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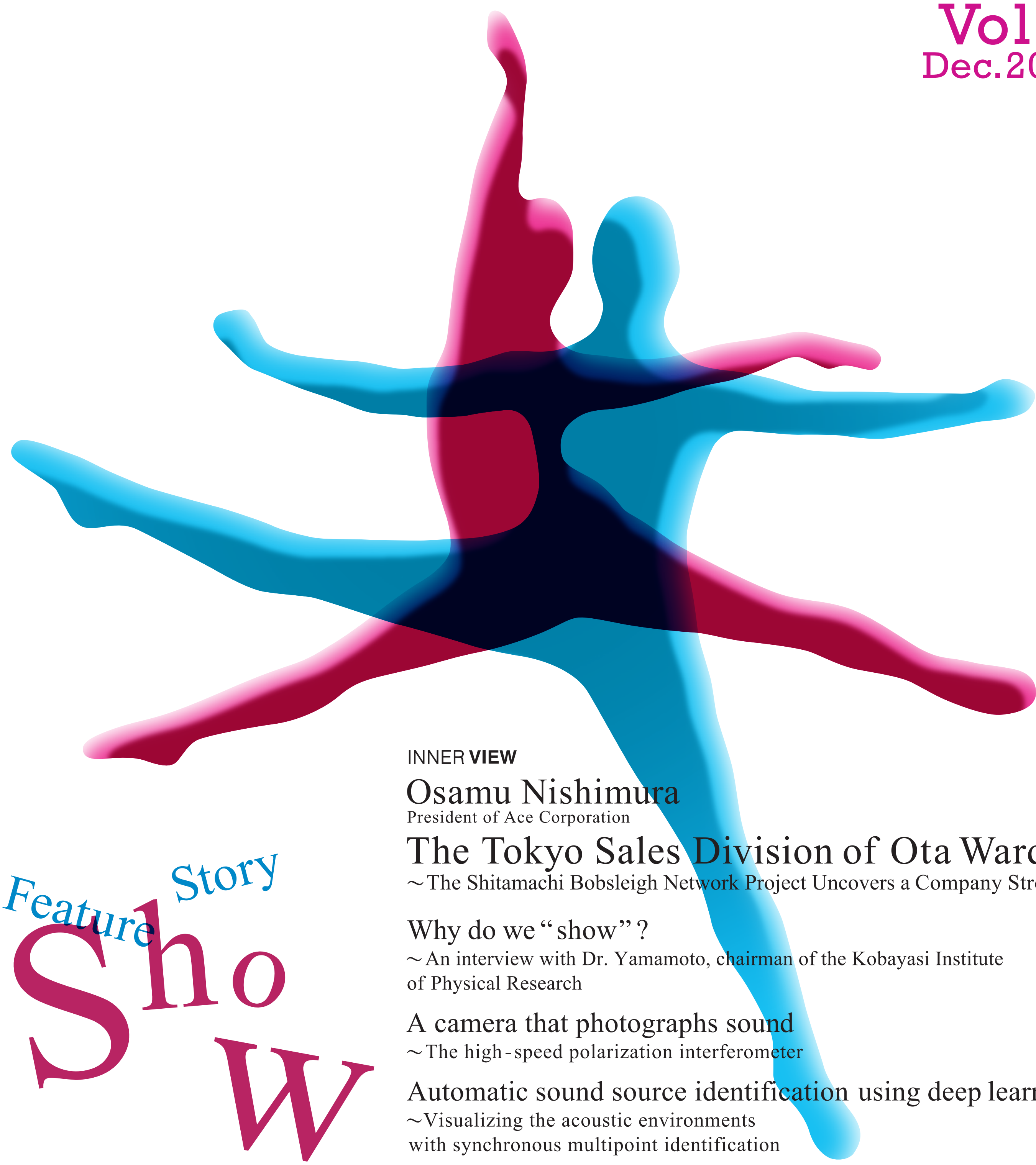


Feature Story

Show

RION CO., LTD.

Osamu Nishimura

Born in 1971, Osamu Nishimura graduated from a vocational college of business. In 1993, he began working for the sales division of the Joto Mitsubishi Fuso Motors Sales Co. Ltd. (now the Minami-Kanto Mitsubishi Fuso Truck and Bus Corporation). In 2001, he joined Ace Corporation. In 2007, he became the president, a position he still holds.
In September 2012, he decided to participate in the Shitamachi Bobsleigh Network Project, starting with the prototype production stage. In June 2014, he assumed the position of project deputy head, overseeing production.
The photo shows "Bob peace," the signature pose of the Shitamachi bobsleigh project.

Ace Corporation website
http://www.ace-tech.jp/

Official site of the Shitamachi Bobsleigh Network Project
http://bobsleigh.jp/

Osamu Nishimura President of Ace Corporation

The Tokyo Sales Division of Ota Ward

～The Shitamachi Bobsleigh Network Project Uncovers a Company Strength

Text by Michinari Okazaki / Photo by Megumi Yoshitake

“ Please send it to us before you weld it ! We’ll test it and send it back to you! ”
Those were the words of a staff member, pleading with a client over the phone from an office behind the partitions, while I interviewed Nishimura — a glimpse of an ordinary day at the small factory in Ota Ward.

Bobsleigh Bobsleigh is a winter sport in which participants seek to complete a run down the course on a sleigh in the fastest time. Bobsleighs can reach speeds of up to 130 km per hour, so the sport is also known as the “ F1 on ice.” It’s been an official Olympics sport since the first winter Olympic Games in 1924.

Mission : Reaching the Pyeongchang Olympic Games

“I apologize for my voice,” says Nishimura, the 45-year-old second president of Ace Corporation in Ota Ward, Tokyo, and deputy head of the Shitamachi Bobsleigh Network Project. “My throat’s been bothering me since yesterday. It must be hard to make out what I’m saying.”
In fact, the condition of his voice makes me self-conscious and apologetic for the timing of this interview. He assures me it’ s not a cold.
The Shitamachi Bobsleigh Network Project began as a plan conceived by a staff member of the Ota Ward Office in 2011. The plan was a grand one, with the goal of producing a bobsleigh capable of Olympic-level performance through intercompany cooperation and a combination of technologies deployed at small factories in Ota Ward, many of which had never seen an actual bobsleigh. The plan was submitted in hopes of promoting awareness of the strength of monozukuri (manufacturing) cultivated by these small factories.
It’s been six years since the Shitamachi Bobsleigh Network Project was launched. The bobsleigh created by the project has been officially selected by the Jamaican team, after a few twists and turns. Now, the goal is to compete in the Pyeongchang Olympics in February 2018 with this sleigh. The list of teams qualifying to compete in the Olympics will be finalized in January 2018.

“ You only live once ” — a company president’s ambitions

Ace Corporations was founded by Nishimura’s father in 1974. In the beginning, the company’s business involved designing and manufacturing machinery and equipment. But orders for new machinery dwindled with the collapse of the Japanese asset price bubble. The company was forced to downsize their business. Since then, the company has focused on manufacturing individual component parts.
“I had no intention of succeeding in the company ” says Nishimura. “I lacked the administrative skills. I did like to talk with people, so I thought I might do well in sales. I went to work for a sales company that sold buses and trucks.”
He oversaw the Asakusa district during the nine years that followed, spending his days knocking on the doors of new potential buyers.
“It was a relatively small area, so if I visited 100 companies a day, I could visit all my potential clients in the course of a week,” says Nishimura. “After two years of dutifully showing my face around, whenever they wanted to purchase a new truck, they’d say, ‘Hey, why not buy one from Nishimura? He comes around so often.’ ”
Just before his 30th birthday, Nishimura was invited to work for one of his client’s companies. But the company owner, on hearing that Nishimura’s father was the owner of a small factory in Ota Ward, advised him to return to his family’s company.
“It’ s not often that one gets the chance to be the president of a company,” Nishimura recalls being told. “You only live once. You should tackle the challenge.”
The words were enough to convince Nishimura, and he joined Ace Corporation.

