# ISMTII 2019

## 1-4 September 2019

The 14th International Symposium
on Measurement Technology
and Intelligent Instruments

# ISMTII2019

## 1-4 September 2019

The 14th International Symposium
on Measurement Technology
and Intelligent Instruments

### 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

### Supported by

Niigata Prefectural Tourism Association
Niigata Visitors & Convention Bureau
Mitutoyo Association for Science and Technology (MAST)
NSK Foundation for the Advancement of Mechatronics (NSK-FAM)
The Precise Measurement Technology Promotion Foundation (PMTPF)
MAZAK Foundation

# Contents

# Welcome Speech

It is my great honor to be the host for the 14th international Symposium on Measurement Technology and Intelligent Instruments (ISMTII2019) at TOKI-MESSE, Niigata Convention Center, Niigata-city, Japan. The Symposium is being steered and organized by the International Committee on Measurements and Instrumenttation (ICMI), and the symposium is organized by the Japan Society for Precision Engineering (JSPE) and Technical Committee for Intelligent Nano-Measure of JSPE. In continuation of the successful series of previous thirteen ISMTII symposiums held every two years, this 14th symposium is aimed to provide a forum to open discussions for both research experts and students working in the field precision metrology and instrumentation from all around the world.

The four-day symposium from 1st to 4th September, 2019 will be focused on technical exchanges of the current state-of-the-art and future perspectives of measurement and instrumentation technologies and also introductions of current activities of related industries and research institutions. I am looking forward to your participation and your enjoying all the oral, poster, industrial presentations and Japanese culture/foods in Niigata-city.

Best Regards,

Masato Aketagawa

Professor Masato Aketagawa
Nagaoka University of Technology
General Chair, ISMTII2019

# Committees

## Conference Chairs

| | |
|---|---|
| Nagaoka University of Technology, Japan | Masato Aketagawa |

## International Steering Committee

| | |
|---|---|
| National Taiwan University, Taiwan | K. C. Fan |
| Hong Kong University of Science and Technology, Hong Kong (China) | Y. Gao |
| Tohoku University, Japan | W. Gao |
| Technical University Ilmenau, Germany | G. Jager |
| University of Huddersfield, UK | X. Q. Jiang |
| Tsinghua University, China | G. F. Jin |
| Huazhong University of Science and Technology, China | Z. Li |
| Seoul National University, Korea | H. J. Pahk |
| National Institute of Standards and Technology, USA | J. Song |
| Harbin Institute of Technology, China | J. B. Tan |
| University of Tokyo, Japan | K. Takamasu |
| D.I.Mendeleyev Institute for Metrology, Russia | K. Sapozhnikova |
| University Erlangen-Nuremberg, Germany | A. A. Weckenmann |
| National Institute for Standards, Egypt | S. Z. A. Zahwi |
| Tianjin University, China | G. X. Zhang |
| Korea Advanced Institute of Science and Technology, Korea | S. W. Kim |
| Xi'an Jiaotong University, China | Z. D. Jiang |

## International Program Committee

| | |
|---|---|
| Mansoura University, Egypt | O. Abouelatta |
| Physikalisch Technische Bundesanstalt, Germany | H. Bosse |
| Shanghai Jiao Tong University, China | P. Cai |
| National Taiwan University, Taiwan | L. C. Chen |
| University of Miskolc, Hungary | I. Dudas |
| Vienna University of Technology, Austria | N. Durakbasa |
| Tokyo Denki University, Japan | R. Furutani |
| KU Leuven, Belgium | H. Haitjema |
| Technical University of Denmark, Denmark | H. N. Hansen |
| University of North Carolina at Charlotte, USA | R. J. Hocken |
| University of Science and Technology of China, China | W. H. Huang |
| Mansoura University, Egypt | S. E. Hussein |
| Warsaw University of Technology, Poland | R. Jablonski |
| Physikalisch Technische Bundesanstalt, Germany | M. Krystek |
| Kyusyu University, Japan | S. Kurokawa |
| The University of Nottingham | R. Leach |
| Nanyang Technological University, Singapore | S. F. Ling |
| University of Warwick, UK | X. Liu |
| D.I.Mendeleyev Institute for Metrology, Russia | K. Sapozhnikova |
| RWTH Aachen University, Germany | R. Schmitt |
| Technische Universität Wien, Austria | H. Schweinzer |
| Beijing University of Technology, China | Z. Shi |
| Nagaoka University of Technology, Japan | K. Yanagi |
| Tokyo Institute of Technology, Japan | K. Sasajima |

| | |
|---|---|
| National Metrology Institute of Japan, Japan | T. Takatsuji |
| Tokyo Institute of Technology, Japan | T. Hatsuzawa |
| Tokyo Institute of Technology, Japan | A. Shimokohbe |
| National Taiwan University of Science and Technology, Taiwan | F. J. Shiou |
| Osaka University, Japan | Y. Takaya |
| D.I.Mendeleyev Institute for Metrology | R. Taymanov |
| Tsinghua University, China | L. J. Zeng |
| Tsinghua University, China | S. L. Zhang |
| Drexel University, USA | J. G. Zhou |

## National Program Committee

| | |
|---|---|
| ■**Chair** Tokyo Denki University, Japan | R. Furutani |
| University of Tokyo, Japan | S. Takahashi |
| Shizuoka University, Japan | S. Usuki |
| Nippon Institute of Technology, Japan | M. Ozaki |
| High Energy Accelerator Research Organization, Japan | K. Enami |
| Toyama Prefectural University | S. Ito |
| University of Tokyo, Japan | M. Michihata |

## Publication Committee

| | |
|---|---|
| ■**Chair** National Metrology Institute of Japan, Japan | M. Abe |
| Akita University, Japan | E. Okuyama |
| National Metrology Institute of Japan, Japan | T. Watanabe |
| Kyushu University, Japan | T. Hayashi |
| Osaka University, Japan | Y. Mizutani |
| Kyushu Institute of Technology, Japan | H. Shimizu |
| Kyoto University, Japan | M. Komori |
| Tohoku University, Japan | Y. Shimizu |

