthermore, in comparison to dubbing speeds of five times for DVD-RAM (random access memory) discs (or four times for DVD-RW and eight times for DVD-R discs), the dubbing speed from the HDD to DVD is increased to a maximum of 30 times (or 24 times for DVD-RW and 40 times for DVD-R).

By means of combining a large-capacity HDD and a DVD multi-drive, high-vision programs can be stored and retrieved at high speed.

Key Development Points

Ensuring no deterioration in picture quality of high-vision broadcasts, the "TS (transport stream) mode" is available. And "time shift" function allows viewing of high-vision programs, namely, watching a program from the beginning while it is being recorded. Moreover, for transferring high-vision programs from the HDD to DVDs for storage, Hitachi's own "TSX mode" is fitted and enables high-speed dubbing (or "move" function) to DVD-RAM at five-times speed—the fastest on the world market so far. What's more, during the high-speed "move" of certain programs from the HDD to DVD, "multi-task" operation enables playback of other programs recorded on the HDD or recording of programs being watched.

Operation of the functions for presetting recording of digital programs is made quick and easy by the EPG (electronic program guide) function. And the "*Mirukamo* (may view)" function automatically inputs TV station logos and program information into the TV guide so that the recording status (i.e. recorded programs and to-be-recorded programs) for two weeks' worth of programs can be seen at a glance. Since programs recorded with this function are automatically erased after two weeks have passed, there is no need to worry that the HDD will become full. In this manner, operating the timer and playback functions becomes a simple amenity at the touch of a button.

Future Developments

By fitting higher capacity HDDs in our DVD player/recorders, we are aiming to enable even longer recording times for high-vision broadcasts and to develop products that can record high-vision pictures with no loss of picture quality even on DVD. Furthermore, by means of connections to networks inside and outside the house, we hope to allow users to enjoy more freedom in creating their own images to match their lifestyle.

Efforts to Improve Supercritical-pressure Power Generation and Expand Preventative Maintenance at Overseas Power Plants

With variations in fuel costs and toughening of environmental measures in North America, the expectations on supercritical-pressure power generation plants are growing. At the same time, the needs regarding, (1) thermal power stations around the world that are approaching renewal times, and (2) maintenance of Hitachi's own in-house-developed gas turbines (sales of which are increasing) are becoming greater. Under these circumstances, applying the advanced technologies and prolific achievements that it has accumulated up to now, Hitachi Group is strengthening its overseas development (centered on North America) of supercritical-pressure power generation plants and expanding its preventative-maintenance programs at overseas gas turbines and thermal power plants.

Tetsu Shimoki, Senior Engineer (left) and Tomo Sato, Senior Engineer (right) Overseas Thermal Power Plant Business Development Group, Thermal & Hydroelectric Systems Division, Power Systems

Present Status of Overseas Development of Supercritical-pressure Power Generation Plants

In recent years, centered on North America, the demand for construction of supercritical-pressure power generation plants has been growing. Against this background, and given that the supply of coal for fuel at a low price is relatively stable, it has been reported that these power plants attain high power-generation efficiency and impart low environmental load.

Under these circumstances, as the first Japanese manufacturer to do so, Hitachi Group has installed as a complete BTG (boiler, turbine, generator) package at the Genesee Power Generating Station (495-MW gross output)—the first in Canada to be fitted for supercritical-pressure power generation. At present, the plant is in the final stage of preparations before the start of commercial operation set for 2005. Soon after that, as the first Japanese manufacturer to take on an order for an EPC (engineering, procurement, construction) project, we have started construction at the 870-MW (gross power output) power plant of MidAmerican Energy Company in the USA.

As well as offering a "one stop" lineup of services—for main equipment, boilers, turbines, environmental safety equipment, and so on—aimed at coal-fired thermal power-generation facilities, Hitachi Group also leads non-Japanese companies in regards to supercritical-pressure technologies. Focusing on receiving orders from North America, where these strengths and our merits acquired domestically have been highly appraised, we are aiming to pour our efforts into developing overseas supercritical-pressure-generation power plants.

Efforts to Scale-up Preventative Maintenance at Overseas Power Plants

Many of steam-turbine plants constructed in locations around the world from the 1950s to the 1970s are facing their renewal deadlines. Up till now, Hitachi Group has been performing preventative maintenance centered on the core equipment of our own machinery. However, from now onwards, by strengthening our ties with O&M (operation and maintenance) companies at power-plant sites, we plant to offer solutions—such as setting up "combined cycle" operations for increased efficiency—aimed at not only our own machinery but also other companies' machines.

Moreover, our in-house-developed high-efficiency gas turbine "H-25" (25-MW class) is being sold domestically and overseas; in particular, orders for 65 turbines have been accepted, and they will be starting operations one after another. And from now onwards, our sales target is to hit ten or more orders for these turbines per year. Gas turbines need a relatively short maintenance cycle, so as these sales accomplishments have built up, the demands for maintenance have become stronger.

