10th International Symposium on Measurement and Quality Control 2010

(ISMQC 2010)

Osaka, Japan
5-9 September 2010

# TABLE OF CONTENTS

## PLENARY

**THE ROLE OF METROLOGY IN THE EXCHANGE OF GOODS AND IN THE DEVELOPMENT OF MANUFACTURING TECHNOLOGIES**

Albert Weckenmann, Özgür Tan ................................................................. 1

**B-1  3-D SURFACE TEXTURE AND ITS MICRO CHARACTERISTICS**

**MULTI SCALE MORPHOLOGICAL METROLOGY OF PISTON-RING-TEXTURED CYLINDER LINER ASSEMBLY IN RELATION TO THEIR TRIBOLOGICAL PROPERTIES**

F-P. Ninove, T. Mathia, D. Mazuyer, P. Pawlus, S. Carras, J. Gruszka ................................................................. 5

**CHARACTERISATION OF GEOMETRICAL PROPERTIES OF ELECTROPLATED DIAMOND TOOL**

Mohd Fauzi Ismail, Kazuhisa Yanagi, Hiromi Isobe ................................................................. 10

**3D NATURAL SURFACE FEATURES OF NODULAR SPHEROIDAL CAST IRON AND ITS MORPHOLOGICAL BEHAVIOUR IN ABRASIVE MANUFACTURING**

François-Pierre Ninove, Cezary. Rapiejko, T. Mathia ................................................................. 14

**EVALUATION OF SPREADING BEHAVIOR OF LIQUIDS ON SURFACES WITH FUNCTION- ORIENTED 3D PARAMETERS**

Özgür Tan, Albert Weckenmann ................................................................. 18

## C-1 OPTICAL MEASUREMENT FOR GEOMETRICAL QUANTITY EVALUATION (1)

**ADVANCED ABSOLUTE LENGTH METROLOGY BASED ON PULSE TRAINS' CONSTRUCTIVE INTERFERENCE: TOWARDS MEASUREMENTS OF METER ORDER WITH AN ACCURACY OF NANO ORDER**

Dong Wei, Satoru Takahashi, Kiyoshi Takamasu, Hirokazu Matsumoto ................................................................. 22

**HIGH-RESOLUTION IMAGING TECHNIQUE BASED ON ACTIVE SHIFT OF OPTICAL AXIS**

Shin Usuki, Kenjiro T. Miura ................................................................. 26

## D-1 ADVANCED OPTOELECTRONIC SENSORS AND INSTRUMENT (1)

**OTDR-BASED TECHNIQUE FOR DETECTING SIGNALS OF FBG SENSORS IN THE WIDE SPECTRAL RANGE FOR MEASURING STRAIN AND TEMPERATURE**

Yuri Kulchin, Oleg Vitrik, Anton Dyshlyuk, Zhi Zhou, Jiuping Qu ................................................................. 30

**A COMPACT 2D MICRO-ANGLE SENSOR**

Mengdong Lian, Bing-Feng Ju ................................................................. 33

**AN OPTICAL SENSOR FOR MEASUREMENT OF ANGULAR MOTIONS OF A PLANAR MOTION STAGE**

Hiroshi Muto, Tetsuo Sugeno, Yasuuki Saito, Yoshikazu Arai, Wei Gao ................................................................. 37

**ANALYSIS OF MECHANICAL ERRORS OF PLANAR CAPACITIVE SENSOR FOR TWO DIMENSIONAL DISPLACEMENT MEASUREMENT**

Wen Wang, Jianping Yu, Yaohua Wen, Zichen Chen ................................................................. 41

## E-1 ULTRA PRECISION LENGTH MEASUREMENT

**< KEYNOTE > ULTRAFAST OPTICS FOR ULTRAPRECISION LENGTH MEASUREMENT**

Seung-Woo Kim ................................................................. 45

**3D MEASUREMENTS OF MICROSTRUCTURES WITH LARGE LATERAL DIMENSIONS**

Martin Bretschneider, Moritz Krauff, M. Kästner, Eduard Reithmiller ................................................................. 47

**SUPER-HETRODYNIE INTERFEROMETRIC LENGTH MEASUREMENT USING THE REPETITION FREQUENCY OF AN OPTICAL FREQUENCIES COMB**

Hirokazu Matsumoto, Satoru Takahashi, Kiyoshi Takamasu ................................................................. 51
### F-1 MACROGEOMETRIC FEATURES AND UNCERTAINTY EVALUATION

**Autocollimator Characterization and Calibration at the PTB: Current Status and Future Progress**
Ralf D. Geckeler, Andreas Just, Michael Krause, Harald Bosse