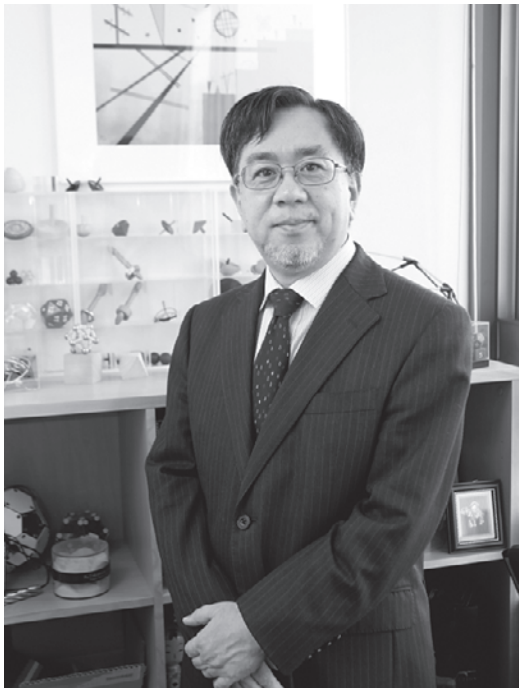
## Technical Exhibition Committee

| | |
|---|---|
| ■**Chair** Tokyo Seimitsu Co.,LTD., Japan | S. Maruyama |
| Canon Inc., Japan | M. Negishi |
| Crystal Optics Inc., Japan | O. Kirino |
| Kosaka Laboratory Ltd., Japan | M. Aokage |
| Nikon Corporation, Japan | A. Takahashi |
| Heidenhain K. K., Japan | T. Sakamoto |
| Magnescale Co., Ltd., Japan | K. Taniguchi |
| Mitutoyo Corporation, Japan | K. Kawasaki |

## Local Organizing Committee

| | |
|---|---|
| ■**Chair** Nagaoka University of Technology, Japan | M. Aketagawa |
| Nagaoka University of Technology, Japan | D. Wei |
| Niigata University, Japan | T. Suzuki |
| Nagaoka University of Technology, Japan | H. Isobe |
| University of Tokyo, Japan | Y. Kajihara |
| Toyama Prefectural University | S. Ito |
| Hosei University | I. Yoshida |

# Welcome reception speech (Septemper 1, 2019)



## 30 years history of ISMTII - Measurement Technology and Intelligent Instruments -

**Prof. Kiyoshi Takamasu**
The University of Tokyo, Department of Precision Engineering

## Micro-M3 Technology using Optical Radiation Pressure - Inspired by the Nobel Prize Winner - (Micro-M3 Technology: Micro-Measurement, Machining, Manipulation)

**Prof. Yasuhiro Takaya**
Osaka University, Department of Mechanical Engineering

# 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.

## 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

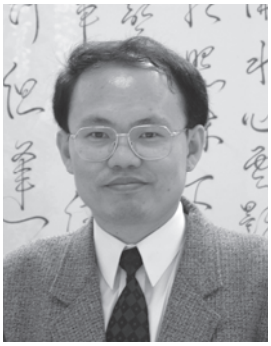
Optical dimensional metrology is always important for designing, manufacturing and re-pairing precise high functional products such as semiconductors, display panels and mi-nute mechanical components. For last two decades, many kinds of measurement technol-ogies had been proposed and developed so they 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.

# Program

## 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)<br>Keynote 2:Prof. h. c. Frank Härtig (Physikalisch-Technische Bundesanstalt (PTB)) | | | |
| 10:10 - 10:30 | Coffee Break | | | |
| | **Session-A**<br>(Toki Messe 4F Marine Hall) | **Session-B**<br>(Toki Messe 3F 301) | **Session-C**<br>(Toki Messe 3F 302) | **Session-D**<br>(Toki Messe 3F 303+304) |
| 10:30 - 12:10 | A-1:Shape measurement<br>Keynote 3:Prof. Zhijing Zhang<br>(Beijing Institute of Technology) | 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<br>Keynote 4:Prof. Ki-Nam Joo<br>(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<br>Keynote 5:Dr. Marco Pisani<br>(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<br>(Department of Mechanical Engineering, National Taiwan University, Taiwan)<br>(Toki Messe 4F Marine Hall) | | |
| | **Session-A**<br>(Toki Messe 4F Marine Hall) | **Session-B**<br>(Toki Messe 3F 301) | **Session-C**<br>(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) |

# Session-A (Toki Messe 4F Marine Hall)

## Monday, September 2

### 10:30-12:10 A-1:Shape measurement

Session Chair : Seung-Woo Kim, Terutake Hayashi

A01 Session Keynote **Shape error measurement and modeling for precision assemblyradiation sources (Keynote 3)**
Zhijing Zhang

A02 **Development of a fiber-based displacement measuring probe using Fizeau configuration (Paper ID 112)**
Hui-Chiang Chung, Chin-Yu Hsieh, Chih-Jer Lin and Liang-Chia Chen

A03 **Eddy Current Displacement Sensor for the Deformation Measurement of Contactless Thin Adaptive Mirror (Paper ID 82)**
Chengliang Pan, Fei Yang, Heng Zuo and Zhihua Feng

A04 **Fast Peak-tracking Method for Sparse FBG Reflection Spectrum and Nonlinear Error Compensation (Paper ID 57)**
Jindong Wang, Tingting Huang, Fajie Duan, Qingrui Cheng, Fumin Zhang and Xinghua Qu

### 13:40-15:00 A-2:Optical measurement

Session Chair : Ming Wang, Dong Wei

A05 Session Keynote **Modifications and improvements of optical systems for dimensional metrology in accordance with industrial demands (Keynote 4)**
Ki-Nam Joo

A06 **Development of a three-dimensional measurement platform for in-situ automated optical wafer inspection (Paper ID 93)**
Guo-Wei Wu, Ming-Jun Jiang and Liang-Chia Chen

A07 **Three-dimensional Coordinate Measurement System Based on Absolute Distance Interferometers (Paper ID 91)**
Jeong Seok Oh, Quoc Khanh Nguyen, Seungman Kim, Seong-Heum Han, Wooram Kim and Seung-Woo Kim

### 15:20-17:00 A-3:Interferometry 1

Session Chair : Frank Haertig, Takamasa Suzuki

A08 Session Keynote **Laser interferometry to the picometer scale: methods and applications (Keynote 5)**
Marco Pisani

A9 **Novel Quadratic Detection for a FBG Enhanced Self-mixing Interferometry Based on the Two-photon Absorption Effect (Paper ID 29)**
Ming Wang, Junbao Chen, Wei Xia, Hui Hao and Dongmei Guo

A10 **Pulse Interval of an Optical Frequency Comb Compressed by an Etalon (Paper ID 52)**
Tatsuya Kume, Hiromasa Yasuda, Tsutomu Mibe, Masaki Michihata and Kiyoshi Takamasu

A11 **Vibration distribution measurement using down sampling phase shifting interferometer (Paper ID 55)**
Yuta Ohara, Takamasa Suzuki and Samuel Choi

# Tuesday, September 3

## 9:10-10:30 A-4:Nanopositioning

Session Chair : Gaoliang Dai, Yasuhiro Mizutani

A12 Invited Paper **Nanopositioning and Nanomeasuring Machines (NPMM) and their application for nanofabrication in extended working volumes (Paper ID 51)**
Michael Kühnel, Ingo Ortlepp, Martin Hofmann, Laura Weidenfeller, Johannes Kirchner, Shraddha Supreeti, Rostyslav Mastylo, Roland Füßl, Ivo Rangelow, Thomas Fröhlich, Eberhard Manske