The “sales division” of the small factories

In the 1990s, when Nishimura joined Ace Corporation, the company had been obtaining blueprints for manufacturing parts from major companies. The original business model for his company involved applying the cooperative efforts of other small factories in Ota Ward to help each other process orders that a single factory wouldn’t be able to handle alone. Eventually, the business model of his company evolved into one in which machinery would be assembled by outsourcing parts that couldn’t be manufactured by Ace to other factories, then delivering the assembled product to clients.
In its heyday, Ota Ward boasted 10,000 small factories; now, there are only 3,400. And nearly 90% are factories staffed by

five or fewer people.
"Our company has a staff of 12, so we're a major business in Ota Ward," laughs Nishimura. "Small factories normally handle parts manufacturing, sometimes without even being informed what the parts would be used for. Our company mainly did assembly, so we were able to present proposals on the machining or finishing methods of parts to our clients. The clients trust us because they have direct communication with technicians, so they pick us to manufacture their parts. Whenever we outsourced the manufacture of parts to other factories, we would insert comments on the blueprints—for example, this is important because this part is to be used for such-and-such purpose—so the technicians would understand what was truly important and manufacture the parts precisely to order. Then, clients can set and bolt down the ordered parts into place as planned, immediately after delivery, so they're satisfied that doing business with us is trouble-free. Our clients are happy, and the cooperating factories are happy. We act as the intermediary for these win-win transactions. So our company is like a Tokyo Sales Division for the small factories. That's the nature of our company."

Parts ready the next day

In 2012, the first briefing session was held on the cooperative project for the Shitamachi Bobsleigh parts. People from about 30 companies at the session returned to their companies with blueprints for the parts that they would be responsible for. Ace Corporation was the first to have their parts ready.
"The briefing session was on September 18," recalls Nishimura. "We returned with blueprints for three parts. At the daily assembly the next morning, I told my employees, 'We're going to make a bobsleigh. I need your cooperation.' Their reply was, 'Sir, do you know the current state of work at our factory? Besides that, we don't have the equipment needed to make parts with these shapes.' I knew I was in a difficult situation, but I'd accepted the responsibility, so this had to be done. I pleaded with them that I had to get the job done, even if it meant we had to purchase new equipment."
Nishimura was looking for an opportunity that would enable the transformation necessary for the company to survive. He had to do something to change his company. That's when the bobsleigh project came along.
"The bobsleigh is an accomplishment you can see with your own eyes," says Nishimura. "It runs fast. It may even appear in the Olympics! I stressed that this is what I wanted our company to do. My staff gave in. They said, 'OK sir, we'll look into this one more time.' Then, the next day, they had the parts ready. Boy, was I overjoyed!"
Over time, Nishimura's role in the project gradually changed. When the decision was made that the Shitamachi bobsleigh would actually be used to race, the need arose to modify the chassis as fast as possible. The strengths of Nishimura's company came into play. With its cooperation, the project met the deadline—if just barely. Nishimura notes, with amusement, that this incident highlighted the characteristics of Ace Corporation for project members.
"Our company can only manufacture angled parts," he says. "But since we had been doing business by outsourcing parts in blueprints that we couldn't manufacture to our cooperating factories, we had a grasp of almost all kinds of parts. So, since a bobsleigh has a lot of parts, the project asked us for advice from the assembly perspective. Many of the participating companies have experience with parts manufacturing, but basically none had any knowledge on how the parts are welded together. The project needed someone who knew about connecting the parts, so they asked me to be the coordinator of the manufacturing processes. So, from the production of the second prototype, I assumed an advisor's role."

Poster of Shitamachi Bobsleigh says ; "A written challenge from Japan." ©Shitamachi Bobsleigh Network Project

This is it! This is our company!

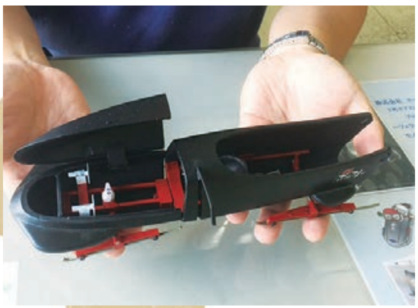
Every year, on the first work day of the

year, Nishimura announces the year's goal to his employees. And that's what's on his mind as the end of the year approaches. He feels he can't come up with something to say. He lacks a vision for his company's future. Will the company survive the next year? Can I pay my employees' salaries next month? Those have always been his day-to-day concerns. His expertise was in sales. He couldn't do the actual manufacturing. After Nishimura became involved in the bobsleigh project, a goal gradually began to take shape.

"Initially, I thought participating in the bobsleigh project would boost our company's name within Ota Ward," he says. "Then, I realized that a bobsleigh, as a vehicle, is a real object we could present to our clients. And my outlook changed. The project was an endeavour that could be promoted nationwide—something truly remarkable."

The decisive incident occurred in November 2015. That summer, the Shitamachi Bobsleigh Project built three bobsleighs concurrently. A TV crew covered the entire process. For two months, Nishimura was followed around by a camera from morning to night. During this time, of course, he couldn't handle his regular duties, so he left them to his employees.

"The filming finally ended in October. When November came, I suddenly realized I'd neglected my responsibilities as company president," says Nishimura. "I immediately went over our business records. To my surprise, I found we'd been doing quite well. Until that time, nearly half of the orders that we got were due directly to my sales activities. But that year, I was busy with the bobsleigh project, and my employees saw the sense of crisis. They knew they had to keep the company going. So they went out to carry on with the sales activities in my place. And to my surprise, sales improved. That's when my outlook changed completely. It occurred to me that we could exist as the Tokyo Sales Division. It was a major discovery. This was it! I'd finally found it! From there, the vision for my company came naturally—let's strengthen this area next year, and then this area the following year. And it's all due to the role I had in the bobsleigh project."



Handmade miniature model of a Shitamachi bobsleigh (courtesy of Ace Corporation)

The project, which Nishimura initially joined with the simple goal of promoting his company, made him see his company's key strength: to build bridges between parts, between clients and factories, and between people.

"Children visit our factory," says Nishimura. "They often ask how to become a company president. I say, making lots of friends is more important than your studies. You can be exceptionally talented, but once you're part of society, you can't achieve anything by yourself. Take the bobsleigh, for example. If even a single part is lacking, the whole thing doesn't work. The same goes for factories. You can win orders, but you can't complete them unless someone handles production at the factory. I think this applies to everything. So, I tell the children, "helping each other out, trusting one another, and, ultimately, making friends that will last through your adult life—that's what you should really focus on."

On the reception table is a miniature model of a Shitamachi bobsleigh, handmade by Ace Corporation. It's an exact scale replica of the actual bobsleigh. Inside it are actual miniature replica parts for those produced by Ace Corporation.

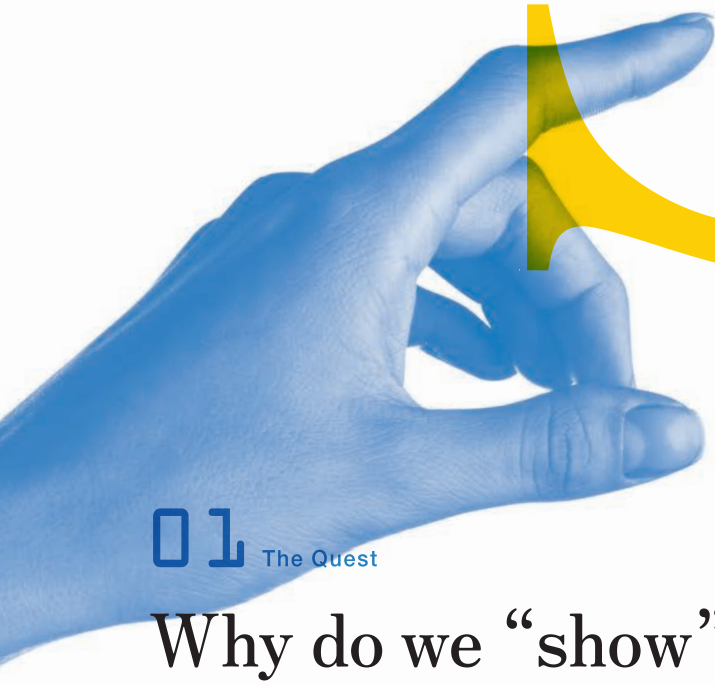
"Even if we have the expertise, it's hard to visualize this in a pamphlet. But a bobsleigh's different," says Nishimura. "We can tell our clients these are the parts that our company made. It's easy to understand. It boosts the motivation of our employees to know something they made is used in the bobsleigh. I think my son believes we're in the business of making bobsleighs," he laughs. "It's a huge advantage to have something concrete to show people."

