ISMTII 2019

1-4 September 2019

The 14th International Symposium
on Measurement Technology
and Intelligent Instruments

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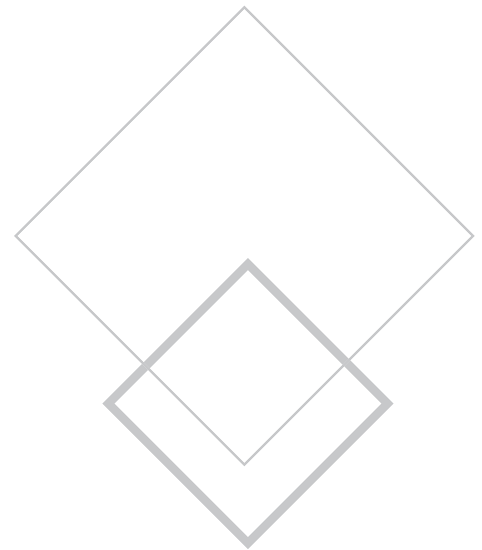
TOKI MESSE Niigata Convention Center



Organized by

Technical Committee for Intelligent Nano-measure, JSPE
International Committee on Measurements and Instrumentation

In cooperation with

The Japan Society for Precision Engineering (JSPE)
Japan Optical Measuring Instruments Manufactures Association (JOMA)
Japan Precision Measuring Instruments Manufactures Association (JMA)
JSPE Affiliate

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The Precise Measurement Technology Promotion Foundation (PMTPF)
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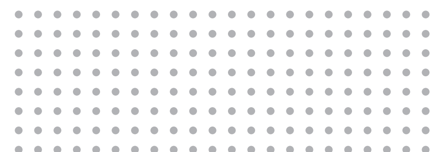

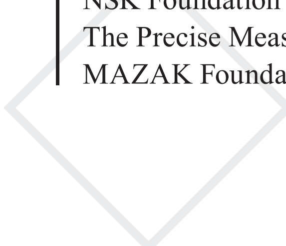

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Keynote speech (September 2-3, 2019)

Fabrication and metrology of precision X-ray optics for new generation synchrotron radiation sources (Keynote 1)

Prof. Kazuto Yamauchi
Department of Precision Science and Technology, Osaka University, Japan

Scientific researches based on Synchrotron radiation (SR) X-rays are rapidly expanding with new sources such as upgraded 3rd generation SR and X-ray free electron laser (XFEL) sources now being constructed world widely. The X-rays emitted from these sources are getting better natures in their brilliance and spatial coherence. In this status, optics for focusing and imaging X-rays are playing indispensable roles and being demanded to be more precise and feasible. We have developed precision X-ray optics with diffraction-limited performances both in focusing and imaging devices to be applied at SR and XFEL facilities. We will talk about fabrication and metrology methods for manufacturing precision optics together with introducing new X-ray optics designed by us to be more applicable and feasible using free form and active shaping technologies. These research activities were partially supported by Grants-in-Aid for the Specially Promoted Research, for the scientific research (S), for promotion of XFEL research, for CREST project, and for the Global COE Program “Center of Excellence for Atomically Controlled Fabrication Technology” from the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT).

The new kilogramme - now approachable for extraterrestrials and nonhumans also (Keynote 2)

Dr.-Ing. Prof. h. c. Frank Härtig
Division 1 Mechanics & Acoustics, Physikalisch-Technische Bundesanstalt (PTB), Germany

At the beginning, the social significance of the historical development of mass standards will be elaborated, especially focusing on the era of the French Revolution. Then, just one single mass standard, the International Kilogramme Prototype (IKP), had been established in order to provide a harmonised basis for trade, and the motto “À tous les temps, à tous les peuples” (for all times and for all people) was born. This resulted in the International System of Units (SI) by means of the seemingly unchangeable quantities and material properties of the earth.

Since the re-definition of the SI on 20 May 2019, all units exclusively rely on so-called defining constants – unchangeable values, carved in stone. An old idea comes true. In 1900, Max Planck stated that such a system would lay the foundations as to enable even extra-terrestrials and nonhumans to understand our metric system.