A13 **Construction of a miniature laser diode interferometer with real-time wavelength correction for displacement feedback of nanopositioning stages (Paper ID 22)**
Baokai Feng, Yindi Cai, Qi Sang and Kuang-Chao Fan

A14 **Shape Control of Nano Periodic Structure Using Hologram-Assisted Talbot Lithography (Paper ID 94)**
Hiroki Nakanishi, Yasuhiro Mizutani, Yoshihiko Makiura, Hiroshi Yokota and Yasuhiro Takaya

A15 **Structural Design and Analysis of an Abbe Error-Free Wafer Inspection Stage (Paper ID 90)**
Tien-Tung Chung, Yen-Tso Kuo, Pin-Yuan Sheng and Liang-Chia Chen

## 10:50-12:10 A-5:Microscopy

Session Chair : Liang-Chia Chen, Masaki Michihata

A16 **Development of a spectroscopic system for THz near-field microscopy (Paper ID 85)**
Ryoko Sakuma, Kuan-Ting Lin, Sunmi Kim, Fuminobu Kimura and Yusuke Kajihara

A17 **Study on Energy Dissipation of Narrow Metal Circuits by Probing Terahertz Evanescent Waves (Paper ID 81)**
Donghui Shi, Qianchun Weng, Kuan-Ting Lin, Kenji Yoshida, Kazuhiko Hirakawa and Yusuke Kajihara

A18 **Monte Carlo Method in Optical Atomic Force Microscopy (AFM) (Paper ID 84)**
A. M. ElMelegy, S. Z. Zahwi

A19 **Reference metrology for quantitative areal surface measuring 3D-microscopy (Paper ID 77)**
Gaoliang Dai, Frank Pohlenz, Xiukun Hu, Thomas Weimann, Andre Felgner and Dorothee Hüser

## 15:20-17:00 A-6:Super resolution

Session Chair : Satoru Takahashi, Yasuhiko Arai

A20 **Investigation on Lateral Resolution using Chromatic Confocal Differential Interference Contrast Microscopy (Paper ID 114)**
Hsiu-Wen Liu, Johannes Belkner, Eberhard Manske and Liang-Chia Chen

A21 **Optical depth measurement of the diffraction-limited microgrooves with a noise-immune dual-wavelength interferometer (Paper ID 63)**
Shiwei Ye, Masaki Michihata, Kiyoshi Takamasu and Satoru Takahashi

A22 **Coherent optical microscopy for micro-structured surface inspection beyond diffraction limit (Paper ID 67)**
Hiromasa Kume, Masaki Michihata, Kiyoshi Takamasu and Satoru Takahashi

A23 **Role of zeroth-order diffraction beam in three-dimensional shape measurement of fine structure based on speckle interferometry (Paper ID 96)**
Yasuhiko Arai

A24 **Sensing Near-Field Light Distribution for Microsphere Measurement Based on Whispering Gallery Mode (Paper ID 78)**
Bohuai Chu, Zheng Zhao, Masaki Michihata, Kiyoshi Takamasu and Satoru Takahashi

# Session-B (Toki Messe 3F 301)

## Monday, September 2

### 10:30-12:10 B-1:Angle measurement

Session Chair : Kun Xiong, Yuki Shimizu

B01 **Total Transmittance measurement of glass flat with a diffusive surface (Paper ID 128)**
Ho-Lin Tsay, Po-Ming Lin, Yu-Hsiang Lin and Ming-Fu Chen

B02 **A super high accurate angular index table (Paper ID 105)**
Yuri Ueyama, Ryoshu Furutani and Tsukasa Watanabe

B03 **An Optical Angle Sensor Based on the Laser Autocollimation employing a Mode-locked Femtosecond Laser Source and a Single Mode Fiber Detector (Paper ID 26)**
Shota Takazono, Yuki Shimizu, Hiraku Matsukuma, Yuri Kanda, Hajime Inaba and Wei Gao

B04 **Dual-comb Based Angle Measurement Using a Grating-Corner-Cube Combined Sensor (Paper ID 44)**
Siyu Zhou, Vunam Le, Lijiang Zeng and Guanhao Wu

B05 **A New Absolute Capacitive Angular Displacement Sensor Using Time-Share Method with a Reflective Structure (Paper ID 121)**
Xingchen Fan, Kai Peng, Xiaokang Liu, Zhicheng Yu and Hongji Pu

### 13:40-15:00 B-2:Gear measurement

Session Chair : Guanhao Wu, So Ito

B06 **Development of the gear measuring system for the production line -Evaluation of the experimental equipment using the industrial SCARA robot- (Paper ID 46)**
Naoki Hashimoto, Tetsuya Taguchi and Aiguo Ming

B07 **Development of tactile and non-tactile hybrid gear measuring machine -Pre-feasibility study of non-tactile gear measurement- (Paper ID 43)**
Ryota Matsuoka, Tetsuya Taguchi and Syuhei Kurokawa

B08 **Accuracy improvement of gear measuring machine with coordinate measuring function -Significant factors of deviation in measurement- (Paper ID 124)**
Yuto Kajitani, Syuhei Kurokawa, Terutake Hayashi, Tetsuya Taguchi and Ryota Matsuoka

### 15:20-17:00 B-3:Coordinate measurement

Session Chair : Xinghui Li, Matsuzaki Kazuya

B9 **Design and Testing a High-Resolution Six-Degree-of-Freedom Surface Encoder (Paper ID 36)**
Hiraku Matsukuma, Ryo Ishizuka, Masaya Furuta, Xinghui Li, Yuki Shimizu and Wei Gao

B10 **Three-dimensional Shape Measurement using Non-contact Line Laser Probe -An abnormal phenomenon of excessive detection error- (Paper ID 87)**
Masanori Kajiki, Syuhei Kurokawa and Terutake Hayashi

B11 **High-Speed Three-dimensional Tracking of Individual 100-nm Polystyrene Standard Particles in Multi-wavelength Evanescent Fields (Paper ID 49)**
Aran Blattler, Panart Khajornrungruang, Keisuke Suzuki and Thitipat Permpatdechakul

B12 **Vertical Focus Probing for High-Precision Optical Dimensional Metrology (Paper ID 103)**
Kerstin Zangl, Reinhard Danzl, Urban Muraus, Franz Helmli and Manfred Prantl

B13 **Evaluation of laser beam straightness measuring system using 2-dimensional in-plane displacement interferometer (Paper ID 101)**
Takumi Yokoyama, Masato Higuchi, Wei Dong and Masato Aketagawa

# Tuesday, September 3

## 9:10-10:30 B-4:Surface measurement

Session Chair : Ping Cai, Hiromi Isobe

B14 **Defect detection for structured surfaces via light scattering and machine learning (Paper ID 8)**
Mingyu Liu, Nicola Senin and Richard Leach

B15 **The influences of light source and roughness ranges on colour image-based visual roughness measurement performance (Paper ID 2)**
Lu Enhui, Liu Jian, Xiong Yan, Chen Shengfeng, Zhang Hang, Suo Xinyu and Chen Ning