At some point during Nishimura's exuberant account of this experience, it dawned on me the hoarseness had left his voice. Neither of us had noticed.

Feature Story

Show

"To see" and "to show"
——the former is something
that can be done alone.
The latter needs another person.
What do people show?
To whom? Why?



01 The Quest

Why do we "show"?

～An interview with Dr. Yamamoto, chairman of the Kobayasi Institute of Physical Research

To Show Is "To Share"

——What comes to mind when you hear the word "show"?

Well, I remember the time I showed an Italian visiting Japan around Tokyo Station.

——What was it about Tokyo Station you wanted to show?

The red brick station building, viewed from the Marunouchi side. Compared to Italy, Japan is a remote country in the Far East. I wanted to show that even in a country as remote as Japan, there's a touch of Europe. The differences between the cultures and languages are significant, and so is the geographical distance. I thought maybe a person coming to Japan from the center of Europe would be amazed to find something so close to his culture in such a faraway land.

——And was your friend amazed?

Well, he looked up and noticed the characters "MMXII" carved into the ceiling and asked me, "Those are Roman numerals signifying 2012. I think it represents the year. What happened in 2012?" That was the year the station building was reconstructed. He was surprised to discover Roman numerals, part of the history of his country, in use in a foreign land. But I also felt, at that moment, that we shared, as human beings, the memory of a long gone past, despite being from totally different cultures. I think the feeling of sharing something or soliciting empathy is what it means "to show."

The role of science in "showing"

——"Showing" is an act that triggers a visual sensation. But human beings have other senses, too.

Yes, the five senses—sight, hearing, smell, taste, and touch. Humans have these five senses to protect ourselves.

Roman numeral MMXII (center of the photograph) which was chopped by the pillar of the Tokyo Station Marunouchi south exit station building

Sight is for discovering enemies from a distance. The enemies we can't see, we perceive through hearing; for example, is it a beast approaching from the back, or is it your child ? Is the food good or spoiled ? We make these decisions through our sense of smell. The five senses help keep us alive. We try to avoid what we can't perceive using any of the five senses based on the fear that we won't be able to protect ourselves from that danger. Fear is the sensation humans feel to ensure our safety.

——Is there a way to overcome fear?

When infrasound is being radiated, we don't hear anything, but we see the screen door shaking. It scares us. But if measurements are taken using an instrument, the sound is presented as numerical data. If the recording is played back at higher speed, we finally make it out as a sound. Without scientific explanations, people feel fear, and that leads to superstition. Science lets humans perceive what they can't through their senses alone. It confirms whether this will affect us. It's great at debunking superstition.

——So, do you see this as one of the roles of science ?

I believe so. We can't see ultraviolet light, infrared light, or radiation. We can't hear infrasound waves or ultrasonic sound waves. Some poisons have no taste or smell. Science shows us such things as numerical data and examines their effects on people. Then, we can find ways to ensure our safety and to feel secure. Making people feel safe, that's definitely one role of science. The role of scientists is to present the correct data to the public.

Can our mind be visualized?

——What's your take on the limits of science?

Is gathering data enough? I don't think so. Some people will refuse to believe the data or fail to understand the significance. " To show " isn't just about presenting data. It involves implicit knowledge. When I see a person, how do I identify him? Not by looking at data. There are things that logic alone can't explain. I believe that's our sixth sense, our "mind."

——Can we quantify emotions like happiness or anger?

We read emotions from expressions and the tone of a voice, but I think it would be hard to show them as numerical data. At this point in time, I think the only way to do this is to monitor the biological reactions triggered by changing emotion signals —brain waves, blood pressure, breathing, and hormonal levels—our body gives out. Brain waves, a beating heart, and respiration are all waves with certain frequencies. Music, which affects humans emotionally, is basically the vibration of air. From that viewpoint, one might say that everything is ultimately attributable to waves.

——Are biorhythms an example of this?

I'm not sure that that's actually science [laughter]. But according to the Buddhist view of the world, the most stable state is nothingness, where everything has vanished.

——Now that's definitely impossible to show [laughter].

Interviewer : Michinari Okazaki

Dr. Kohei Yamamoto

PhD, chairman
of the Kobayasi Institute
of Physical Research.
Born in 1950 in Hyogo Prefecture.
Research interests
in applied acoustics.

02 The Quest

A camera that photographs sound

~The high-speed polarization interferometer

Numerous attempts have been made in the past to visualize sound.
However, one research project stands out in its uniqueness.
In this issue, we're visiting the Oikawa Laboratory of Waseda University.

Photographing sound

What's innovative about this research is that it attempts to visualize sound using a polarization camera, taking advantage of the fact that the phase of light is modulated by differences in air density—in other words, by sound waves; rather than by using microphones to detect sound, then digitizing and imaging the obtained data, as we do in most conventional studies.
The high-speed polarization interferometer that enables this photography was developed jointly by Photron Ltd., a high-speed camera manufacturer, and Kiyohara Optics Inc., an optical device manufacturer. The high-speed polarization camera made by Photron Ltd. is what led to the technological breakthrough. It's the only optical camera in the world with polarization sensitivity capable of ultrafast photography at up to 1.5 million shots per second.
Says Dr. Oikawa, " Photron made a camera we could never have made by ourselves. We use the images recorded by this camera and convert them into information on sound. This study is extremely significant, one to which both Photron and we contributed our respective expertise."

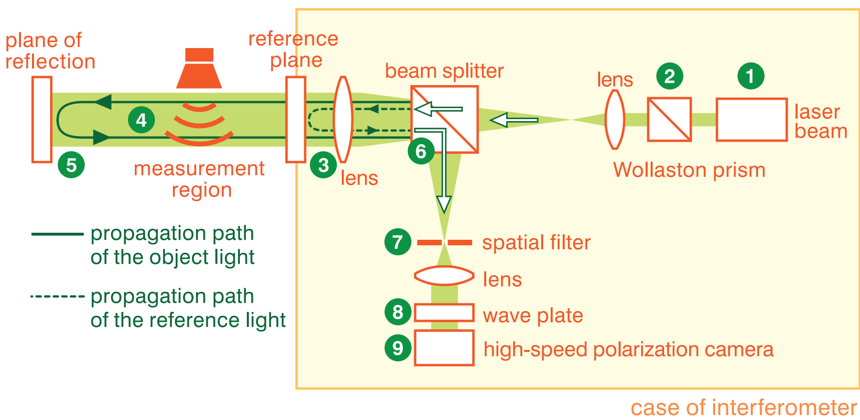
Capturing a one-time-only sound event

About 10 years ago, the Oikawa Laboratory began research on acoustic measurements using light. The laser Doppler vibrometer used in the past could measure only temporal change at the single point at which the laser beam was aimed. Seeing the target in its entirety took repeated measurements and changes in the direction of the laser beam, and so the sound had to be reproducible.
Says Mr. Ishikawa, "Now, with the development of the high-speed polarization interferometer, it takes just a single run to measure the targeted space. So, now it's possible to measure sound that's emitted just once and can't be reproduced."
Actually, attempts to visualize the density distribution of air have been made for quite some time in fields outside acoustics. For example, many of our readers may recall seeing images of jet streams or images of heat radiating from objects.
Says Dr. Yatabe, " Compared to such phenomena, the change induced in light by sound is quite small. Roughly speaking, the effects of sound on light in terms of distance (apparent optical path difference) are on the order of 0.1 nanometers — smaller than the effects of jet streams or heat transfer phenomena by two or three orders of magnitude. So, it used to be very hard to observe sound as light. Conversely, it may be said that the human sense of hearing, which is capable of detecting such minute changes in air density as sound, is a surprisingly highly sensitive sensor."