**Reflective Property of Typical Micro Structures Under White Light Interferometer**
Z. Sun, A. Weckenmann

**Estimation of Measurement Uncertainty of Line Edge Roughness Based on the Next Generation GPS**
Jiang Zhuangde, Zhao Fengxia, Jing Weihsuan, Wang Chenying, Philip D. Prewett, Kyle Jiang

**Naturally Grown Silicon Structures as an Intercomparison Standard for Multisensor Data Fusion in Geometrical Surface Characterization**
Sophie Gröger, Michael Dietzsch

### B-2 GEAR METROLOGY

**Comprehensive Representation of Pitch Deviations Suitable for Engagement Evaluation in Different Types of Gears**
Syuhei Kurokawa, Yasutane Ariura, Toshiro Doi

**Laser Interferometric Measuring Method of Involute Artifact**
Masaharu Komori, Fumi Takeoka, Aizok Kubo, Hiroshiige Fujio, Takehiro Ito, Sonko Osawa, Osamu Sato, Toshiyuki Takatsuiji

**Fast Algorithms for In-Line Gearwheel Measurements**
A. Pahlke, M. Kästner, E. Reithmeier

**Novel Artifacts Using Simple Geometries for Evaluation of a Gear Measuring Instrument**
Sonko Osawa, Osamu Sato, Yohan Kondo, Masaharu Komori, Fumi Takeoka, Toshiyuki Takatsuiji

**A Novel Method & Its Realization for Single-Flank Testing of Fine-Pitch Gears**
Zhaoyao Shi, Wannian Zhang, Jiachun Lin

### C-2 MEMS/MOEMS APPLICATION IN MEASUREMENT FIELD

**Fabrication and Characterization of a Miniature Self-Sensing Joint of Carbon Nanotube Bundles**
Hsin-Ying Lin, Ding-Hao Chen, Shang-Yi Liu, Po-Ken Chung, Wen-Pin Shih, Lung-Jieh Yang

**Counting of Electric Charge for Control of Local Metal Plating Using a Scanning Nanopipette Probe Microscope**
So Ito, Futoshi Iwata

**Design and Evaluation of Oil-Filled Isolated High Temperature Piezoresistive Pressure Sensor**
Libo Zhao, Zhuangde Jiang, Yulong Zhao, Yuanhao Liu, Juanbo Li, Jingbo Xu, Yong Li

**< Keynote > Focus and Dose Control for Lithography of Semiconductor Manufacturing Using Many Kind Measurement Tools Respectively**
Hideki Ina

### D-2 ADVANCED OPTOELECTRONIC SENSORS AND INSTRUMENT (2)

**Error Analysis of Optical Activity for Standardization by Dual Rotating Polarimeter**
Masanosuke Tanaka, Yoshinori Nakajima, Hideyuki Amemiya, Yukitoshi Ohnuki

**Dimension Measurement of the Inside Shape of Special Oil Pipe with Three-Dimensional Endoscope**
Wei Tao, Hui Zhao, Yi Shen, Wenying Ji

**Development of a Single-Shot Laser Rangefinder with Quadrature Reference Signals Sampling**
Masahiro Ohishi, Fumio Ohimoto, Yoshiatsu Tokuda, Chikao Nagasawa

**Design and Realization of Dual Waveguide Differential Magnetostriuctive Linear Position Sensor**
Yongjie Zhang, Hui Zhao, Weiwen Liu, Ruojie Tao, Wei Tao
E-2 CMM METROLOGY (1)

TACTILE-OPTICAL MICROPBRES FOR THREE DIMENSIONAL MEASUREMENTS OF
MICROPARTS
Rainer Tutsch, Matthias Andreae, Ulrich Neuscheuer-Behe, Marcus Petz, Thomas Wiedenhoefer, Mark Wissmann

CALIBRATION OF ARTICULATED ARM COORDINATE MEASURING MACHINE
CONSIDERING MEASURING POSTURE
Hiroyuki Hamana, Mitsushi Tominaga, Miura Ozaki, Ryosuke Furutani

INSPECTION OF SPATIAL CAMS USING COORDINATE MEASURING MACHINE
Jiachun Lin, Zhouyao Shi, Lin Tung

DEVELOPMENT OF MICRO CONTACT DETECTION PROBE FOR MICRO-HOLE QUALITY
CONTROL
Ichiro Ogura, Yuichi Okazaki

DESIGN AND CONTROL OF 3-DOF ACTIVE SCANNING PROBE USING PARALLEL LINK
MECHANISM
Takashi Harada, Ke Dong

E-2 UNCERTAINTY EVALUATION AND TRACEABILITY (1)

< KEYNOTE > CALIBRATION OF SURFACE PLATES USING AUTOCOLLIMATOR, LASER
SYSTEMS AND COORDINATE MEASURING MACHINES (CMMs)
Sarwat Zaki Ahmed Zahwi