B16 **High speed 3D deformation field measurement system based on ESPI (Paper ID 12)**
Zengyu Sun, Yuan Yuan and Ruiya Yang

B17 **High-reflected surface 3D measurement by using a novel high dynamic range imaging system (Paper ID 58)**
Wei Feng, Daxing Zhao and Guodong Sun

## 10:50-12:10 B-5:Pattern projection

Session Chair : Richard Leach, Shin Usuki

B18 **Modelling Fringe Projection Based on Linear Systems Theory and Geometric Transformation (Paper ID 155)**
George Gayton, Rong Su and Richard Leach

B19 **High-resolution non-fluorescent imaging with structured illumination for patterned surface measurement (Paper ID 86)**
Gaku Shibata, Shin Usuki and Kenjiro T. Miura

B20 **Phase Fringe Pattern Quality Assessment Method based on Phase Gradient in DSPI (Paper ID 38)**
Liu Chiyue, Cai Ping, Long Jun, Yan Hao and Li Pengfei

## 15:20-17:00 B-6:Nano fabrication

Session Chair : Jian Liu, Tetsuya Taguchi

B21 **Visualization of stress distribution during drilling of grass by deposited diamond wheel (Paper ID 50)**
Yuya Igarashi, Keisuke Hara and Hiromi Isobe

B22 **Multiple Exposure Fusion for Abrasive Grain Diamond Wire Saw Acquisition (Paper ID 72)**
Po-Hsuan Lu, Chao-Ching Ho, Matthew Bolger, Yuan-Jen Chang and Chia-Lung Kuo

B23 **Development of a piezoelectric three-axis fast tool servo with in-process cutting force measurements (Paper ID 102)**
Fuwen Chen, Zhongwei Li and Yuan-Liu Chen

B24 **Assessment of diamond grinding wheel performance degradation based on self-learned features of acoustic emission signals (Paper ID 104)**
Bi Guo, Wang Huixue, Shao Shengyang, Su Shibo, Zhou Lian, Yang Ping, Wang Zhenzhong and Peng Yunfeng

B25 **Development of an electromagnetic driving fast tool servo with an cutting force self-sensing function (Paper ID 123)**
Peng Hu, Ye Tao and Yuan-Liu Chen

# Session-C (Toki Messe 3F 302)

## Monday, September 2

### 10:30-12:10 C-1:Geometric tolerance analysis

Session Chair : Xiuguo Chen, Hiraku Matsukuma

C01 **Influence of installation error of detectors on accuracy for simultaneously measuring MDOF geometric motion errors of a linear axis (Paper ID 113)**
Fajia Zheng, Qibo Feng, Bin Zhang, Jiakun Li and Yuqiong Zhao

C02 **Simultaneous measurement of six-degrees-of-freedom errors of high precision linear guides (Paper ID 153)**
Kuan Diao, Xiaojun Liu, Zhenjian Yao, Wenjun Yang and Chi Zhang

C03 **Proposal on simple evaluation method for geometrical error of additive manufacturing product (Paper ID 45)**
Kazuya Matsuzaki, Makoto Abe, Osamu Sato and Toshiyuki Takatsuji

C04 **The Kinematics Calibration of Industrial Robot in Semi-spherical Region Using Double Ball Bar (Paper ID 107)**
Ping Yang, Zhiguang Guo, Wei Yang, Zhenzhong Wang and Yunfeng Peng

C05 **Measurement of Geometrical Parameters of Cutting Tool based on Focus Variation Technology (Paper ID 53)**
Lin Yuan, Tong Guo and Zhongjun Qiu

### 13:40-15:00 C-2:Confocal imaging

Session Chair : Yukitoshi Otani

C06 **Chromatic confocal distance sensor with sub-micron accuracy by downsizing the focal spot and usage of corrected centroid peak extraction algorithm (Paper ID 61)**
Jiao Bai, Xinghui Li, Xiaohao Wang, Qian Zhou and Kai Ni

C07 **Analysis of temperature influence on a chromatic confocal probe with a mode-locked femtosecond laser (Paper ID 150)**
Ryo Sato, Yuki Shimizu, Hiraku Matsukuma and Wei Gao

C08 **High accuracy radius measuring system by combining the confocal system and frequency modulated interferometer (Paper ID 151)**
Vu Hai Linh Nguyen, Toan Thang Vu, Tuan Van Le and Thanh Tung Vu

## 15:20-17:00 C-3:Polarization and new analysis method

Session Chair : Tangh Tung Vu, Muzheng Xiao

C9 **End Face Recognition and Positioning Method in Unstable Definition Image based on Cross Entropy Estimation (Paper ID 116)**
Weichen Sun, Muzheng Xiao, Weimin Zhang, Zhijing Zhang, Heng Zhang and Qiushuang Zhang

C10 **Numerical simulation of the image formation and the spatially resolved Mueller matrix of non-periodic objects based on a high-numerical-aperture Mueller-matrix ellipsometer (Paper ID 120)**
Cai Wang, Xiuguo Chen, Chao Chen and Shiyuan Liu

C11 **Feature Extraction and Recognition of Focused Surface Infrared Hyperspectral Polarization Imaging (Paper ID 148)**
Chang Hong, Lu Kuan, Zhou Yang and Gao Yang

C12 **Autonomous Close-range Photogrammetry Using Machine Learning (Paper ID 39)**
Joe Eastwood, Danny Sims-Waterhouse, Samanta Piano, Ralph Weir and Richard Leach

C13 **Video-rate quantitative phase imaging by a differential interference contrast microscope using a polarization camera (Paper ID 137)**
Wataru Takano, Shuhei Shibata, Nathan Hagen, Masaru Matsuda and Yukitoshi Otani

# Tuesday, September 3

## 9:10-10:30 C-4:Interferometry 2

Session Chair : Yusuke Kajihara

C14 **Liquid crystal hologram for cylinder lens measurement (Paper ID 6)**
Yao Hu, Shaopu Wang, Wanlong Zhang and Qun Hao

C15 **Heterodyne interferometer eliminating periodic interpolation error (Paper ID 130)**
Kosuke Iwafune, Thanh Dong Nguyen, Masato Higuchi, Dong Wei and Masato Aketagawa

C16 **Simple phase meter using phase-locked loop and FPGA for heterodyne interferometer (Paper ID 73)**
Thanh Dong Nguyen, Quang Anh Duong, Masato Higuchi, Dong Wei and Masato Aketagawa

C17 **Noise reduction in coherence scanning interferometry for surface measurement (Paper ID 17)**
Carlos Gomez, Rong Su, Simon Lawes and Richard Leach

## 10:50-12:10 C-5:Fitting algorithm

Session Chair : Yidong Tan, Tatsuya Kume

C18 **Analysis-suitable T-splines-based surface fitting for accurate 3D surface reconstruction (Paper ID 42)**
Yu Lu, Jian Wang, Wenlong Lu, Liping Zhou and Xiangqian Jiang