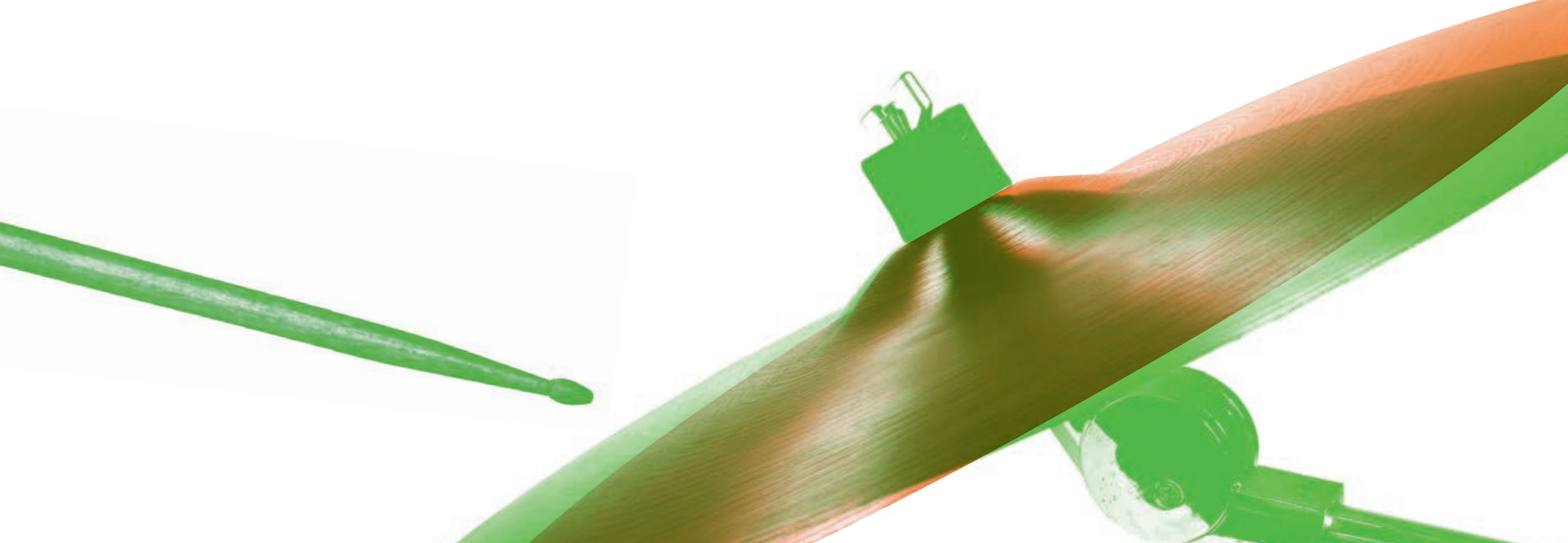
Expanding our view

Perhaps these unique research results stem from the distinct personalities and wide perspectives of the three researchers.
During his years as a student at the Department of Electrical Engineering,

The mechanism of a high-speed polarization interferometer



1. Light is emitted.
2. Light is split into two linearly polarized beams of perpendicular polarization.
3. The component reflected here becomes the reference light, and the transmitted beam propagates to the measurement region.
4. The phase of the object light is modulated by the sound wave.
5. The object light is reflected back into the case of the interferometer.
6. The returned object light and the reference light overlap, and the beam splitter sends the overlapped light in the downward direction in the figure.
7. The unnecessary light is removed.
8. The polarization state of the light is converted.
9. A single image sensor simultaneously detects up to four types of interference fringes. The device used here is the CRYSTA PI-1P, manufactured by Photron Ltd. The interference fringes shown in the photograph are processed and converted to the acoustic image.



Waseda University, Dr.Oikawa claims he was "interested in fields associated with humans—that's how I discovered the field of acoustics."

When Dr. Yatabe was young, he wanted to be a musician. But, he says, " Research can be more creative than music. I'm the only one in the world capable of doing my research."

With interests in both music and physics, Mr. Ishikawa chose this field after he discovered a field existed that dealt with sound in physics. He said to himself, "Why not choose a topic I' m truly interested in?"

Says Dr.Oikawa, "Not just us, but everyone in our laboratory, has diverse perspectives and ideas on how they should pursue research. Acoustics in particular is a field that requires knowledge in various areas. It isn't necessary for each and every person to have a broad perspective, but the contributions made by each person to expand the perspective of the laboratory as a whole is what matters."

The present research, in a sense the result of this collective effort, is more than a major contribution to achieving an understanding various unresolved sound phenomena. One example of applications for which this research is expected to show high potential is the sensor technology incorporated into the automated driving systems of cars and autonomous robots, something that will come to pass if future studies can succeed in visualizing ultrasonic sound over wide areas. Expectations for this field in the coming years are high. " The goal of our research is to create a space that offers more comfort and convenience for communication between people," says Dr.Oikawa. "We want to learn how sound radiates in a space by taking sound measurements. That's the true theme of our research. The method for visualizing sound is just one output along the way."

(Reference)

Ishikawa, Yatabe, Oikawa et al., "High-speed imaging of sound using parallel phase-shifting interferometry", Optics Express, Vol.24, No.12, pp.12922-12932, 2016.

With cooperation in interview from:

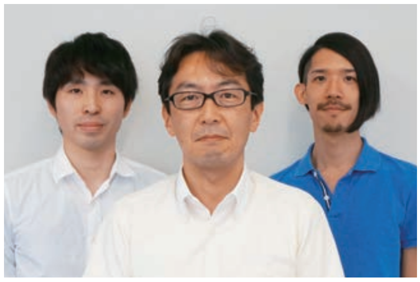
Oikawa Laboratory in the Department of Intermedia Art and Science, School of Fundamental Science and Engineering, Waseda University

http://www.acoust.ias.sci.waseda.ac.jp/

Photron Limited

http://www.photron.com/

Interview and photo by Yuichiro Fuse (music technical writer)



From left to right : Kenji Ishikawa (doctoral student), Yasuhiro Oikawa, Dr. Eng. (professor), Kohei Yatabe, Dr.Eng. (assistant professor)

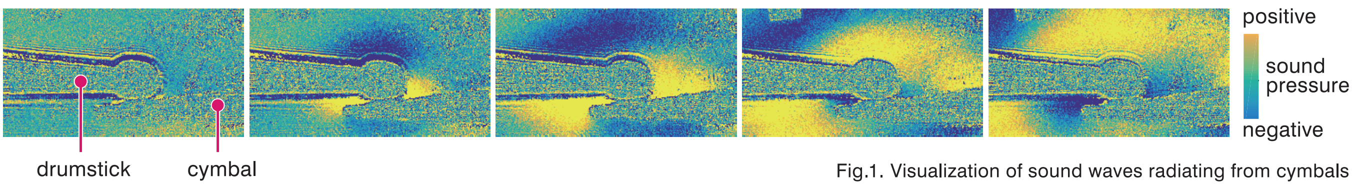


Fig.1. Visualization of sound waves radiating from cymbals
We see how sound wave radiates from the point where the cymbal is struck.

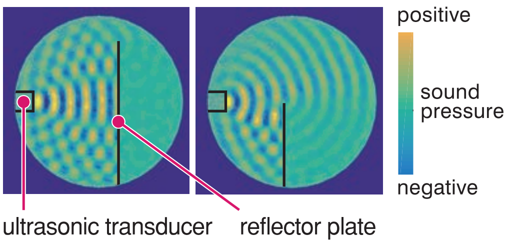


Fig.2. Visualizing reflected and diffracted sound waves
Sound waves are reflected (left) and diffracted (right) by a reflector plate.

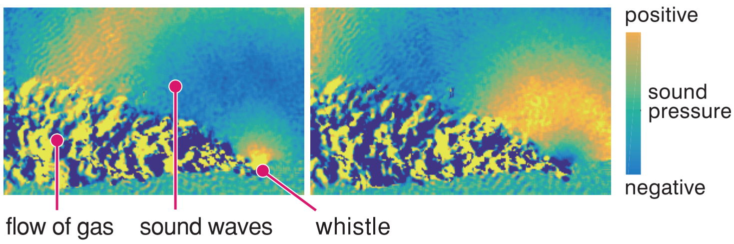


Fig.3. Simultaneous visualization of flow and sound waves
An image that simultaneously captures the flow of gas exiting from a whistle and the radiating sound waves.

03 An Example of Measurement

Automatic sound source identification using deep learning

～Visualizing the acoustic environments with synchronous multipoint identification

" Tap, tap, tap, What's that sound ? The sound of the wind " — from a Japanese nursery rhyme, "Abuku Tatta" (Bubbles Are Rising)
The human ear generally has no trouble identifying the source of a sound. How close to the capabilities of a human ear can a machine get ?
Here, we introduce a new attempt to visualize the change in acoustic environments based on automatic sound identification.

Why Deep Learning?