ERROR BUDGETING OF A THERMALLY STABLE CALIBRATION SETUP FOR TWO-
DIMENSIONAL SENSORS
José A. Yagüe-Fabra, José Antonio Albaiez, J.J. Aguilar, Margarita Valenzuela, Sinué Ontiveros

METROLOGICAL COMPATIBILITY AND STATISTICAL CONSISTENCY
Ragha N. Kacker, Rüdiger Kessel, Klaus-Dieter Sommer

RE-CALIBRATION EVALUATION UTILIZING DATA MINING METHODS
Adriana Hornikova, M. Numan Durakbas, Friedrich Bleicher

B-3 OPTICAL MEASUREMENT FOR GEOMETRICAL QUANTITY EVALUATION (2)

3D MEASUREMENT OF THE INNER SHAPE OF ACCELERATOR CAVITIES
Kazuhiro Enami, Tatsuya Kume, Yasuo Higashi, Kenji Ueno

DESIGN AND CALIBRATION OF COORDINATE MEASURING SYSTEM BASED ON
SCANNING LASER PLANE
Dabao Lao, Xueyou Yang, Jiguai Zhu

RESOLUTION CHARACTERISTICS OF SUPER-RESOLUTION OPTICAL INSPECTION USING
STANDING WAVE ILLUMINATION
Ryota Kudo, Shin Usuki, Satoru Takahashi, Kiyoshi Takamasu

PROFILE MEASUREMENT OF LARGE ASPHERIC OPTICAL SURFACE BY SCANNING
DELECTROMETER WITH ROTATABLE MIRROR - METHOD FOR ENLARGING
MEASURING RANGE OF AUTOCOLLIMATOR
Muzheng Xiao, Satomi Jujo, Satoru Takahashi, Kiyoshi Takamasu

OPTICAL 3D-CHARACTERIZATION FOR MULTISCALE WORKPIECES
Laura Shaw, Albert Weckenmann

C-3 PRE-, IN-, POST PROCESS MEASUREMENT

< KEYNOTE > EFFECTS OF COOLANT CONCENTRATION ON TRANSPARENT WINDOW
SIZE FOR THE WATER BEAM ASSISTED FORM ERROR IN-PROCESS OPTICAL
MEASUREMENT
Yongsheng Gao

RESEARCH REGARDING MEASURING THE LASER BEAM DURING LASER PROCESSING
Camil Octav Chetreanu Don, Gabriel Dumitru

DUAL-WAVELENGTH SIMULTANEOUS PHASE SHIFTING INTERFEROMETRY (SPSI) FOR
ONE-SHOT MEASUREMENT
Liang-Chia Chen, Sheng-Lih Yeh, Yan-Chao Liao, Abraham Mario Tapilouw

THE SIMULATION AND INSPECTION FOR THE STARTING PHENOMENON OF SLIT
COATING PROCESS ON GLASS SUBSTRATE
Ta-Hsin Chou, Wen-Hsien Yang, Kuei-Yuan Cheng, Yu-Chen Chang, Thomas Luo
D-3 QUALITY CONTROL

GEOMETRY ASSURANCE AND QUALITY CONTROL PLANNING BY QAM ............................................................. 196
Richard Lindqvist, Karl-Johan Karlsson, Stefan Hedman, Lars Mattsson

SUSTAINABLE QUALITY ASSURANCE BY ASSURING COMPETENCE OF EMPLOYEES ........................................... 200
Teresa Werner, Albert Weckenmann

INTRODUCING QUALITY CONTROL LOOPS FOR THE INTEGRATED ANALYSIS AND DESIGN OF STABLE PRODUCTION SYSTEMS ................................................................. 204
Robert Schmitt, Tilo Pfeifer, Sebastian T. Stiller, Patrick Beaupain

Capable Production Processes by Dynamic Tolerancing .................................................................................... 208
Rainer Tutsch, Carlos Hernandez

EQUIPP – EXCHANGE OF QUALITY MEASUREMENT PROCESS PLANS .............................................................. 212
Richard Lindqvist, John Horst, Robert Brown, Lars Mattsson

E-3 CMM METROLOGY (2)

METHOD FOR A TRACEABLE GEOMETRY ASSESSMENT OF ARBITRARILY SHAPED SCULPTURED SURFACES ................................................................. 216
Markus Bartischer, Marko Neukamm, Michael Krystek

A THREE LASER INTERFEROMETERS AND ONE AUTOCOLLIMATOR SYSTEM FOR MEASURING THE YAW AND STRAIGHTNESS ERRORS OF A X-Y STAGE ON HIGH PRECISION CMM ................................................................. 220
Ping Yang, Shusaku Shibata, Tomohiko Takamura, Satoru Takahashi, Kiyoshi Takamatsu, Osamu Sato, Sonko Osawa, Toshiyuki Takatsui