At the end, the modern realisation of mass on quantum standards will be outlined explaining the two most reliable and established experiments, i.e. the so-called X-Ray Crystal Method (XRCD) and the Kibble Balance principle. Finally, possible ways to exceed existing limits of mass realisation and mass determination will be shown.

Shape error measurement and modeling for precision assemblyradiation sources (Keynote 3)

Prof. Zhijing Zhang
School of Mechanical Engineering, Beijing Institute of Technology, China

According to the ISO and ASME standards, form errors such as flatness and cylindricity are determined by minimum tolerance principle. In this technique, two ideal surfaces are used to cover the real surface, and the orientations of these ideal surfaces are adjusted until the distance between them is minimized—and flatness error, Δ, is the minimum distance between them. This tolerance-based analysis can provide tolerance information in the height direction, but for precision assembly, it does not reflect actual surface irregularity. Even if the △ value is the same, the different error distribution on mating surface will result in a completely different spatial position and orientation, and furthermore, the stress state of contact surface is completely different.

In this report, some basic concepts of form error for precision assembly are introduced firstly, the measurement and data processing method for different geometric features are proposed. The report focuses on the accurate modeling of form error for precision assembly based on pre-processed discrete measurement data, including mathematical model constructing, calculating methods and integrating methods with 3-D design models. On this basis, the 3-D virtual assembly and some mechanical performance simulation cases based on error propagation are demonstrated to prove the validity of theories and methods in this study.

Cancelled

Modifications and improvements of optical systems for dimensional metrology in accordance with industrial demands (Keynote 4)

Prof. Ki-Nam Joo
Department of Photonic Engineering, Chosun University, Korea

Optical dimensional metrology is always important for designing, manufacturing and re-pairing precise high functional products such as semiconductors, display panels and mi-nute mechanical components. For last two decades, many kinds of measurement technol-ogies had been proposed and developed so they have been realized as commercial meas-urement or inspection tools in industrial fields. However, it seems that fundamental meas-urement technologies are recently matured and the trend of technology development fo-cuses on specific applications, which needs several important performances such as high measurement speed, high precision and cost reduction. It is important to know and find the proper technologies to cope with difficulties occurred in measurement and inspection of the products as demands. In this presentation, research works for three categories of application fields, i.e. surface measurements, film structure characterizations and distance measurements in optical me-trology will be given and show the approaches and concerns to improve the performance and functionalities. For surface metrology, modified low coherence interferometer and continuously scanning structure illumination microscopy (CSSIM) are presented to mainly speed up the measurement procedure. Large Area Spectroscopic Imaging Ellipsometry for Characterizing Multi-Layered Film Structures (LASIE), Spatially PhAse-Retarded Spectroscopic Ellipsometry (SPARSE) and Measurement sYstem of Film structure by Interferometry and ELlipsoMetry (MYFIELM) are explained for characterizing multi-film structures. The multi-channel proximity optical sensor is also given as a distance measurement tool. Based on well-known basic technologies, the advanced and interesting techniques were implemented and the performances of typical metrological tools were improved. I hope this presentation can support the audience having new inspiration and collaborating with each other.

Laser interferometry to the picometer scale: methods and applications (Keynote 5)

Dr. Marco Pisani
Physics Department, Instituto Nazionale di Ricerca Metrologica, Italy

Laser interferometry (LI) is the preferred measurement instrument when dealing with extremely small displacement and when extremely high accuracy is required. The well-known Michelson interferometer –with all its declinations- allows to obtain an interference signal which changes with the displacement of one of the two mirrors. The interference signal has the periodicity of half of the wavelength of the laser source used, thus LI behaves like an infinite ruler having the accuracy of the laser source. The laser source, in turn, can be stabilized in order to generate a wavelength with a known and stable value. For macroscopic length size, indeed, the LI behaves almost as an ideal measurement tool.
When dealing with measurement at the nanoscale, in practice, several physical effects limit the resolution and the accuracy of LI. When the displacement to be measured is of the order of one wavelength or less, the accuracy of the measurement depends on how well we are able to divide the interference fringe into equal parts. One picometer is about one millionth of the laser wavelength, so to reach the picometer scale is not an easy task. The main error source is the so-called “cyclic non-linearity” meaning that the phase of the interference signal is not a linear function of the displacement of the mirror. This is mainly caused by the optical separation/recombination methods used in the Michelson interferometer that, because of a non-ideal behaviour of the optical components, cause spurious signals that mix with the good ones. In classical LI these effects limit the accuracy of the measurement to the order of one nanometer. In order to reduce the cyclic non-linearity to the picometer level, special optical schemes must be adopted based on optical path multiplication and on optical path separation.