In the everyday environment around our homes, we hear various sounds, like the sound of cars, trains, bicycles, bird song, and airplanes. Knowing what sound sources are present in an environment is an important step in designing noise countermeasures for that location. Visualizing how sound travels or propagates allows both temporal and spatial evaluations. To this end, we need to hear and identify the sound sources in the collected sound data. The human ear has a remarkable ability to distinguish sound sources; making a machine do the same automatically isn't easy.

At Rion, we're currently involved in a study of automatic sound source identification based on deep-learning. Deep learning generally requires massive volumes of data to achieve desired performance levels. In collecting the data to create this automatic sound source identification system, we saw the need to label each data collected with the respective source of the sound captured. Up to that point, this labor-intensive task had been done manually. In our present study, we developed a tool that instantly inputs the source type on site (Fig.1), reducing the work required associated with automatic sound source identification.

* Deep learning : This approach to automatic learning is based on the idea of neural networks (modeled on the structure of the human brain). The processing technology learns abstractions from input data on multiple levels. One newsworthy example is Google's automatic face recognition technology for cats.

Collecting and Learning Sound Data

To gather sound data for this study, we set out noise meters at multiple locations. There were 15 points for measurement : 12 points around a park in a residential area, and 3 points within company premises. Of these points, individuals assigned the task of labeling the sound source were positioned at two points, and information on the sound source was recorded using the tool we developed. The labeling was done at points 4 and 7. Using this sound data and a deep-learning neural network with the configuration shown in Fig. 3, we built an

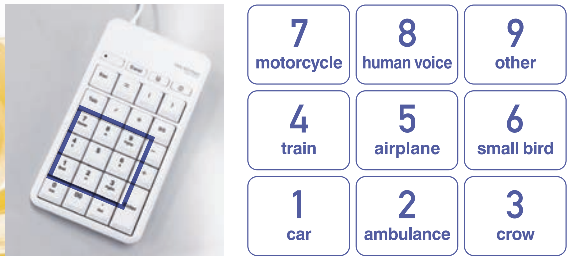


Fig.1. Labeling tool.
Each sound source is assigned a specific key on the numerical keypad.

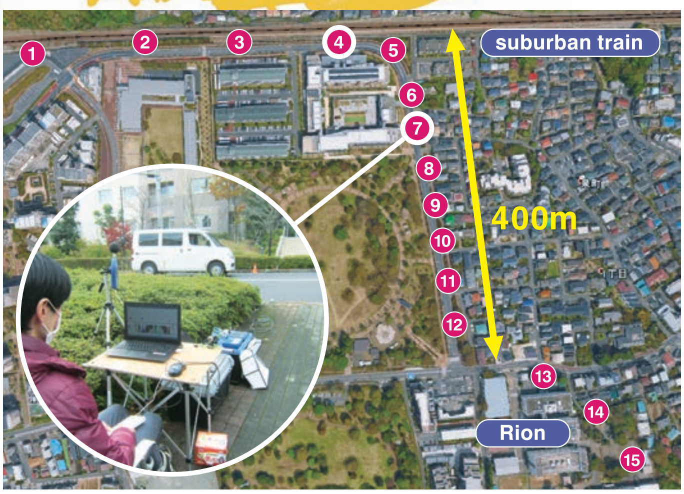
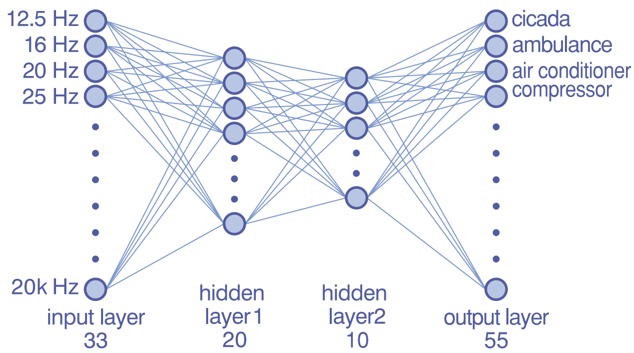


Fig.2. Fifteen measurement points around the park;
a worker placing a label at Point 7. Points 1–12 are located along a road.
The structure visible in the upper half of the photo is the railway.



Input layer : noise levels measured for each 1/3 octave band (33 bands)
Output layer : posterior probability(0-1) for each sound source category (55 categories)
The number of data captured and learned is 38,328 (1 per second, total duration of approximately 10.6 hours).

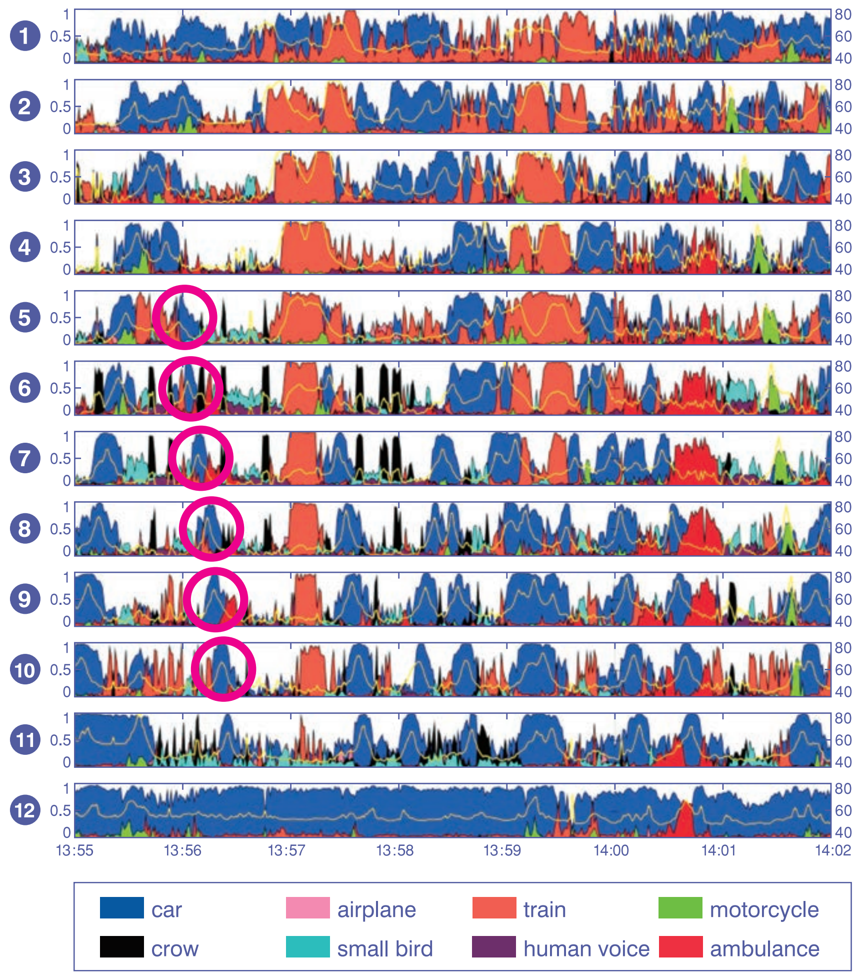
Fig.3. The architecture of the deep-learning system

automatic sound source identifier.
Synchronous Multipoint Sound Source Identification

Synchronous Multipoint Sound Source Identification

Using the identifier created, we applied our automatic sound source identifier to all the sound data.
An example of the identification is presented in a graph aligned with the time of measurement at the points, showing the results of automatic sound source identification at 12 points around the park for seven minutes during the daytime (Fig.4). The identification results are colored by sound source. The results are superimposed, with sources occurring more often placed towards the rear. The yellow line plot shows overall noise levels at one-second intervals.
The figure shows how one perceives moving sound sources like cars, motorcycles, and trains moving from point to point; how the sound of a train propagates to a point located at a distance from the rails; how the intermittent sound of a crow cawing or bird chirping occurs; and how the sirens of an ambulance can be heard in the distance. At nearly all 12 points, we can identify the sound of automobiles throughout the measurement—that's the sound of an idling car parked nearby. The 12 points, including the one at which the labeling was done, were placed along the sidewalk surrounding the perimeter of a park. Identifying the sounds of passing cars and motorcycles was relatively easy, since the variations in propagation characteristics from the sound source to the point of measurement were small, allowing stable identification at all points. Errors included a noise being identified as a train when no trains were passing and failure to register the voices of people talking on the sidewalk. Adding information on temporal changes and the direction from which a sound arrives may eliminate such errors.
The graph showing the results of synchronous multipoint automatic sound source identification is one way to visualize the acoustic environment in a measured area, presenting the sound sources present in this environment in readily perceived format.