C19 **Evaluation of form error of non-axisymmetric aspheric surface based on genetic algorithm (Paper ID 60)**
Yung-Tien Liu, Yen-Chih Huang and Tung-Kuan Liu

C20 **Phase stitching based Multi-CCDs deformation measurement in DSPI (Paper ID 54)**
Jun Long, Ping Cai, Shuyuan Pan, Chiyue Liu, Hao Yan and Pengfei Li

C21 **Research of dynamic characteristics of air bearing stylus surface topography measuring sensor (Paper ID 15)**
Wu Hao, Chang Suping, Zhao yanqing, Zhang Zhongyu and Zhou Jianfei

## 15:20-17:00 C-6:Sensors

Session Chair : Cheng Zhenying, Tsukasa Watanabe

C22 Invited Paper **Acquisition and recognition of remote speech signals based on laser feedback interferometry (Paper ID 98)**
Zhong Xu, Xiliang Zhang, Shulian Zhang and Yidong Tan

C23 **Calibration Technology of the Passive Wireless SAW Pressure Sensor (Paper ID 13)**
Tian Bai, Lei Yan, Fengju Sun and Xiaosan Wang

C24 **The method for restraining laser's drift based on active compensation system (Paper ID 142)**
Shujie Liu, Siyuan Tan, Yubin Huang and Kuang-Chao Fan

C25 **Dynamic Measurement Uncertainty Evaluation for a Newly Developed Low-Frequency Micro-Vibration Accelerometer (Paper ID 122)**
Liying Liu, Zhenying Cheng, Ruijun Li, Wenwen Liu and Kuang-Chao Fan

C26 **Experimental Study on Reducing the Drift of Long Distance Laser Beam caused by the variation of air refractive index (Paper ID 133)**
Pan Tao, Ruijun Li, Yongjun Wang, Zhenying Cheng and Kuangchao Fan

# Session-D (Toki Messe 3F 303+304)

## Monday, September 2

## 10:30-12:10 D-1:On-machine measurement

Session Chair : Yuan-Liu Chen, Akira Takahashi

D01 **On-machine Measurement of Tool Edge Shape by Detecting Fluorescence of Water-soluble Cutting Fluid (Paper ID 89)**
Kohei Matsumoto, Yasuhiro Mizutani and Yasuhiro Takaya

D02 **In-Process Measurement Technique of Micro-Fiber Diameter with Interfered Scattering Pattern of Two Beam Irradiation (Paper ID 65)**
Masaki Michihata, Zhao Zheng, Kiyoshi Takamasu and Satoru Takahashi

D03 **Local electrodeposition of 3D metallic microstructures with in-process monitoring of ionic currents (Paper ID 110)**
Yutao Wang, Yuyang Wang and Yuan-Liu Chen

D04 **On-Machine Surface Metrology by a Force Sensor-Integrated Fast Tool Servo (Paper ID 41)**
Jianping Yu, Bo Wen, Toshiki Saito, Keisuke Adachi, Yuki Shimizu, Hiraku Matsukuma and Wei Gao

D05 **Error Characteristics of the In-Process Optical Form Profile Measurement (Paper ID 30)**
J. Zhu and Y. Gao

## 13:40-15:00 D-2:Error separation

Session Chair : Yung-Tien Liu, Panart Khajornrungruang

D06 **Control and Trajectory Accuracy Research for a Large Stroke Wafer Inspection Stage (Paper ID 117)**
Min Wei, Jie-An Chen, Yang-Cheng Huang, Syuan-You Jhu, Po-Chih Shih, Jia-Yush Yen and Liang-Chia Chen

D07 **Creation and utilization of straightness standard Due to reciprocal measurement of linear stage (Paper ID 19)**
Kanji Yamaguchi and Ryoshu Furutani

D08 **Error Evaluation of Straightness Measurement Using a MEMS Device Integrating 10 Cantilever Displacement Sensors (Paper ID 125)**
Hiroki Shimizu, Shoichiro Mizukami, Makoto Manabe and Yuuma Tamaru

D9 **Research on Angle Setting Error of Diameter Measurement Based on Three-Point Method (Paper ID 140)**
Xin Chen, Runze Zheng, Jinyu Ma, Guoqing Ding, Junjie Wu, Lihua Lei and Yuan Li

## 15:20-17:00 D-3:Calibration & compensation

Session Chair : Yongsheng Gao, Hiroki Shimizu

D10 **Research on Self-Calibration Positions Scheme for Rectangular Stage Based on Least Squares (Paper ID 1)**
Xin Chen, Xinyang Chen, Xiaoyue Qiao, Yufei Shi, Jielin Sun, Jiasi Wei and Xiaoyu Cai

D11 **Development of Linear Scale Calibration System with Sub-nanometer Resolution (Paper ID 56)**
Kayoko Taniguchi, Hideaki Tamiya, Tsutomu Enomoto, Hideaki Aoyama and Kazuo Yamazaki

D12 **A method for dynamic 3D measurement based on dual line-scan cameras (Paper ID 145)**
Linghui Yang, Ruiying Liao, Bo Sun, Jiarui Lin, Yongjie Ren, Yanbiao Sun and Jigui Zhu

D13 **An On-line Contour Measurement and Locating Compensation Method of the Carriage Roof for High-speed Rail Combining Laser and Vision (Paper ID 149)**
Xiao Chen, Zhi Li, Kaimei Liu, Yuanzhi Liu, Wei Tao and Hui Zhao

D14 **Data Processing Methods for High Accuracy Photoelectric Autocollimator (Paper ID 10)**
Kun Xiong, Yan Liu, Chunxi Wang and Yue Wu

# Poster Session (Toki Messe 4F Foyer)

## Tuesday, September 3

### 13:40-15:00

P01 **Cross-talk Analysis of Multiple Channels in the Laser Self-mixing Interference Measurement System (Paper ID 92)**
Xin Xu, Kaiyi Zhu, Yueyue Lu, Shulian Zhang and Yidong Tan

P02 **On-Line Defect Detection of High Reflection Annular Thin-Wall Groove (Paper ID 31)**
Suo Xingyu, Liu Jian, Dong licheng, Chen Shengfeng, Lu Enhui and Chen Ning

P03 **Direct joining of metal and polymer by applying hot water treatment to metal surface (Paper ID 74)**
Shuaijie Zhao, Fuminobu Kimura, Shotaro Kadoya, Eiji Yamaguchi, Nayuta Horie and Yusuke Kajihara

P04 **Multi-type error cross-talk analysis for high-precision measuring the angular positioning error of a rotary axis (Paper ID 95)**
Jiakun Li, Qibo Feng, Bin Zhang, Fajia Zheng and Chuanchen Bao

P05 **Surface Error Consistency Coefficient Based on Cross-correlation for Evaluating the Consistency of Surface Error Measurement Methods (Paper ID 21)**
Qun Hao, Xin Tao, Yao Hu and Xuemin Cheng