MOBILE MULTI-LATERATION MEASURING SYSTEM FOR HIGH ACCURATE AND TRACABLE 3D MEASUREMENTS OF LARGE OBJECTS ................................................................. 224
Klaus Wendt, Matthias Franke, Frank Härtig

EFFICIENT MULTIPLE-MEASUREMENT Technique FOR ROTATIONALLY SYMMETRIC MEASURANDS ................................................................. 228
Osamu Sato, Yohan Kondo, Sonko Osawa, Toshiyuki Takatsui

ISARA 400: ENABLING ULTRA-PRECISION COORDINATE METROLOGY FOR LARGE PARTS ................................................................. 231
Henny Spaan, Rilpho Donker, Ivo Widdershoven

F-3 UNCERTAINTY EVALUATION AND TRACEABILITY (2)

METHODOLOGY FOR UNCERTAINTY ESTIMATION OF COORDINATE MEASUREMENTS ................................................................. 235
Wladyslaw Jakubiec, Wojciech Plowucha

ANALYSIS AND DESIGN OF THE BEST LAYOUT BASED ON THE NETWORK MEASUREMENT OF WMPS ................................................................. 239
Zhi Xiong, Ji Gui Zhu, Yong Jie Ren, Da Bao Lao, Lei Geng, Xue You Yang, Sheng Hua Ye

UNCERTAINTY IN 3D METROLOGY INTEGRATED WITH THE PROCESS OF PRODUCT AND MEASUREMENT REALIZATION ................................................................. 243
Christian R. Baldo, Alvaro J. Abakerli, Gustavo D. Donatelli, Francisco A. Arenhart

A MORE GENERAL TYPE A EVALUATION ................................................................. 248
Rüdiger Kessel, Raghu N Kacker, Klaus-dieter Sommer

PROPOSAL OF A CYLINDRICAL STANDARD TO EVALUATE THE UNCERTAINTY OF MEASUREMENT FOR MICRO GEAR MEASUREMENTS ................................................................. 254
Gisela Lanza, Benjamin Viering

POSTER SESSION

NEW DETECTION TECHNIQUE FOR TIMING OF CONTACT AND NONCONTACT OF ATHLETE’S FOOT WITH GROUND IN SPORTS ................................................................. 258
Koichi Kurita

A HIGH-STABLE PRESSURE SENSOR BASED ON A SOI HETEROSTRUCTURE AND MEMS TECHNOLOGY FOR MEASURING AIRCRAFT SPEED-ALTITUDE DATA ................................................................. 262
Leonid Sokolov

QA FOR BLOOD CHEMICAL ANALYSIS BY ISO-GUM (4) ................................................................. 266
Yasuo Iwaki
PARAMETERS SELECTION FOR CMM CONTACT MEASUREMENTS OF FREE-FORM SURFACES SHAPEDEVIATIONS
Andrzej Werner, Malgorzata Poniatowska ............................................................................................................................... 270

ANALYSIS OF GEOMETRIC DEVIATIONS OF FREE-FORM SURFACES DETERMINED IN COORDINATE MEASUREMENTS
Malgorzata Poniatowska, Andrzej Werner ............................................................................................................................... 274

GENERATION AND ASSESSMENT OF RANDOM SURFACE TEXTURE IN A WIDE AREA
Yoshikazu Kobayashi, Kenji Shirai, Kiyotaka Kawasaki ............................................................................................................................... 278

A MULTI-PROBE SURFACE ENCODER FOR MOSAIC XY GRATING
Koji Hoshino, Woo-Jae Kim, Wei Gao, Lijiang Zeng ............................................................................................................................... 282

INVESTIGATING METHODS OF MATHEMATICAL MODELLING OF MEASUREMENT AND ANALYSIS OF SPHERICAL SURFACES
Stanislaw Adameczak, Darisaz Janecki, Krzysztof Stepien ............................................................................................................................... 286

DEVELOPMENT OF A SYSTEM FOR COMPLEX GEOMETRY PARTS MEASURING USING A ROBOT AND A TRIANGULATION LASER PROBE
J.J. Aguilar, D. Guillomía, C. Cajal, F.J. Brosed ............................................................................................................................... 290

ACCURACY ANALYSIS OF DIFFERENT PROBES USED IN ARTICULATED ARM COORDINATE MEASURING MACHINES
Jorge Santolaria, J.J. Aguilar, Agustín Brau, Lorenzo Vila ............................................................................................................................... 294

COMPARATIVE ANALYSIS OF INTERNATIONAL STANDARDS FOR PERFORMANCE EVALUATION OF ARTICULATED ARM COORDINATE MEASURING MACHINES: ASME B89.4.22-2004 AND VDI 2617 9-2009
Jorge Santolaria, J.J. Aguilar, Ana Cristina Majarena, David Samper, Jesús José Garcia ............................................................................................................................... 298