In the lecture, the main limits to the use of LI at the picometer scale will be illustrated together with some tricks to overcome them. Some practical examples of the use of interferometers in the field of nano-metrology, space applications and fundamental physics will be given.

Evolution and recent progress on optical microscopy toward the realization of submicron- and nanometer-scale resolution in 3D profilometry (Keynote 6)

Prof. Liang-Chia Chen
Department of Mechanical Engineering, National Taiwan University, Taiwan

Microstructure 3-D measurement has become extremely important as it is crucially impact the manufacturing competitiveness. Lateral imaging resolution has been a key factor to be further breakthrough in optical measurement. Diffraction limit defined by Ernst Abbé states that the minimum lateral resolvable size of any lens-based imaging system is restricted by approximately the half of the illumination wavelength. Recently, with the rapid development and growing demands in the fields such as cell biology, semiconductor industries, MEMS/NEMS and other novel technological processes, many new optical techniques are developed in leading to current potential establishment of advanced imaging systems with a resolving ability reaching beyond the diffraction limit from several hundreds to less than 100 nanometers. Thus, super-resolution approaches open a new door to disclose the sub-wavelength details that are restricted by the diffraction barrier in conventional optical microscopy. Recent breakthrough in biological optics has great achievement in lateral resolution enhancement in which few tenth of nanometers can be achieved for cancer treatment and novel medicine development. As these new developments are significant as well as diversely influential to scientific breakthroughs, this talk presents a technological review on how these super-resolution imaging techniques have been progressed. Some key factors which affect the resolution ability of optical systems are discussed for the effectiveness of beyond-diffraction-limit-resolution. Meanwhile, since non-fluorescent optical microscopy for industrial inspection has been still restricted by diffraction limit, some recent research attempts have been developed with a level of progress with lateral resolution over the diffraction limit. To clarify the current trend, the talk analyzes the latest development using various new approaches, such as structured illumination microscopy (SIM), differential interference contrast (DIC), phase singularity detection or other novel methods. Analyses are made to summarize the issues remained and potential direction to move next.

Sunday, September 1

16:00 - 17:00	Registration (Toki Messe 2F Foyer)
17:00 - 19:00	Welcome Reception & Speeches (Toki Messe 2F Snow Hall)

Monday, September 2

8:30 - 9:00	Registration (Toki Messe 3F Foyer)			
9:00 - 9:10	Opening Ceremory (Toki Messe 4F Marine Hall)			
9:10 - 10:10	Keynote 1:Prof. Kazuto Yamauchi (Osaka University) Keynote 2:Prof. h. c. Frank Härtig (Physikalisch-Technische Bundesanstalt (PTB))			
10:10 - 10:30	Coffee Break			
	Session-A (Toki Messe 4F Marine Hall)	**Session-B** (Toki Messe 3F 301)	**Session-C** (Toki Messe 3F 302)	**Session-D** (Toki Messe 3F 303+304)
10:30 - 12:10	A-1:Shape measurement Keynote 3:Prof. Zhijing Zhang (Beijing Institute of Technology) Cancelled	B-1:Angle measurement	C-1:Geometric tolerance analysis	D-1:On-machine measurement
12:10 - 13:40	Lunch			
13:40 - 15:00	A-2:Optical measurement Keynote 4:Prof. Ki-Nam Joo (Chosun University)	B-2:Gear measurement	C-2:Confocal imaging	D-2:Error separation
15:00 - 15:20	Coffee Break			
15:20 - 17:00	A-3:Interferometry 1 Keynote 5:Dr. Marco Pisani (Instituto Nazionale di Ricerca Metrologica)	B-3:Coordinate measurement	C-3:Polarization and new analysis method	D-3:Calibration & compensation