P06 **Enzymatic modified glucose sensor with heterodyne interferometer (Paper ID 25)**
Jia-Hui Zhao, Cheng-Chih Hsu, Chyan-Chyi Wu, Ju-Yi Lee and Ching-Liang Dai

P07 **Improving quality of 3D printing using handy measuring tools (Paper ID 62)**
Katsunori Kimura, Fujio Uchida, Takahiro Kaneyoshi, Yoshihito Hagihara, Masaaki Furuya, Nao Terasaki, Kazuya Matsuzaki, Osamu Sato, Mariko Kajima, Makoto Abe and Toshiyuki Takatsuji

P08 **An Assembly Optimization Method to Minimize Mass Eccentricity Error in the Assembly of Axisymmetric Rotary Components (Paper ID 83)**
Chen Yue and Cui Jiwen

P09 **Step profile measurement using full field SD-OCT based on wavelet transform (Paper ID 99)**
Hidenori Yamaoka, Takamasa Suzuki and Samuel Choi

P10 **Active Magnetic Compensation System With Atomic Magnetometer For Unshielded Cardiac Magnetic Measurement (Paper ID 141)**
Xiang Cheng, Guochen Zhong and Hua Liu

P11 **Intelligent Dynamic Weighing Method Based on Transient Overshoot Response (Paper ID 144)**
Dasen Xu, Guoqing Ding, Xin Chen and Jigang Chen

P12 **Measurement of 3D Motion Error of 6 degree of freedom (Paper ID 20)**
Kento Ozawa and Ryoshu Furutani

P13 **Single shot measurement for surface height and film thickness of film structure (Paper ID 32)**
Jin Sub Kim and Ki-Nam Joo

P14 **Displacement measurement for a linear positioning stage by using three-axis acceleration sensor (Paper ID 71)**
Taichi Kamata, Daichi Kato, So Ito, Kazuhide Kamiya and Kimihisa Matsumoto

P15 **Measurement of number based particle sizing distribution using nanoparticle micro array (Paper ID 64)**
Jiaqing Zhu, Terutake Hayashi and Syuhei Kurokawa

P16 **Real-Time Vibration Measurement with a Fiber Coupler Laser Diode Interferometer Utilizing Synchronous Detection (Paper ID 68)**
Takumi Sumizawa, Takamasa Suzuki and Samuel Choi

P17 **In-process height monitoring system by light section method for laser metal-wire deposition (Paper ID 80)**
Shigeru Takushima, Daiji Morita, Nobuhiro Shinohara, Hiroyuki Kawano, Yasuhiro Mizutani and Yasuhiro Takaya

P18 **Laser micro machining using a photonic nanojet controlled by intensity distribution of incident laser (Paper ID 88)**
Tsutomu Uenohara, Yasuhiro Mizutani and Yasuhiro Takaya

P19 **Active control to suppress residual amplitude modulation of electro-optic modulator for sinusoidal phase modulation interferometer (Paper ID 97)**
Takashi Iwakura, Masato Higuchi, Wei Dong and Masato Aketagawa

P20 **Displacement measurement using artificial interferometric signal and phase locked loop for sinusoidal frequency/phase modulation interferometers (Paper ID 100)**
Masato Higuchi and Masato Aketagawa

P21 **Study on measurement of multi-degree-of-freedom using transmission and block of light by transmissive liquid crystal (Paper ID 14)**
Gemba Kikuchi and Ryoshu Furutani

P22 **Simultaneous measurement of the birefringence and optics axis orientation of a birefringent medium by straight-through Mueller matrix ellipsometry (Paper ID 134)**
Honggang Gu, Xiuguo Chen, Hao Jiang and Shiyuan Liu

P23 **Improvement of interference fringe reconstruction by zero padding process - Principle confirmation by numerical calculation - (Paper ID 126)**
Mitsuru Onodera, Masato Aketagawa and Wei Dong

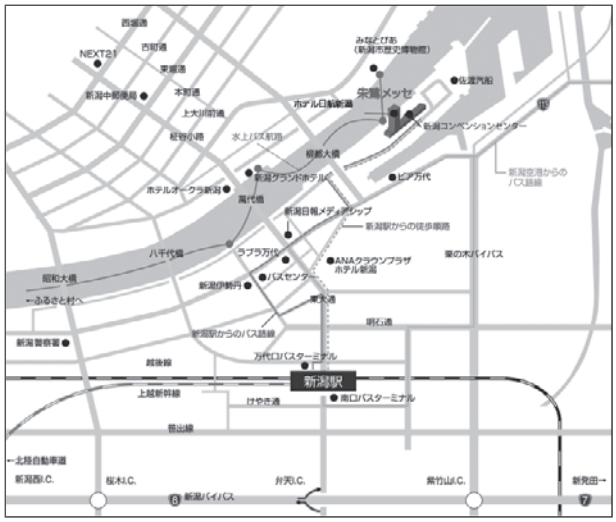
P24 **Multi-wavelength spatial phase shifting interferometry for the single shot surface profiling (Paper ID 33)**
Jun Woo Jeon and Ki-Nam Joo

# Venue & Dinner

## ■ Conference Venue and Access

### TOKI MESSE

Niigata Convention Center
6-1 Bandaijima,Chuo-ku,Niigata City,
Niigata 950-0078 Japan
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