TWO-WAVELENGTH LASER INTERFEROMETER SYSTEM WHICH REDUCES THE EFFECT OF THE REFRACTIVE INDEX OF AIR
Kazuo Miyata, Hidekazu Oozeki, Hideyuki Nakagawa, Hiroki Masuda ............................................................................................................................... 302

THE MEASUREMENT OF CURVATURES BY USING MOIRÉ FRINGES AND MULTIPLE LIGHT SOURCES
Jing-Heng Chen, Kun-Huang Chen, Shou-Wei Kuo, Wei-Lun Wu, Fan-Hsi Hsu, Yung-Tsung Chang ............................................................................................................................... 306

TASK-SPECIFIC UNCERTAINTY EVALUATION OF COORDINATE MEASUREMENTS USING MULTIPLE CALIBRATED WORKPIECES
Francisco A. Arenhart, Gustavo D. Donatelli, Mauricio C. Porath ............................................................................................................................... 310

SIMPLE OPTICAL APPARATUS FOR MEASURING THE CONCENTRATION OF SOLUTIONS
Kun-Huang Chen, Jing-Heng Chen, Jian-You Lin, Shi-Sheng Hu, Yi-Zuo Song, Yung-Tsung Chang ............................................................................................................................... 314

METROLOGICAL COMPETENCE OF ANGLE CALIBRATION FACILITY AT MEASUREMENT STANDARDS LABORATORY
Fazil Syed, Faheem Mohammad, Federico Cejalvo ............................................................................................................................... 317

INTERFERENCE-FREE FIVE-AXIS NC MACHINING AND IN-PROCESS MEASUREMENT OF CYLINDRICAL CAM USING ENVELOPING ELEMENT
Jeng-Nan Lee, Ying-Chien Tsai, Hung-Shyong Chen ............................................................................................................................... 322

ROLL-TO-ROLL EMBOSSTING OF SUNLIGHT GUIDE FILM WITH WIDE OUTGOING ANGLE
Ta-Hsin Chou, Wen-Hsien Yang, Tsu-Yu Huang, Hong Hocheng ............................................................................................................................... 326

A METHOD OF HIGH-ACCURACY LASER SCANNING MEASUREMENT FOR CAMSHAFT
Yong-Jie Ren, Ji-Gui Zha, Xue-Yu Yang, Sheng-Hua Ye ............................................................................................................................... 330

THERMAL ERROR MODELING AND FORECASTING FOR NC MACHINE TOOLS BASED ON INTELLIGENT TECHNOLOGY
Jian-Zhong Fu, Xin-Hua Yao, Zichen Chen ............................................................................................................................... 333

RESEARCH ON THE THERMAL STABILITY COMPONENTS WITH CELLULAR STRUCTURES AND THE PHASE CHANGE MATERIAL IN MACHINE TOOLS
Yong He, Jian-Zhong Fu, Zichen Chen ............................................................................................................................... 340

SURFACE SHAPE MEASUREMENT FOR SMALL LENS USING PHASE SHIFT SHEARING INTERFEROMETER
Ryohei Hanayama, Katsuhiro Ishii ............................................................................................................................... 344

MODELLING OF THE CMM PROBE HEAD ERRORS
Jerzy Sladek, Adam Gaska ............................................................................................................................... 348

B-4 INTELLIGENT MICRO AND NANO METROLOGY (1)

MEASUREMENT OF LONG-TERM DIMENSIONAL STABILITY OF GLASS CERAMICS USING A HIGH-PRECISION LINE SCALE CALIBRATION SYSTEM
Akira Takahashi ............................................................................................................................... 354
NON-CONTACT REMOTE MEASUREMENTS OF RING GAUGE USING A LOW-COHERENCE INTERFEROMETER ............................................................ 358
Nobuyuki Ohsawa, Hirokazu Matsumoto, Akiko Hirai, Masatoshi Arai, Tohru Shimizu, Takashi Kikuchi

A NOVEL SCANNING TUNNELING MICROSCOPY FOR LONG RANGE AND HIGH ASPECT RATIO MEASUREMENT ........................................ 362
Yuan-Liu Chen, Bing-Feng Ju

STRUCTURALIZATION OF METAL NANOPARTICLES BY PHOTOINDUCED AGGREGATION ............................................................................................................................... 366
Kok Foong Lee, Terutake Hayashi, Yasuhiro Takaya

MEASUREMENT OF ABSOLUTE OPTICAL THICKNESS DISTRIBUTION OF SEMICONDUCTOR WAFER USING A WAVELENGTH TUNING INTERFEROMETER ........................................ 370
Yangjin Kim, Kenichi Hibino, Youichi Bitou, Sonko Osawa, Nohiko Sugita, Mamoru Mitsuishi