9:00 - 17:00	Industrial Exhibition (Toki Messe 3F Foyer)

Tuesday, September 3

8:00 - 8:30	Registration (Toki Messe 3F Foyer)		
8:30 - 9:00	Keynote 6 : Prof. Liang-Chia Chen (Department of Mechanical Engineering, National Taiwan University, Taiwan) (Toki Messe 4F Marine Hall)		
	Session-A (Toki Messe 4F Marine Hall)	**Session-B** (Toki Messe 3F 301)	**Session-C** (Toki Messe 3F 302)
9:10 - 10:30	A-4:Nanopositioning	B-4:Surface measurement	C-4:Interferometry 2
10:30 - 10:50	Coffee Break		
10:50 - 12:10	A-5:Microscopy	B-5:Pattern projection	C-5:Fitting algorithm
12:10 - 13:40	Lunch		
13:40 - 15:00	Poster Session (Toki Messe 4F Foyer)		
15:00 - 15:20	Coffee Break		
15:20 - 17:00	A-6:Super resolution	B-6:Nano fabrication	C-6:Sensors
18:00 - 20:00	Banquet (Hotel Nikko Niigata 31F)		

9:00 - 15:30	Industrial Exhibition (Toki Messe 3F Foyer)

Wednesday, September 4

8:00 - 19:00	Excursion (See Page 26)

ISMTII2019

Paper review
Submitted Abstracts: 154
Presented Paper (Oral): 89
Presented Paper (Poster): 24

Total Participants: 204 (Registered 189 + Others15)

Best Paper Awards

Chiyue Liu, Ping Cai, Jun Long, Hao Yan and Pengfei Li

Gaoliang Dai, Frank Pohlenz, Xiukun Hu, Thomas Weimann, Andre Felgner and Dorothee Hüser

Yuri Ueyama, Ryoshu Furutani and Tsukasa Watanabe

Young Researcher Awards

Hiraku Matsukuma, Ryo Ishizuka, Masaya Furuta, Xinghui Li, Yuki Shimizu and Wei Gao

Fajia Zheng, Qibo Feng, Bin Zhang, Jiakun Li and Yuqiong Zhao

Masaki Michihata, Zhao Zheng, Kiyoshi Takamasu and Satoru Takahashi

Special Section on the 14th International Symposium on Measurement Technology and Intelligent Instruments (ISMTII2019)

Guest Editor: Masato Aketagawa (Nagaoka University of Technology), Ryoshu Fukutani (Tokyo Denki University) and Makato Abe (Mitutoyo Corporation)

Scope

The 14th International Symposium on Measurement Technology and Intelligent Instruments (ISMTII2019) was held in Niigata, Japan, on September 1–5, 2019. This symposium focused on presenting the latest scientific and engineering breakthroughs to develop cutting edge measurement technologies and intelligent instruments. This special issue of Measurement Science and Technology includes selected articles from all papers presented at ISMTII2017. We would like to thank all contributors to the Symposium and to this special issue.

Editorial

Special Section on the 14th International Symposium on Measurement Technology and Intelligent Instruments (ISMTII2019)

Masato Aketagawa 2020 *Meas. Sci. Technol.* **31** 110101

+ Open abstract View article PDF

Papers

A differential strategy for measurement of a static force in a single-point diamond cutting by a force-controlled fast tool servo

Bo Wen *et al* 2020 *Meas. Sci. Technol.* **31** 074014

+ Open abstract View article PDF

High-resolution nonfluorescent imaging with structured illumination for patterned surface measurement

Shin Usuki *et al* 2020 *Meas. Sci. Technol.* **31** 084003

+ Open abstract View article PDF

A novel unsupervised domain adaptation based on deep neural network and manifold regularization for mechanical fault diagnosis

Zhongwei Zhang *et al* 2020 *Meas. Sci. Technol.* **31** 085101

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Evaluation of the pitch deviation of a linear scale based on a self-calibration method with a Fizeau interferometer

Xin Xiong *et al* 2020 *Meas. Sci. Technol.* **31** 094002

+ Open abstract View article PDF

A new signal processing method for a differential chromatic confocal probe with a mode-locked femtosecond laser