Yasutaka Nakajima
Development Department



Result of synchronized, multipoint automatic sound source identification.
The vertical axis on the left presents the probability of the sound source (0-1).
The right vertical axis shows L_A (dB), yellow line.

Understanding Measuring Instruments

We will explain a measuring instrument from various angles in a three-part series

The seismometer (Part 3 of 3)

How we use seismometers

In previous issues, we discussed how ground motion is transformed into digitized data and how seismometers work. This final part of the series will describe how we use seismometers.

Based on the news reports that follow earthquakes, which typically present information on seismic intensity and magnitude, most people have some notion what seismometers are. But seismometers do other things, too. Generally speaking, we can classify seismometers into one of two groups, based on the application: seismometers used for observations and seismometers used for control. Seismometers used for observation measure ground motion, whether for immediate purposes or for future research. Seismometers used for control tend to be used as part of safety management efforts for the social infrastructure or for plant facilities. In both cases, the environments in which seismometers are installed can be quite diverse, so seismometers incorporate various features to prevent malfunctions due to static electricity or magnetic fields, as well as fail-safe measures, such as redundant communication methods.

Seismometers used for observation

Besides relaying information on seismic motions after an earthquake, observational seismometers are used for research, including explorations of the effects of an earthquake. Given below are some typical applications:

• **Vibration analysis of bridges**
The ground motion experienced by a bridge during an earthquake or a meteorological event is recorded and studied to improve seismic resistance design and extend the design life of structures (Fig.1).

• **Monitoring structural behavior**
The data gathered by seismometers on ground motion during earthquakes is analyzed and studied to improve the seismic resistance, seismic isolation, and seismic damping performance of structures.

Seismometers used for control

Widely installed in various facilities, control seismometers are used to help prevent damage during earthquakes. Some examples are given below:

• **Factories**
Seismometers are linked to emergency broadcasting systems to prevent secondary disasters (for example, fires), facilitate evacuation guidance, and control factory line operations (Fig. 2).

• **Water treatment facilities**
In distribution reservoirs, seismometers are linked to emergency cutoff valves to prevent the loss of drinking water by flooding or collapse. These systems help secure lifelines in the event of disasters.

• **Railways**
Seismometers also provide the information needed to initiate emergency train stops. Perhaps most notably, an earthquake early-warning P-wave system has been introduced to control bullet trains.

The current state of seismometer deployment

Compared to other countries, Japan has a remarkably dense network of seismometers deployed for earthquake observations. The Japan Meteorological Agency has installed seismometers across Japan at 20 km intervals to gather seismic information. In addition, following the Hyogo-ken Nanbu (Kobe) earthquake (the Great Hanshin earthquake), local public agencies deployed their own seismic information networks. All told, including seismometers operated by the public sector and academia, more than 10,000 seismometers are currently deployed in Japan.

Earthquake Early Warning (EEW)

The Earthquake Early Warning service, which currently operates seismometers at over 1,000 locations, began broadcasting to the general public in October 2007.* The system detects the primary wave (P-wave) of seismic motion to predict the intensity of the secondary wave (S-wave) that will follow, and broadcasts the anticipated danger. Factors contributing to these predictions include the dense base of seismometers deployed, which enables monitoring systems capable of immediately detecting earthquakes; advances in processing power, which enables instantaneous calculations; and effective prediction methods.

*This seismic observation network consists of seismometers operated by the Japan Meteorological Agency (270 locations) and the National Research Institute for Earth Science and Disaster Resilience (approximately 800 locations). Cited from the Japan Meteorological Agency website, "How the Earthquake Early Warning system works."

Long-period ground motions

Major earthquakes generate slow, large ground motions with long periods referred to as long-period ground motion. Long-period ground motion can induce sympathetic vibrations when their periods match the natural periods of high-rise buildings. If this occurs, it tends to amplify the violence of the movement at higher building levels and the risk of injury.

Currently, the seismic information made available is insufficient for assessing motion at higher building levels. For testing purposes, the Japan Meteorological Agency has publicly released data on long-period ground motion since 2013. This is an indicator consisting of four categories based on the level of damage, such as the difficulty experienced by humans to respond and the movement and falling of furniture. Currently, only observationally based information is provided. However, with the increase in the number of high-rise buildings in recent years, the number of people that will be affected by long-period ground motion will also increase. Presumably, this information will be needed in various situations: for example, securing worker safety on high-rise structures and elevator control. Studies are underway to determine the nature of the prediction information. Public awareness of long-period ground motion remains low, but this issue will definitely become more important in the coming years.

Kensuke Nagashima
Development Department

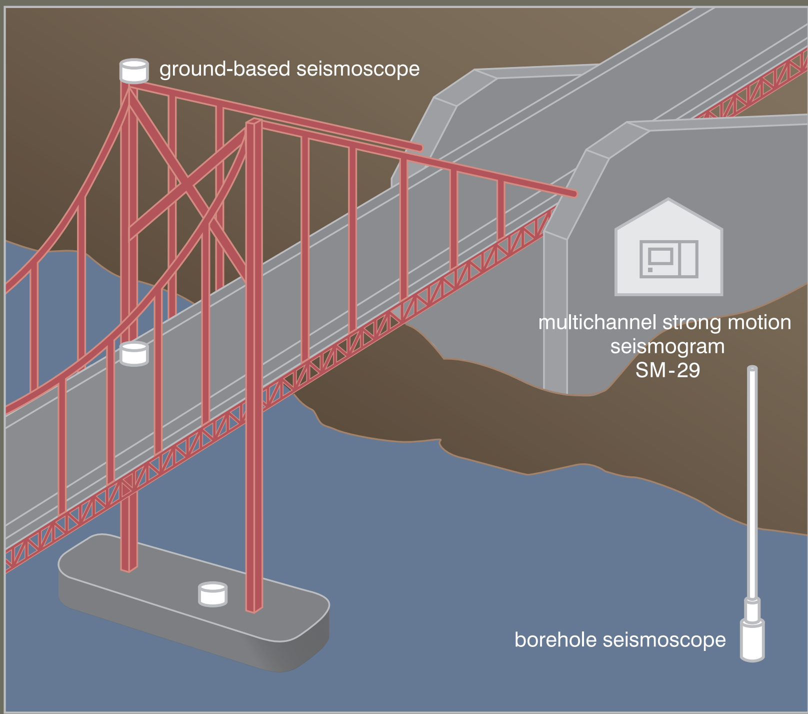


Fig.1. Example of a vibration analysis of a bridge

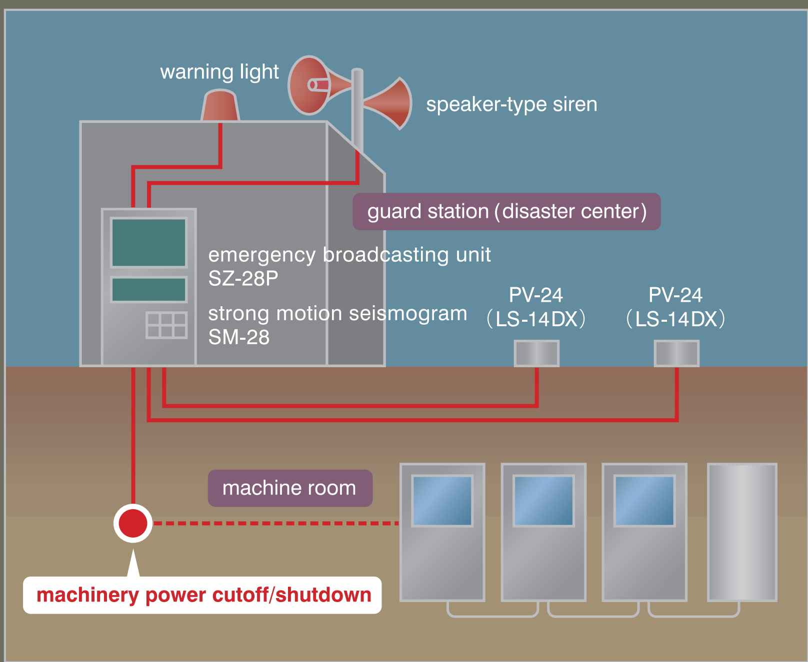


Fig. 2. Example of seismometer installation at a factory

Rion's History of Technology

LEARNING from our Past Products

The igniter with near-infinite design life that took Japan by storm

The Rionosparker

Requiring no battery power and having near-infinite design life, the product was hailed as " flint for the 21st century" and emerged as a major hit. Here's an interview with Mr. Takahiro Kurosawa,* who worked on the product design.