C-4 ANALYTICAL METHOD FOR UNCERTAINTY EVALUATION

< KEYNOTE > ANALYTICAL METHOD OF CALCULATING THE MEASUREMENT ACCURACY ............................................................................................................................... 374
Ryszard Jablonski

PROBABILITY DESCRIPTION OF TWO-PROCESS SURFACE TOPOGRAPHY ............................................................................................................................... 380
Wieslaw Grabon, Pawel Pawlus

SOFTWARE DATUM FOR CROSS-AXIS MOTION MEASUREMENT OF X-STAGE BASED ON LEAST UNCERTAINTY CRITERION ...................................................... 384
Eiki Okuyama, Hiroshi Takahashi, Hiromi Ishikawa

EVALUATION METHOD FOR CONDITIONED POLISHING PAD SURFACE TOPOGRAPHY APPLYING FOURIER TRANSFORM ANALYSIS ........................................ 388
Keiichi Kimura, Panart Khajornrungruang, Takahisa Okusono

D-4 OPTICAL MEASUREMENT FOR GEOMETRICAL QUANTITY EVALUATION (3)

FREE SPECTRAL RANGE MEASUREMENT OF FABRY-PEROT CAVITY USING FREQUENCY MODULATION AND NULL METHOD UNDER OFF RESONANCE CONDITION ........................................ 392
M. Aketagawa, T. Yashiki, S. Kimura, H. Iwata, T.Q. Banh

DEVELOPMENT OF A CONSTANT TEMPERATURE/ “AIR-REFRACTIVE-INDEX” CHAMBER USING FABRY-PEROT CAVITY ...................................................... 396
T.Q. Banh, Yuria Ohkubo, M. Aketagawa

IN-SITU MICROSCOPIC SURFACE PROFILOMETRY BY LATERAL CONFOCAL SCANNING (LCS) FOR ROLL-TO-ROLL THIN-FILM FABRICATION ........................................ 400
Liang-Chia Chen, Sheng-Han Chen, Yi-Wei Chang, Zhi-Kai Li, Shih-Hsuan Kuo, Huang-Wen Lai

INFLUENCES OF SURFACE PARAMETERS ON LASER 3D SCANNING ................................................................. 408
Nermina Zaimovic-Uzunovic, Samir Lemes

NEW OPTICAL DISTANCE MEASUREMENT WITHOUT A PRISM REFLECTOR USING AN OPTICAL FREQUENCY COMB LASER ................................................................. 412
Kazumasa Isaka, Satoru Takahashi, Kiyoshi Takamizu, Hirokazu Matsumoto

E-4 CMM METROLOGY (3)

HIGH PRECISION TACTILE PROBING SIZE AND FORM MEASUREMENTS WITH A MICRO-CMM ............................................................................................................................... 416
Michael Neugebauer, Frank Härtig, Otto Jusko

EXPERIMENTAL EVALUATION OF TECHNIQUES FOR OUTLIER RECOGNITION AND ELIMINATION ON FORM MEASUREMENT PROFILES ........................................ 420
Felipe L. Probst, Francisco J. Arenhart, Gustavo D. Donatelli, Robert Schmitt, Susanne Nisch

VERIFICATION OF INTERIM CHECK METHOD OF CMM ................................................................. 424
Yusuke Asano, Ryoshu Furutani, Miyu Ozaki

EVALUATION METHOD FOR MICRO-CMM SPHERICAL STYLUS TIPS USING MICRO-EDM ON-MACHINE MEASUREMENT ......................................................... 428
Dong-Yea Sheu, Richard Leach
F-4 TOLERANCE, TESTING, TEST PLANNING

EVALUATION OF THE MEASUREMENT ALGORITHM FOR OUT-OF-ROUNDNESS MEASUREMENT WITH CMM

Michał Wieczorowski, Bartosz Gapinski, T. Mathia

ESTABLISHMENT OF A PRIMARY LEVEL LAB FACILITY AT MEASUREMENT STANDARDS LABORATORY TO CALIBRATE AIR VELOCITY SENSORS

Fazil Syed, Faheem Mohammad, Federico Cejalvo

MEASUREMENT UNCERTAINTY IN THE ASSESSMENT OF CONFORMITY

Michael Krystek, Klaus-Dieter Sommer, W. Tyler Estler

DESIGN AND VERIFICATION OF BONDING MODULE FOR LARGE-SCALE PCB BONDER

Tien-Tung Chung, Chin-Te Lin, Hsun-Fu Chian, Shou-Heng Chen, Kuang-Hao Fan

MORPHOLOGICAL CRITERIA FOR MICRO TOLERANCING IN MANUFACTURING PROCESSES OF ASSEMBLY JOINTS UNDER FRETTING CONDITIONS

K.J. Kubiak, T. Mathia, S. Carras

B-5 NOVEL METHOD FOR MEDICAL AND BIOLOGICAL MEASUREMENT

PERSPECTIVE SENSORY MEASUREMENT METHOD BY USING MULTI VIEW POINT 3D GLASS-FREE DISPLAY

Yoshihito Kobuchi, Takahiro Yamamori

PHOTONIC BIOSENSOR FOR LAB-ON-A-CHIP APPLICATIONS

Stefanie Demming, Andreu Llobera, Victor Javier Cadarso, Jahir Orozco, Cesar Fernandez-Sanchez, Ralph Wilke, Stephanus Buettgenbach