To ensure reliability over a long period, on top of providing answering services over the internet for swift and appropriate technical support, remote monitoring, and long-term maintenance contracted by LTSAs (long-term service agreements), we are planning to set up preventative-maintenance service centers for swift supply of parts. We have also set our sights on cultivating partnerships with regional company near site in order to establish after-sales services. To ensure that the optimum technical support is provided, Hitachi, Ltd. has placed specialized technical staff in call centers and has started the business of answering the needs concerning with power-plant maintenance.

Future Prospects for Both Tasks

In regards to expanding our business overseas, since the key to success will be obtaining as much on-site information as possible, directly talking with customers, and speeding up our responses, it is important to develop and strengthen our bases in the field. Accordingly, in the case of supercritical-pressure power generation plants, as our North American base, Hitachi America, Ltd. is continuing to improve our system for accepting orders regarding EPC projects.

Starting with the USA, countries around the world will continue to demand more power in the future.

Genesee supercritical-pressure power generation plant (Canada)

New Technology Driving Life Science Research in the Post-genomic Era "NanoFrontier": A Mass Spectrometry System for Analyzing Proteomes

After the human genome has been fully deciphered, analysis of a whole set of proteins—known as proteome analysis—has become ever more important, because proteins expressed by the genome bear vital activities for life. Hitachi Group developed a new mass spectrometer system that can analyze proteins sensitively with high mass accuracy, so as to greatly enhance the power of proteome analysis for preventing, diagnosing, and treating diseases. This research was supported in part by the New Energy and Industrial Technology Development Organization (NEDO), Japan.

Yasushi Terui, Senior Engineer, Biosystems Design Department, Hitachi High-Technologies Corporation (left); Izumi Waki, Chief Research Scientist, Life Science Research Center, Advanced Measurement Project Leader, Central Research Laboratory, Hitachi, Ltd. (right)

Overview of the Mass Spectrometry System for Analyzing Proteomes

Proteins are formed by a sequence of hundreds to thousands of amino acids, of which there are 20 species. In a typical proteome analysis, hundreds of proteins in a sample are first digested with enzyme, thereby producing shorter sequences of about tens of amino acids called peptides. After thousands of peptides thus created are separated by liquid chromatography, the peptides are introduced into a mass spectrometer. Each peptide species is then further decomposed into fragments (or fragmented) of amino acids within the spectrometer. From mass-spectral data of the fragmented amino acid sequences, it is possible to determine the whole amino-acid sequence of each protein, and thereby identify the proteins contained in the pre-digestion sample.

Characteristics of the Mass-spectrometry System for Analyzing Proteomes

Disease-related proteins are often minute in quantity and complex in structure. Their structure can be changed by cellular chemical reactions, which result in "modified proteins." To analyze such proteins, a mass-spectrometric technology called "linear ion trap" is widely used recently, because it offers 10 times higher sensitivity compared to conventional ion traps, which are powerful tools to analyze modified proteins because ion traps are capable of multiple steps of fragmentation, which is advantageous to determine the structure of modifications. Mass accuracy of linear ion traps, however, is typically 50 ppm (parts-per-million), which is unsatisfactory compared to 5 ppm mass accuracy that is required to identify unknown modified proteins.

To realize high sensitivity of a linear ion trap with high mass accuracy, Hitachi, Ltd. and Hitachi High-Technologies Corporation developed a new mass spectrometer that combines a linear ion trap and a TOF (time-of-flight) mass spectrometer that offers 5 ppm mass accuracy. In combining a linear ion trap and a TOF, a breakthrough was necessary because simple combination results in diffusion of ions at the exit of linear ion trap that degrades TOF mass accuracy. To solve this problem, Hitachi developed a "collisional damper" between the ion trap and the TOF, so that the ions are focused to achieve 5 ppm accuracy with high sensitivity.

In addition, the new system incorporates a novel information processing technology that enables analysis of scarce disease-related proteins. Conventionally, it was difficult to analyze scarce proteins because they tended to be obscured by abundant proteins. To overcome this problem, Hitachi developed a real-time database technology that registers analysis data of abundant proteins into an internal database, which is used to enhance analysis of scarce proteins by suppressing interference from abundant ones, resulting in three times increase in the number of identified proteins in a typical analysis. This technology was developed with support from NEDO.

Mass spectrometer with highly-sensitive multiple fragmentation capability with 5-ppm mass accuracy (right); Nano-flow chromatograph for handling minute flow volumes of liquid, namely, 50-nano-liter per minute (i.e. 50 billionths of a liter per minute)

Future Prospects

Proteome analysis will be an indispensable tool of genome-based medicine by tracking down proteins related to many diseases. For example, if proteins appearing characteristically in nerve cells affected by Parkinson's disease could be identified, or if changes in protein levels in cancerous cells could be spotted, it would be possible to uncover the mechanisms of these pathologic changes in cells, and to develop medical treatments targeted at the pathological proteins. Our Linear-Ion-Trap TOF mass spectrometer system is thus expected to significantly accelerate application of proteome analysis for genome-based early diagnosis, drug development, and therapy of diseases.