* When he joined our company, he belonged to Division 2 of the Engineering Department.

——Many among the younger generation of employees have never heard of the Rionosparker. How do you feel about that?

The Rionosparker (igniter) is a product with special significance. It's an igniter device used in gas appliance for homes and lighters. It replaced the conventional match and stroking strips used to light fires and didn't require a battery. It was an innovative product.

——What was the ignition mechanism?

A piezoelectric element produces a very small voltage when pressure is applied to it. The Rionosparker was a larger version of the device. Together with Kobayashi Institute of Physical Research, Rion's parent company, we developed a piezoelectric element called Zirunama™ (PZT: lead zirconate titanate porcelain). We developed a large version of this element. It's what revolutionized igniters. We created an ignition unit using this element for incorporation into gas stove burners and lighters.

——How much voltage did it produce?

Around 15 kV. The element is struck by a spring device inside the ignition unit to discharge an electric current into a spark gap of about 3-4 mm. That's the electrode (tip of the wire in the photo on top). The duration of the electrical discharge is short, a bit longer than 10 microseconds, and so the energy produced is extremely small. Once you're used to the elements, you can hold the electrode between your fingers to induce a charge and guess the voltage to a decent approximation. Later, instruments like memory scopes entered the market. They made it possible to precisely measure voltage and current.

——Was it a high-performance device?

Well, in Japan, it did take the market by storm. It featured smooth back-and-forth motion during ignition, reliable ignition

Scene from inside the factory in 1965

The disassembled parts of a lighter
(The ignition unit is shown in the center.)

performance, over 30,000 ignitions, and low cost. To reduce product costs as far as possible, we negotiated the price of parts to fractions of a yen, 0.1 yen, for each part. There was also competition for a patent on the mechanism, so it became a regular practice at our company to apply for patents and utility models.

——Were you (Mr. Kurosawa) involved in the development from the very beginning?

I joined the company in 1996, well after the Rionosparker had become a major success as the ignition device for gas stove burners. It was even after it had won the Ota Award, one of the most prestigious awards in the gas industry. When I first joined the company, the factory had just been completed, so my job was mainly designing the ignition device for lighters.

——Can you tell us something about the factory?

The factory was ideal for all stages of piezoelectric element production, from materials development to element production, and even in-house manufacture of the ignition device. Producing a piezoelectric element involves blending, kneading, forming, baking, polishing, and electrode coating. For the baking process, we implemented precise temperature control for a long tunnel furnace at high temperatures, which made stable production of piezoelectric elements possible. We needed a large factory to house all the facilities necessary for element production occurring at the scale of that time. The furnace ran 24 hours a day. There was even a night shift.

——Very different from things at Rion today...?

Yes. There were four to five assembly lines, about 30 meters each. When you entered the plant, you would see rows of female employees along the assembly lines. The female employees were very fond of the chief manager of the factory at the time, and I hear even now they have a reunion once a year. Everybody from that time is considerably older now, but the bonds formed back then are surprisingly strong.

——I heard there were some issues after the element became popular.

There was the problem of cracking in sparker units for gas stoves. The absorption of moisture by the urea formaldehyde resin, the material used to make the unit, was causing internal discharges. We changed the material, which solved the problem. But I remember having to work overnight to replace faulty parts. We heard a lot of complaints from our customers, so it was a stressful time.

——What do you value the most as a designer?

Looking over my work after making the design. I rethink the whole design process, to determine if the design truly satisfies the original specifications. Then, occasionally, I come up with a better design. Always applying for patents and design rights is important, too. I try to drop by to see the patent staff as much as I can.

Interviewer : Norihito Sekijima

Mr.Takahiro Kurosawa

【 Rionosparker 】

The development of an ignition unit began in 1962. A novel material, PZT (lead zirconate titanate porcelain) was developed, and the resulting product, the Rionosparker, was introduced in 1964. The product was initially used in gas stove burners. In May 1967, the product received the Ota Award, the most prestigious award presented by the Japanese Gas Association, which boosted our company's reputation. In the summer of the same year, the issue of defective parts emerged. Our company responded by performing repairs and exchanging parts. Later, the Rionosparker was used as an ignition unit for lighters. In 1973, control of the igniter division was transferred to a subsidiary company, then sold to an outside company.

The Sole Distributor of Rion in UK

ANV Measurement Systems

ANV Measurement Systems became UK Distributors for Rion Sound and Vibration in 2001. At the time Rion's UK sales were very small. In his previous role as an Environmental Noise and Vibration Consultant, ANV's Managing Director, Mike Breslin, had become a Rion user. Impressed with Rion instruments' quality, reliability and ease of use, combined with their realistic pricing, Mike recognised an opportunity to make Rion a leading player in the UK sound and vibration market.

ANV and Rion have achieved a market leading position in the UK sound and vibration market, particularly with acoustic consultants and in construction and demolition. A number of strategies have been important in ANV and Rion achieving success in the UK:

• Positioning the Rion brand within the marketplace;
• Developing solutions, based on Rion products, to suit specific market requirements;
• A rental service;
• A calibration service; and
• Prioritising customer service.

From day one, recognising Rion's size and wide range of high quality products, ANV have always primarily distributed Rion products rather than offering Rion as one of several brands equally sharing the limelight.

Offering a rental service provides ANV with an income stream and offers customers the opportunity to try Rion instruments with a relatively small financial outlay compared to purchasing instruments. This is particularly important for customers who are new to the Rion brand. ANV's experience is that most hire customers became sales customers (who still continue to hire when they are temporarily short of instruments).

ANV have an accredited calibration laboratory (UKAS 0653). This provides an income stream and fits in with ANV's ethos of fully supporting the instruments and putting customer service first.

Both calibration and hire provide an opportunity for regular contact with customers without an overt sales agenda. This generates familiarity with the customers which makes it easy for them to call us and vice versa. ANV believe that if you provide good service then sales will naturally follow.

This priority is reflected in the makeup of ANV's team, which numbers 17 in total. Three Applications Engineers have a clear sales role in the Sales and Marketing Department which is headed by Jenny Krailing. Andy Jones heads a Services Delivery team of 5 and Kiran Mistry is head of ANV's 6 strong Calibration Team.

ANV are based in Milton Keynes around 80 km north of London, a location easily reached by national and international travel. ANV are keen to share experiences and collaborate with the international community of Rion distributors.

Mike Breslin, DIRECTOR, in front of ANV's office
with the Golden NL-27 awarded to ANV
by Kiyo for our 2013-2014 Sales Result

a Live to Web system
based upon the Rion XV-2P vibration meter

ANV measurement systems
Beaufort court, 17 Roebuck Way Milton Keynes,
MK5 8HL UK
TEL:01908 642846
www.noise-and-vibration.co.uk

SCIENCE COLUMN

The starlit sky, plasma, and particle measurement

In the past, I used to watch plants and meteor showers, an amateur's idea of astronomical observation. Most meteor showers are plasma emissions generated when dust particles of less than several centimeters collide with the Earth's atmosphere and vaporize. I was amazed how emissions caused by such small dust particles at altitudes above 100 km from the surface of the Earth could be so bright and visible to the naked eye. That's one of the reasons I became interested in plasma. The lights from stars and the tails of comets seen in the night sky are also plasma emissions. And auroras are created by the plasma winds from the Sun.

Plasma refers to a group of ionized particles in free motion, whether positive or negative. While neutral as a whole, plasma has characteristics distinct from the other three physical states—solid, liquid, and gas. Sometimes it's called the fourth state of matter.