DEVELOPMENT OF AFM SYSTEM HAVING MULTI-FUNCTIONAL TOOLS FOR MEASUREMENT AND MANIPULATION UNDER SEM OBSERVATION

Hideyuki Ka, Hisayuki Aoyama, Tatsuo Ushiki, Futoshi Iwata

TECHNIQUE FOR SEPARATELY MEASURING VISCOS AND ELASTIC FORCES OF A CELL USING AN OPTICALLY MANIPULATED MICROPROBE

Ryoosuke Tsutsumi, Kazuhiro Gesho, Akira Nishiyama, Shoichi Gohtani, Ichiro Ishimaru

C-5 MACHINE VISION AND IMAGE PROCESSING

HARD- AND SOFTWARE SYSTEMS FOR EVALUATION OF NEW MULTI CHANNEL IMAGE PROCESSING ALGORITHMS

Martin Correns, Maik Schumann, Maik Rosenberger, Matthias Rückwardt, André Göpfert, Gehard Linß

TABULATION METHOD FOR ELECTRONIC PACKAGE

Motoharu Fujigaki, Akishiro Masaya, Yoshihara Morimoto, Tadashi Misaka, Minoru Inada, Ryosuke Murakami

A NOVEL TECHNOLOGY-MATCHING-BASED METHOD FOR DETECTING EDGES OF MICRO ACCESSORIES

Weiren Wu, Li Jiang, Zhijing Zhang, Xin Jin

THE PERFORMANCES OF A VISION INSPECTION SYSTEM WITH DIFFERENT INTERFACE CAMERAS

Qi Li, Rong-Sheng Lu, Yan-Qiong Shi, Qing-Ping Yu, Ning Liu

D-5 INTELLIGENT MICRO AND NANO METROLOGY (2)

DEVELOPMENT OF AN AUTO-FOCUS SYSTEM BY THE MOIRÉ METHOD

Ju-Yi Lee, Yu-Ju Lin, Tung-Hsing Wang, Chien-Sheng Liu

ULTRA-PRECISION SCANNING TUNNELING MICROSCOPE FOR MEASUREMENT OF HIGH-ASPECT RATIO STRUCTURES

Shigeaki Goto, Wei Gao

DESIGN OF AN ACTIVE PROBE FOR A CONTACT-TYPE MEASURING DEVICE USING LASER INTERFEROMETRY SYSTEM

Yung-Tien Liu, Han-Lin Wu, Yutaka Yamagata

SPINDLE RADIAL MOTION ERROR MEASUREMENT USING TWO-DIMENSIONAL ATOMIC ENCODER

Patamaporn Chaikool, M. Aketagawa, Eiki Okayama, Jaratrit Soeatuptim, Nusorn Nimnual
E-5  NANO PHOTONICS IN INTELLIGENT MEASUREMENT

DETECTING TERAHERTZ NEAR-FIELD RADIATION WITHOUT EXTERNAL ILLUMINATION
Yusuke Kajihara, Keishi Kosaka, Susumu Komiyama
501

HEIGHT MEASUREMENT OF A PARTICLE IN EVANECENT FIELD CONTROLLING PENETRATION DEPTH
Takayuki Kurihara, Ryuichi Sagimoto, Ryota Kudo, Satoru Takahashi, Kiyoshi Takamasu
505

THIN FILM THICKNESS MEASUREMENT BY SURFACE PLASMON RESONANCE USING MODIFIED OTTO’S CONFIGURATION COMBINED WITH ELLIPSOMETRY
Yasuhiro Mizutani, Tetsuo Iwata
509

STUDY OF PHOTO-DRIVEN LEVER BEAMS FABRICATED BY TWO-PHOTON POLYMERIZATION FOR SENSOR APPLICATIONS
Chih-Lang Lin, Tien-Tung Chung, Chin-Te Lin, Yue-Lun Yang, Patrice L. Baldeck
513

F-5 INTELLIGENT MEASUREMENT ALGORITHM AND SIMULATION (1)

CLOSED LOOP CONTROL FOR A PARALLEL MICROROBOT BASED ON INTEGRATED CAPACITIVE POSITION SENSORS
Christoph Boese, Marco Feldmann, Stephanus Büttgenbach
516