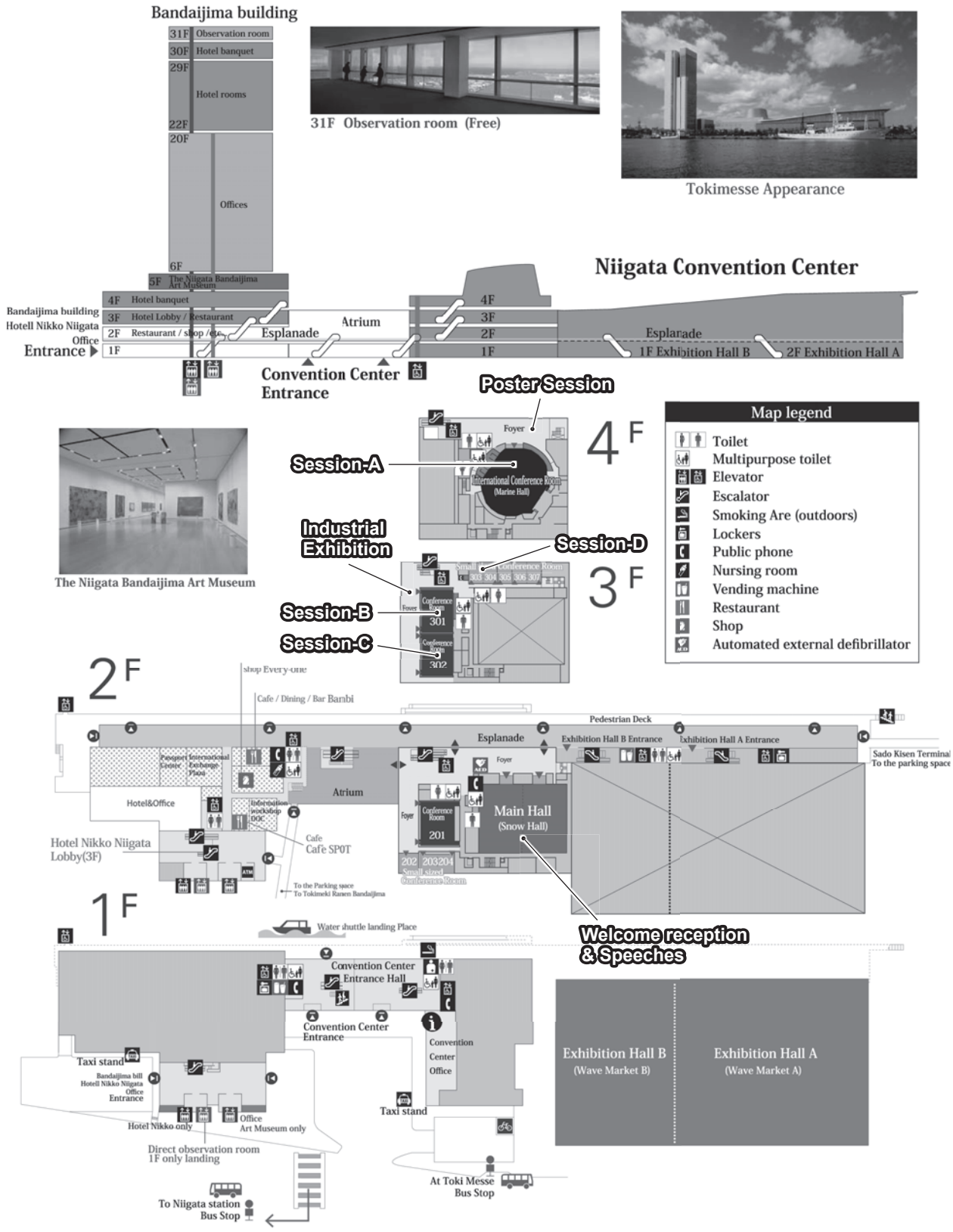
## ■ Industrial Exhibition

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

# Floor Map


Bandaijima building
31F Observation room
30F Hotel banquet
29F
Hotel rooms
22F
20F
Offices
6F
5F The Niigata Bandaijima Art Museum
4F Hotel banquet
3F Hotel Lobby / Restaurant
2F Restaurant / shop /etc.
1F
Bandaijima building
Hotell Nikko Niigata
Office
Entrance
Esplanade
Atrium
Convention Center Entrance
31F Observation room (Free)
Tokimesse Appearance
Niigata Convention Center
4F
3F
2F
1F
Esplanade
1F Exhibition Hall B
2F Exhibition Hall A
Poster Session
Session-A
Industrial Exhibition
Session-D
Session-B
Session-C
4F
3F
Foyer
International Conference Room (Marine Hall)
Small Conference Room 303 304 305 306 307
Conference Room 301
Conference Room 302
The Niigata Bandaijima Art Museum
Map legend
Toilet
Multipurpose toilet
Elevator
Escalator
Smoking Are (outdoors)
Lockers
Public phone
Nursing room
Vending machine
Restaurant
Shop
Automated external defibrillator
2F
shop Every-one
Cafe / Dining / Bar Bambi
Pedestrian Deck
Esplanade
Exhibition Hall B Entrance
Exhibition Hall A Entrance
Sado Kisen Terminal
To the parking space
Passport International Exchange Plaza
Atrium
Foyer
Hotel&Office
Information workshop DOC
Conference Room 201
Main Hall (Snow Hall)
202 203204 Small sized Conference Room
Hotel Nikko Niigata Lobby(3F)
Cafe
Cafe SPOT
To the Parking space
To Tokimeki Ranen Bandaijima
1F
Water shuttle landing Place
Convention Center Entrance Hall
Convention Center Entrance
Convention Center Office
Taxi stand
Bandaijima bill
Hotell Nikko Niigata
Office
Entrance
Hotel Nikko only
Office
Art Museum only
Direct observation room
1F only landing
Taxi stand
At Toki Messe Bus Stop
To Niigata station Bus Stop
Welcome reception & Speeches
Exhibition Hall B (Wave Market B)
Exhibition Hall A (Wave Market A)

# 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**

# Magnescale

http://www.magnescale.com/mgs/language/english/

Magnescale Co., Ltd. provides high precision position detection systems based on magnetic and optical detection principles.

Founded in 1969, Magnescale Co., Ltd. reached 50 years this year in pursuit of high speed, high accuracy, and high resolution scales. The business is centered around three main products: Magnescale, Laserscale, and Digital Gauge. Magnescale and Laserscale products are used for linear and rotational feedback of machine tools and industrial equipment, whereas Digital Gauge products are used as a digital probe for measuring parts.

Magnescale products, derived from the principle of magnetic detection, are praised for their performance in harsh environments filled with oil and coolant such as machine tools.

Laserscale, which uses the grating interferometer technique, achieves a highest resolution of 2.1 pm and is used in semiconductor manufacturing equipment and nano processing machines. The recently developed self-calibrating high precision rotary encoder is a revolutionary rotational scale that can self-calibrate and maintain an angle accuracy of ± 0.2 angle seconds or less at ultra high resolution of $2^{30}$, and can also be used as a calibration reference for the device rotational axis.

# 株式会社東京精密

http://www.accretech.jp/

Tokyo Seimitsu, as a manufacturer of precision measuring devices and semiconductor manufacturing equipment, has been supplying Machine Control Gauges, Surface Texture Measuring Instruments, Wafer Probing Machines, and more to the global market applying our key technologies such as high precision micro positioning and measuring technologies. We will continue to introduce superb products to global market going forward.

Our high precision measuring instruments are used in measurement labs and facilities in various industries such as automobiles, machine tools, aircraft parts and so on. This equipment is highly valued by our customers. We continually strive to enhance product development by improving durability and reliability under all environmental conditions, making products more compact, and automating product functionality.

# カンタツ株式会社

https://kantatsu.co.jp/spaceart/form.cgi

“ First in the world ” *

“ Two-way ” : Stereolithography 3D printer & Direct Exposure machine  High speed and High Precision 3D Printer

1) Electric circuit patterns formed on curves surface
2) L/S (line & space) = 0.1mm/0.1mm
3) 35mm tall Eiffel Tower printed in 4 minutes (530mm/H: Super high-speed mode 3D printing)
4) World's thinnest laminated pitch up to 2.5μm
5) Possible to make Surface mounting (using solder paste) without special surface treatment such as plating
6) Double-sided circuit with minimum mismatch of front and back land pattern (less than 30μm)
7) Both Solder resist coating and resin potting on circuits patterns are possible
8) 720P HDTV-resolution make it possible for “SPACE ART ” to do high precision 3D printing with same level of accuracy as an expensive 3D printer
9) MEMS mirror + 405 nm semiconductor laser is used to achieve high energy saving and productivity
10) A compact and easy-to-use “SPACE ART” is safe to use at home

*As of June 2019, by Kantatsu survey

## 大阪精密機械株式会社

http://www.osk-corp.co.jp/en/pages/top_page.html

Osaka Seimitsu Kikai Co., Ltd. (OSK) is always developing gear measuring technology for new age, utilizing high precision manufacturing technology and software technology of machine control and data analysis.