Ryo Sato *et al* 2020 *Meas. Sci. Technol.* **31** 094004

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A super-high-accuracy angular index table

Yuri Ueyama *et al* 2020 *Meas. Sci. Technol.* **31** 094006

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High-speed three-dimensional tracking of individual 100 nm polystyrene standard particles in multi-wavelength evanescent fields

Aran Blattler *et al* 2020 *Meas. Sci. Technol.* **31** 094012

+ Open abstract View article PDF

Interferometer for pitch and yaw measurement using LC-screen and four ball lenses

Gemba Kikuchi and Ryoshu Furutani 2020 *Meas. Sci. Technol.* **31** 094016

+ Open abstract View article PDF

Effect of detector installation error on the measurement accuracy of multi-degree-of-freedom geometric errors of a linear axis

Fajia Zheng *et al* 2020 *Meas. Sci. Technol.* **31** 094018

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ISMTII2019

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(Early bird 1)

Regular	60000JPY
Students	40000JPY
Extra Manuscript	40000JPY
Accompanying person	25000JPY

(Early bird 2)

Regular	65000JPY
Students	45000JPY
Extra Manuscript	40000JPY
Accompanying person	25000JPY

(On-site)

Regular	70000JPY
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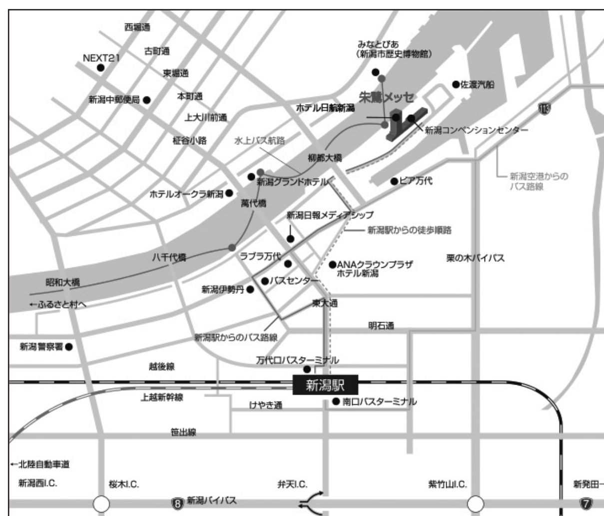
Extra Manuscript	40000JPY
Accompanying person	25000JPY

Venue & Dinner

■ Conference Venue and Access

TOKI MESSE



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URL:https://www.tokimesse.com/english/access/index.html

The name of TOKI-MESSE (the hypocorism for Niigata Convention Center) is from TOKI (Niigata Prefectural bird.), whose scientific name is Niponia Nippon. TOKI-MESSE, Niigata Convention Center, is located at the mouth of the Shinano-river (the longest river in Japan), in the heart of Niigata city.The TOKI-MESSE is integrated by the exihibition hall, the conference rooms, and the skyscraper hotel, which is the landmark in Niigatacity. Niigata, with population 800,000, is the capital of Niigata Prefecture and one of the largest cities facing the Japan Sea.

■ Welcome reception & Speeches

Date : Sep 1 (Sun) 2019
Place: Toki Messe 2F Snow Hall

■ Session-A

Date : Sep 2 (Mon) 2019, Sep 3 (Tue) 2019
Place: Toki Messe 4F Marine Hall

■ Session-B

Date : Sep 2 (Mon) 2019, Sep 3 (Tue) 2019
Place: Toki Messe 3F 301

■ Session-C

Date : Sep 2 (Mon) 2019, Sep 3 (Tue) 2019
Place: Toki Messe 3F 302

■ Session-D

Date : Sep 2 (Mon) 2019
Place: Toki Messe 3F 303+304

■ Poster Session

Date : Sep 3 (Wed) 2019
Place: Toki Messe 4F Foyer

■ Industrial Exhibition

Date : Sep 2 (Mon) 2019, Sep 3 (Tue) 2019
Place: Toki Messe 3F Foyer

■ Banquet

Date : Sep 3 (Wed) 2019
Place: Hotel Nikko Niigata 31F
HP: https://www.okura-nikko.com/japan/niigata/hotel-nikko-niigata/meetings-events/#hotel-nikko-niigata