EXTRACTION OF GEOMETRICAL PRIMITIVES FROM A SET OF CONTOUR POINTS
Maik Schumann, Alexander Schlegel, Martin Correns, Jörg Burgenda, Maik Rosenberger, Gerhard Linß
520

SURFACE TOPOGRAPHY AFTER VAPOUR BLASTING FORECASTING
Pawel Pawlus, Rafal Reizer, Lidia Galda, Andrzej Dziwera, Wieslaw Grabon
524

B-6  X-RAY APPLICATION FOR 3-D MEASUREMENT

A TEST OBJECT FOR CALIBRATION AND ACCURACY ASSESSMENT IN X-RAY CT METROLOGY
Kim Kiekens, Frank Welkenhuyzen, Ye Tan, Philip Bleys, Wim Devulb, André Voet, Jean-Pierre Kruth
528

REPRODUCIBILITY OF DIMENSIONAL MEASUREMENTS PERFORMED BY COMPUTED TOMOGRAPHY
Vitor Camargo Nardelli, Gustavo D. Donatelli, Carlos Alberto Schneider, Christian Niggemann, Robert Schmitt
532

PROFILE MEASUREMENT OF POLISHED SURFACE WITH RESPECT TO A LATTICE PLAIN OF SILICON CRYSTAL USING A SELF-REFERENCED LATTICE COMPARATOR
Hiroyuki Fujimoto, Atsushi Waseda, Xiaowei Chang
536

C-6  OPTICAL MEASUREMENT FOR GEOMETRICAL QUANTITY EVALUATION (4)

MONITORING OF DRYING PROCESS OF PAINT BY DIGITAL HOLOGRAPHY
Masayuki Yokota, Yoshihito Kimoto, Ichiro Yamaguchi
539

INFLUENCE ANALYSIS OF THE ELASTIC MEMBRANE’S ARC LENGTH CHANGE ON THE AIR ISOLATION UNIT’S STIFFNESS
Chao Xia, Jiubin Tan
543

EVALUATION TECHNOLOGY OF MICRO THREE-DIMENSIONAL STRUCTURE USING PHASE-SHIFTING DIGITAL HOLOGRAPHY
Yoshiaki Kiyama, Terutake Hayashi, Yasuhiro Takaya
547

D-6  PRE-, IN-, POST PROCESS MEASUREMENT (2)

COMBINATION OF MULTI-SENSOR TECHNOLOGY AND MULTIPLE MEASUREMENT STRATEGIES IN MICRO- AND NANOMETROLOGY
Eberhard Manske, Gerd Jäger, Tino Hausotte
551

VERIFICATION OF GENERATION AND REMOVAL PROCESS OF SURFACE BRITTLE FILM, IN POLISHING PROCESS USING WATER SOLUBLE FULLERENOL
Kazumasa Kano, Terutake Hayashi, Yasuhiro Takaya, Ken Kokubo
555

INVESTIGATION ON SLURRY FLOW AND TEMPERATURE IN POLISHING PROCESS OF QUARTZ GLASS SUBSTRATE
Panart Khajornrungruang, Nagisa Wada, Ryuji Yui, Keiichi Kimura
559

A PIEZODRIVEN THREE DIMENSIONAL MICROPPOSITIONING STAGE FOR NANO-MANUFACTURING
Wen Wang, Robert J. Hocken, Zhu Zhu, Zichen Chen
563
E-6 GEOMETRICAL PRODUCT SPECIFICATION AND FORM TEST

M. Numan Durakbasa, P. Herbert Osanna, Pinar Demircioglu

COMPLETE GEOMETRICAL PRODUCT SPECIFICATION FOR THE UNAMBIGUOUS VERIFICATION OF FUNCTIONAL PROPERTIES ........................................................................................................... 571
Sophie Gröger, Michael Dietzsch

CURRENT SITUATION AND PROBLEMS FOR REPRESENTATION OF TOLERANCE AND SURFACE TEXTURE IN 3D CAD MODEL .................................................................................................................. 575
Fumiki Tanaka

RESEARCH ON INCREASING THE ACCURACY OF CYLINDRICITY MEASUREMENTS BY THE V-BLOCK METHOD ......................................................................................................................... 579
Stanislaw Adamczak, Dariusz Janecki, Krzysztof Stepień

F-6 INTELLIGENT MEASUREMENT ALGORITHM AND SIMULATION (2)

LONG DISTANCE STRAIGHTNESS MEASUREMENT USING A LEVEL ............................................................................ 583
Tatsuya Kume, Eiki Okuyama, Masanori Satoh, Tsuyoshi Suwada, Kazuro Fujikawa

A METHOD FOR DETERMINING THE MEDIAN LINE OF A MEASURED CYLINDER ............................................................................. 587
Dariusz Janecki, Jaroslav Zwierzchowski

Author Index