Beyond Electrocardiographs: A New Magnetocardiograph System

Heart disease is the second leading cause of death behind cancer in Japan today. With eating habits becoming more westernized in an increasingly aging society, the death rate from heart disease continues to climb each year. Some experts even predict that Japan will soon have the same death rate from heart disease as the United States. For people who suffer from heart disease, early diagnosis and treatment are very important. New types of MCG (magnetocardiograph) systems are attracting attention as tools for early diagnosis by the way they can discover diseases that conventional ECG (electrocardiograph) cannot.

Shigeaki Naito (left), General Manager, MCG, Marketing Department, Medical Systems Sales & Marketing Division, Life Science Business Group, Hitachi High-Technologies Corporation; Akihiko Kandori (right), Senior Research Scientist, Project Leader, Biomagnetic Measurement Project, Life Science Research Laboratory, Central Research Laboratory, Hitachi, Ltd.

World Leader in Bringing New Products to Market

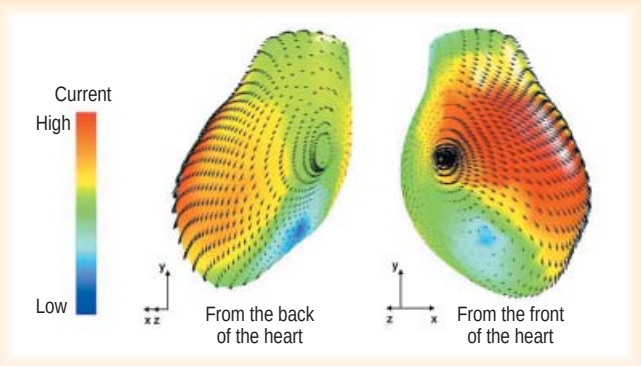
ECG, which is a widely used technique, examines the heart's condition by indirectly measuring weak electrical pulses discharged by the cardiac muscle from the surface of the body. By contrast, an MCG system uses SQUID* (superconducting quantum interference device) sensors to directly measure the extremely faint magnetic field emitted during electric current activity of the cardiac muscle. MCG is a revolutionary diagnostic tool for clinical testing because it can detect with a high degree of precision the location of problems like ischemia and arrhythmia and other heart diseases. Hitachi's Central Research Laboratory (HCRL) is advancing R&D of superconducting technology for this new type of magnetic device. At the same time, HCRL is cooperating with clinicians from Tsukuba University Hospital and the National Cardiovascular Center to develop clinical software for the analysis of measurement data. The result of our joint efforts has led to the introduction of a world-leading MCG product for medical treatment.

Local Electrical Phenomena Captured with Great Precision

Magnetic field characteristics that are measured using MCG are different from the heart activity characteristics currently captured by ECG from the body surface. MCG is not influenced by body tissue like blood, bone, or fat, so it can capture the location of cardioelectric phenomena with a very high degree of precision. MCG, unlike ECG, can also detect angina pectoris condition. Early detection of angina pectoris makes it possible to initiate treatment to prevent myocardial infarction. MCG can also detect where ischemia is occurring in the heart.

Hitachi MC-6400 Magnetocardiograph system (manufactured by Hitachi High-Technologies Corporation)

The non-contact characteristic of MCG is very attractive: a patient can be tested while clothed in 10 to 30 seconds under the sensors. MCG is completely non-invasive as it only senses magnetic information that is emitted naturally from a living body, so a patient suffers no stress or burden. The safe features of MCG also make it possible to measure electric signals from the heart of an infant and fetus. Up to now signals from a fetus have not been measurable. MCG opens up a whole new field of prenatal heart treatment.



The world's first 3D imaging of electric-current distribution within the heart based on magnetocardiogram measurements from the front and the back of the heart.

Compact Size and Clear Display

To measure the faint magnetic field emitted by the cardiac muscle, a magnetic shield is used to shut out surrounding magnetic noise. At HCRL, we have developed an improved open-shielded room that helps to reduce the size of the examination room by one-fifth. We are also developing a more compact MCG system that uses high-temperature superconductivity. We expect this system to be introduced as equipment in local clinics and medical centers. For MCG data analysis, HCRL has developed the world's first 3D imaging technology that shows electric-current distribution. We expect this feature will help doctors to understand the mechanism of heart disease and establish new diagnostic methods.

* SQUID (superconducting quantum interference device)
The Hitachi MC-6400 is a 64-channel MCG system installed with Hitachi's own SQUID sensors. This system has received the 2004 R&D 100 Award.