Group Photograph

Banquet

Fire works

Information of Excursion

■ TSUBAMESANJO Craft Tour (Optional Tour, Tour fee: JPY10,000-)

The industry of TSUBAMESANJO started during the early Edo period (1603~) by producing "Wakugi" (Japanese nail) and the processing technology inherited from pioneer craftsmen is utilized nowadays in the manufacturing of hand hammered metal crafts and sharp-edged craftsmen's tools. Currently, TSUBAMESANJO forms a major industrial cluster area of industrial products which inherited the ancient tradition such as cutting tools, work tools, metal tableware and others products making its name known of course in Japan but also in the world.
In the tour, you can visit the following 4 craftmanship manufacturing companies, and lastly come to nice bars nearby Toki-Messe.

Schedule September 4

08:40 Meeting at Toki-Messe 1st floor entrance
09:00 Start from Toki-Messe 1st floor entrance
10:00 Suwada Blacksmith Works, Inc.: The manufacture of fine nail nippers.
11:00 MARUNAO CO.,LTD: The manufacture of Japanese fine chopsticks.
12:00 Lunch at TSUBAMESANJO Regional Industries Promotion Center (Italian)
13:30 GYOKUSENDO Inc.: The manufacture of Tsuiki (hand hammered) copperware.
15:00 TOJIRO Co., Ltd.: The manufacture of Japanese handmade knifes.
17:30 Dinner at Pia Bandai nearby Toki-Messe: In the bars you can enjoy Japanese Saki and seafoods.

■ Sado Gold Mine Excursion & Aikawa trip (Optional Trip, Trip fee: JPY10,500)

It is said that "three Japans" exist in Sado.
Coastal topography: Due to nearly 3 million years of tectonic movement, all sorts of geological shapes seen elsewhere in Japan are gathered here.
Flora: Nearly 1700 species of flora live along the boundary between cold and warm biogeographic regions.
Culture: People and things intermingled due to the development of the gold mine: exiled aristocrats and intellectuals, and traders and sailors of the Kitamaebune ("northbound ships") of the Edo and Meiji periods.
Harshness, warmth, deliciousness, ordinary, and extraordinary. Sado is a "microcosm of Japan" which has it all. Sado's expression is never the same from one day to the next. If you visit Sado, you will find a time and experience which is unique to you.
One of Sado's greatest appeals is that one can experience all at once the "three Japans" created by the fusion of the harsh nature and abundant culture of the region.
Harshness, warmth, deliciousness, ordinary, and extraordinary. Sado is a "microcosm of Japan" which has it all. Sado's expression is never the same from one day to the next. If you visit Sado, you will find a time and experience which is unique to you.
Sado interweaves majestic scenery, nostalgic mountain villages, nature's abundant food sources, and experiences of the islands beauty. Each is not very large on its own, but one can certainly feel the breath of those who live on Sado. Sado is always ready to enfold your wishes for your journey. Come take a walk to discover your own beautiful Sado.

Schedule September 4

07:30 Meeting at 3rd floor waiting room in Sado kisen boarding platform
(https://www.sadokisen.co.jp/en/access-map)
07:55 Start from Niigata port by Jetfoil
09:00 Arrival at Ryotsu Port
09:50 Senkakuwan Ageshima Yuen
10:40 Kitazawa Flotation Plant
11:30 Historic Site Sado Kinzan Gold Mine
12:30 Meotoiwa Drive-In (Lunch)
13:30 Mumyouiyaki Gyokudou Kamamoto
14:30 Obata Shuzo Sake Brewery
16:05 Departre at Ryotsu Port
18:35 Arrival at Niigata Port

Industrial Exhibition

(Toki Messe 3F Foyer)

Booth 1 Magnescale

Booth 2 株式会社東京精密

Booth 3 カンタツ株式会社

Booth 4 大阪精密機械株式会社

Booth 5 三鷹光器株式会社

Booth 6 Nikon

Booth 7 中央精機株式会社

Booth 8 株式会社第一測範製作所

Booth 9 HEIDENHAIN