It's only been in recent years that plasma has been used in industry. Since the desired high-energy fields can be obtained by controlling the state of the plasma, it's now used in various industries for applications like the decomposition or generation of materials. Plasmas are especially important in the semiconductor industry, which requires the formation of precise microstructures. They're used in producing thin films or etching. The plasma for these applications has to be "clean"—that means not just that the plasma has to be free of contaminants, but that it can't produce any by-products. I've had the honor of meeting many of the scientists who specialize in plasma engineering or semiconductor engineering in my time working on developing measurement systems of any contamination for foreign materials and methods to suppress their generation. Once, I recall, some of us were discussing over drinks the classical idea of the four elements of earth, water, air, and fire. We concluded fire must have been plasma.

The people of ancient times may have already had some glimmering that the light from the stars and the auroras in the night sky represented matter in an unknown state.

Kaoru Kondo, Development Department

Japanese scenery

Photo taken at Sengokuhara, Hakone-cho
Photo by : Nobuhiko Hiruma
Hearing Instruments Development Section 3

The Susuki grass (Miscanthus sinensis), one of the seven grasses of fall in Japan, is sometimes called the tail flower for its resemblance to a horse's tail. A field covered with Susuki grass is a classic scene that captures a sense of nostalgia for the Japanese.

ShineView!

Introducing one of Rion's shine workers, someone who shines, on and off duty.

Ryoma Tada
Sound and Vibration Measuring Instrument Manufacturing Section

Relaying excitement through illustrations

What's an illustration?
Unlike paintings, which express how an artist views the world, illustrations are pictures that relay information for a certain purpose — for example, book illustrations.
The word irasuto is a Japanese word derived from the English word " illustration", meaning, to make something easier to understand.

——When did you first begin drawing?

In elementary school. I drew a character on a snack package. I continued on to draw all kinds of pictures. Everyone around me thought I was strange, always drawing pictures.
(— Did you win any awards?)
I won an award from the city for my drawing of a five-storied pagoda, which I drew for art class in school. It hung in the mayor's office. I was presented with the award in front of all of the students at my school. I was happy.

——What do you use to draw ?

Since college, I've used a tablet and pen. Tablets let me draw intuitively, and I can upload my works immediately after I'm done. I also like how the tablet lets me experiment with different ways of coloring and with various effects.

——How do you complete an illustration?

Say, for example, that I want to draw a scene of someone eating at a restaurant. I close my eyes and try to envision the scene I want to draw in my mind and insert the people into the scene. Then, they start to move around, as if on their own. When all of them are in the right position, I cut the perfect scene out mentally and start to draw. I draw the walls, cabinets, windows, and the objects in the restaurant. Then I draw in the people. Then, I erase and redraw until the drawing approaches what I wanted to draw. (—That's quite an imagination.) More like fantasizing. [laughter]

——What delights you most about drawing?

When I learn that I can draw more things successfully, or that I'm getting better. At first, it took me one week to draw a hand. Now, I can draw a hand in about 30 seconds. It's satisfying to know you're growing. And, I can get immediate feedback from someone who looks at the illustration. I enjoy how you can communicate the excitement of creating an illustration.

—— Do you have any advice on improving one's drawing skills?

Draw every day. Every day, after eating dinner and taking a bath, I draw until I sleep. Ever since I learned a single day of not drawing sets me back three days, I've never been able to stop doing it [laughter]. Of course, how much you draw is important, but it' s also important to grow more and more aware of shapes and forms. I read a book on anatomy and learned how bones and muscles are connected, and that helped me draw lines with greater confidence.

—— Do you want others see your drawings?

Yes, I do. Then, I get to hear what they think.

An illustration in which bride and groom are depicted as Kaguyahime and Momotaro (characters of Japanese old tale)..

Work in progress. The tablet pen has been modified to facilitate manipulation.

From the interviewer :
Asked roughly how much time he has spent on drawing over the course of his life, he replies, " Umm, maybe around 7,000 hours." Awesome, isn't it?
(Michinari Okazaki)

PRODUCT INFO

A simple and reliable constant monitoring instrument
the NA-39A aircraft noise monitoring system

This constant noise monitoring system is lighter and more compact than our conventional products. The source of a detected noise event is precisely identified from information such as the arrival direction of the sound sources and real-time 1/3 octave analysis. Operations are simple, making the instrument easy to use. The dual data storage feature increases reliability.

A sound calibrator that requires correction
the NC-75 sound calibrator

An on-board reference microphone eliminates the need to correct for each microphone, enhancing both reliability and user convenience when calibrating the noise meter. The output frequency is 1,000 Hz and sound pressure levels are 94 dB. It can perform calibrations for 1-inch, 1/2-inch, and 1/4-inch microphones.

A simple facility diagnosis instrument operated by a pressing a button —Vibration meter (Riovibro)
VM-63C

This is the simple version of the handheld vibration meter series used to diagnose vibrations generated by rotary machinery and other equipment. To take measurements, you simply hold the sensor at the tip of the unit (pickup) against the target machine and press a button. It offers superb mobility, toughness, and usability and will definitely come in handy for daily inspections and simple diagnoses.

Liquid-Borne Particle Sensor
KS-19F

- Detects particles to 0.03 µm
- User can freely select particle size
  Up to 10 channels from 0.03 µm to 0.13 µm
- Sapphire flow cell
- With abundant options, it can be used for both in-line and off-line measurement

TOPICS Research presentations, articles, etc.

【Related to sound and vibration measuring instruments】

◎NOISE-CON 2017 (June 12-14, Michigan, USA)

- Hammering sound characteristics in a tunnel by rotary hammer inspection equipment / Y.Yonemoto, Y.Nakajima, T.Taniguchi*[1], D.Kuwano*[2]

*1 West Nippon Expressway Engineering Kyushu Co., Ltd. *2 Elwing Co., Ltd.

◎Noise and Vibration Technical Committee of the Acoustical Society of Japan (August 9, Nihon University)

- Acoustic measurement in a chapel / M. Okazaki, A. Nagai, C. Fujita, Y.Yonemoto, T. Naito, N. Okamoto

◎24th INTERNATIONAL CONGRESS ON SOUND AND VIBRATION (July 23-27, London, UK)

- Case study of application of a wireless measurement system / M.Ohya, Y.Kurosawa, Y.Nakajima

◎INTER-NOISE 2017 (August 27-30, Hong Kong, China)

- Sound source identification for unattended aircraft noise monitoring / K.Sakoda, K.Shinohara, T.Ozaki, N.Sato

【Related to particle counters】

◎The 6th Microbes Symposium (June 30, Shinagawa)

Presents the latest data and interpretations related to the rapid testing method for microbes / K. Minakami et al, Microbe Rapid Test Method Group, Aseptic Product GMP Committee Parental Drug Association—Japan Chapter (in Japanese).

Exhibitions

[S] Related to sound and vibration measuring instruments
[P] Related to particle counters

[S] Automotive Testing Expo China (September 19-21, Shanghai, China)
[S] The 25th national meeting of the Japan Environmental Measurement and Chemical Analysis Association (October 12-13, Chiba)
[S] Railway Technology Exhibition (November 29-December 1, Makuhari)
[P] BioJapan / Regenerative Medicine Japan 2017 (October 11-13, Yokohama)
[P] Takamatsu Waterway Exhibition (October 25-27, Takamatsu, Kagawa)
[P] SEMICON Europe 2017 (November 14-17, Munich, Germany)
[P] SEMICON Europe 2017 (December 13-15, Tokyo)
[P] SEMICON Europe 2017 (January 31-February 2, Seoul, South Korea)

Seminars

We conduct seminars on sound and vibration across the country. Please visit the website (http://rion-sv.com/event/all) for dates, venues, programs and other details.

NEWS

On July 21, 2017, Rion signed a memorandum of understanding with the Civil Aviation Authority of Viet Nam (CAAV) for technological cooperation and joint research on establishing monitoring and measuring technologies for aircraft noise.

Editorial Postscript

Lately, I'd lost interest in reading and even in watching TV or movies. It bothered me that I was losing interest in some of the joys of life. Then, I was fitted with a new pair of glasses. I regained the life I'd had. Once again, I loved reading and watching TV and movies. I thought perhaps the glasses would even help me understand the scientific topics discussed in this issue, but I found that was asking too much. (Matsuzaki)

About the Front Cover

Dance is the action of moving the body dynamically to sound. It has both ceremonial and artistic functions. Humans may have an instinctive need to show, or act out with their bodies, what can't be expressed in words alone. (Oana)

This magazine can be downloaded from the *Shake Hands* website, where you can take part in a reader survey : http://rion-sv.com/shakehands/

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