OSK developed the computerized NC gear measuring machine for the first time in the world gear measuring history. In 1976, we launched the GC-HP Series of machines for measuring gear profile, lead and pitch, which were widely adopted at gear factories around Japan for measuring gears. These success were the start of domestic manufacture, which freed Japanese manufacturers from importing gear measuring machines from the western countries. Our technology has brought the progress for precise machining and quality control of gears, and our products are used for wide range of gear measurement for automobile transmission as well as OA device and so on.

OSK is providing the world's top gear accuracy evaluating systems to gear manufacturing sites in Japan and overseas. As the technical proof, our Gear Measuring Center (GMC) is certified and registered as gear calibration organization with ISO/IEC 17025 (only one company in Japan) from ilac-MRA IA Japan in 2008 (JCSS 0190). GMC performs calibration of gear artifacts for calibration of gear measuring instrument with the best accuracy gear measuring instrument in the world, which is developed as our calibration machine on consignment of state institution.

From now on, we will keep on contribute to the growth of industrial, by continuing the delivery of highly efficient and reliable machines to many users all over the world.

## 三鷹光器株式会社

http://www.mitakakohki.co.jp/english/

Mitaka Kohki Co., Ltd. is a precision optical technology company established in 1955. We started our business by producing astronomical telescopes and observation equipment for rockets and artificial satellites. In the early 1990s, we applied all our technology and know-hows, gained in various space and development, to produce non-contact 3D measuring instruments and neurosurgical microscope. Both products are favorably accepted in the industrial and medical fields.

## Nikon

https://www.nikon.com/products/industrial-metrology/

Nikon offers an innovative metrology product portfolio, including optical inspection and mechanical 3D metrology solutions complemented with state-of-the-art vision measuring instruments and microscopes. These innovative measuring and precision solutions respond to the advanced inspection requirements of manufacturers active in consumer, automotive, aerospace, electronics, medical and other industries.

Nikon's X-ray and CT inspection systems provide detailed insight into the internal structure of various parts, ranging from miniature electronics to aircraft parts. These systems facilitate the non-destructive detection of connectivity failures, material defects, and assembly issues.

The Laser Radar is a large-scale metrology solution that provides automated, non-contact measurement capability for large-volume applications of up to 50-meter radius. This system is suited for repetitive, complex, hard-to-reach, delicate and labor-intensive inspection tasks in automotive, aerospace, renewable energy and many other large-scale applications.

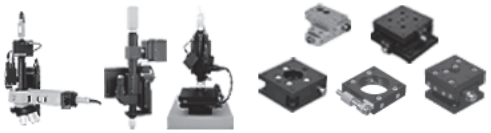
Nikon also offers CNC video measuring systems, laser scanners, measuring microscopes, and industrial microscopes as part of the vast product portfolio. Nikon continues to contribute to a high-performance manufacturing process that allows companies to deliver premium quality products in a shorter time.

# 中央精機株式会社

https://www.chuo.co.jp/

CHUO PRECISION INDUSTRIALCO.,LTD.

Founded in 1955, CHUO Precision Industrial Co., Ltd. has been focusing on manufacturing and sales in two main fields; optical measuring instruments using laser beams based on original branded work microscope “Tool Scope” and the mechanical stage system integrating advanced positioning mechanism. In recent years, we have been developing optical measuring instruments, “Laser Auto Collimator” and “Straightor” that simultaneously measure error factors such as displacement and angle in high precision using laser beams. We are also developing “Positioning Unit” with improving mechanical stage system.



# 株式会社第一測範製作所

https://issoku.jp/

ISSOKU
DAI-ICHI SOKUHAN WORKS CO.

Company introduction
Name : DAI-ICHI SOKUHAN WORKS CO. (ISSOKU)
Address : 826-2, Tsubono, Ojiya City, Niigata Pref., 947-0044

Employees : 233 (as of Jun. 2019)
Sales Dept. : Niigata, Tokyo, Osaka, Nagoya, Toyama, Ball Screw Dept.
Overseas Business Sec.
Subsidiary : Shanghai Issoku Gauges Trading Co.,Ltd.
ISSOKU (THAILAND) CO.,Ltd.
Certification : Japan Industrial Standard Mark Certified Factory for thread gauge
ISO 9001 Quality Management System (JQA-2223)
ISO 14001 Environmental Management System (Headquarters&factory)

【Features】
Since being established in 1944, we have contributed to the development of industry and the economy as a manufacturer specializing in the production of precise measuring instruments and have been providing reliable products that make use of unique precision processing technology.
We aim at being the top manufacturer in this industry and to continue to pursue new challenges as a company that guarantees quality in the nanotechnology era and leads in new technology.
We "ISSOKU" are one of the top gauge manufacturing company, and our expert technology is grinding and precision lapping process for hardened steel.
【Production item】
Thread gauges, Various gauges, Air gauges, Jig for precision measurement, Automatic Measuring Machine, Measuring machine for small diameter, High precision calibration systems, Height gauge, Ball screw etc.
We are Japan General Agent of TRIMOS in Switzerland.
One product or requirement will be designed and manufactured for R&D use etc.
Please feel free to contact us.

# HEIDENHAIN

https://www.heidenhain.co.jp/

HEIDENHAIN

HEIDENHAIN develops and manufactures linear and angle encoders, rotary encoders, and digital readouts for demanding positioning tasks.

With our extensive experience and know-how in the development and manufacture of measuring devices, we create the groundwork for the automation of tomorrow’s plants and production machines.
This comprehensive product program offers solutions for all applications in which the highest possible accuracy, reliable reproducibility and repeatability, safe process management, high machine dynamics, simple operation and of course maximum efficiency are required.
Our products are therefore used primarily in high-precision machine tools, in plants for the production and processing of electronic components as well as in automated systems and machines. In addition, we supply our products to manufacturers of elevators, medical technology and others.

# ISMTII2019

**1-4 September 2019**

The 14th International Symposium
on Measurement Technology
and Intelligent Instruments

## 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

## Supported by

Niigata Prefectural Tourism Association
Niigata Visitors & Convention Bureau
Mitutoyo Association for Science and Technology (MAST)
NSK Foundation for the Advancement of Mechatronics (NSK-FAM)
The Precise Measurement Technology Promotion Foundation (PMTPF)
MAZAK Foundation