

Proceedings of the 13th international conference of the european
society for precision engineering and nanotechnology

May 27th – 31st 2013
Berlin, Germany

Volume I

Editors:

R. Leach
P. Shore

Proceedings Compilation:

T. Horwood
D. Nyman
D. Phillips
N. Williams



- K3** **Keynote 3:** "Industrial Measurement – A Reflection on Progress from 1960 to 2060"
Mr Nick Orchard, Rolls Royce, UK **21V1**

Oral Session 0: Advanced Optics Technology

- 00.1** **State-Of-The-Art X-Ray Optical Systems and their Fabrication** **27V1**
A. Erko
Institute for Nanometre Optics and Technology, Helmholtz Zentrum Berlin, Germany
- 00.2** **Optical Glass Grinding with Laser Structured Coarse-Grained Diamond Wheels** **31V1**
B. Guo, Q. L. Zhao, W. Zhang,
CPE-Center for Precision Engineering, School of Mechatronics Engineering, Harbin Institute of Technology, China
- 00.3** **Manufacturing of Freeform Mirror by Milling and Altering its Optical Characteristics by ALD SiO₂ Coating** **35V1**
J. Mutanen¹, J. Väyrynen², S. Kivi³, M. Toivainen³,
J. Laukkanen¹, P. Pääkkönen¹, T. Itkonen¹, A. Partanen¹,
M. Juuti³, M. Kuittinen¹, K. Mönkkönen²
¹University of Eastern Finland, Joensuu, Finland
²Karelia University of Applied Sciences, Joensuu, Finland
³VTT Technical Research Centre of Finland, Kuopio, Finland
- 00.4** **Photonic Flip-Flop Based Solutions to Overcome Memory-Wall Challenges** **39V1**
P. Tcheg¹, B. Wang¹, M. Palandöken¹, T. Tekin^{1,2}
¹Forschungsschwerpunkt Technologien der Mikroperipherik, TU-Berlin
²Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration (IZM)

Oral Session 1: Precision Engineering Advancements Enabling Progress in Energy Technologies

- O1.1** **Precision Engineering for Concentrating Solar Power (CSP) Applications** **53V1**
C Sansom¹, P Comley¹, P King¹, N Macerol¹
¹Cranfield University, UK
- O1.2** **Photocatalytic Activity Influenced by Thickness of TiO₂ Measured in Nano and Macro Scale** **57V1**
S. Daviösdóttir¹ K. Dirscherl² R. Shabadi S. Canulescu¹
R. Ambata¹
¹DTU and Denmark
²DFM and Denmark

- 01.3** **An Unconventional Experimental Setup for Testing Cutting Performance/ wear Resistance of Diamond Cutting Wires** **61V1**
V. Herold¹ S. König¹ M. Berg²
¹University Jena, Institute for Materials Science and Technology, Germany
²j-fiber GmbH, Germany

Oral Session 2: Nano and Micro Metrology

- 02.1** **In-line Metrology of Functional Surfaces with a Focus on Defect Assessment on Large Area Roll to Roll Substrates** **71V1**
L. Blunt¹, L Fleming¹, M. Elrawemi¹, D. Robbins²,
H. Muhamedsalih¹
¹University of Huddersfield, UK,
²Centre for Process Innovation, Sedgfield, UK
- 02.2** **High-resolution Investigation and Application of Diamond Coated Probing Spheres for CMM- and Form Metrology** **75V1**
M. Neugebauer, S. Bütefisch, T. Dziomba, S. Koslowski, H. Reimann
Physikalisch-Technische Bundesanstalt (PTB), Germany
- 02.3** **Validation of On-machine Microfeatures Volume Measurement Using Micro EDM Milling Tool Electrode as Touch Probe** **79V1**
G. Tristo¹, M. Balcon¹, S. Carmignato², G. Bissacco³
¹Department of Industrial Engineering, University of Padua, Italy
²Department of Management and Engineering, University of Padua, Italy
³Department of Mechanical Engineering, Technical University of Denmark, Denmark
- 02.4** **Virtual CMM Method Applied to Aspherical Lens Parameters Calibration** **83V1**
A. Küng, A. Nicolet, F. Meli
Federal Institute of Metrology METAS

Oral Session 3: Ultra Precision Machines and Control

- 03.1** **Concept for a Miniaturized Machine-Tool-Module for the Manufacturing of Micro-Components Operated at its Resonance Frequency** **167V1**
C. Oberländer¹, J.P. Wulfsberg¹
¹Helmut-Schmidt-University, University of the Federal Armed Forces Hamburg, Germany
- 03.2** **Concrete Based Parts for High Precision Applications** **171V1**
C. Hahm¹, R. Theska¹, K. John¹, A. Flohr², A. Dimmig-Osburg²
¹Technische Universität Ilmenau, Germany
²Bauhaus-Universität Weimar, Germany

- O3.3** **Fast Nanometer Positioning System by Combining Fast Resonant Mode and Accurate Piezostack Direct Drive** **175V1**
 A. Santoso, J. Peirs, F. Al-Bender, D. Reynaerts
KU Leuven, Department of Mechanical Engineering, Belgium
- O3.4** **Towards the Realization of the New INRIM Angle Comparator** **179V1**
 M. Pisani and M. Astrua
Istituto Nazionale di Ricerca Metrologica, INRIM, Italy
- O3.5** **Geometrical-based approach for flexure mechanism design** **184V1**
 T.J. Teo¹, G. Z. Lum^{1,2,3}, G.L. Yang¹, S. H. Yeo², M. Sitti³
¹*Singapore Institute of Manufacturing Technology, Singapore*
²*Nanyang Technological University, Singapore*
³*Carnegie Mellon University, United States.*

Oral Session 4: High Precision Mechatronics

- O4.1** **FEM Model Based POD Reduction to Obtain Optimal Sensor Locations for Thermo-elastic Error Compensation** **275V1**
 J. van der Sanden, P. Philips
Philips Innovation Services, The Netherlands
- O4.2** **2-DoF Magnetic Actuator for a 6-DoF Stage with Long-stroke Gravity Compensation** **279V1**
 R. Deng, J. W. Spronck, A. Tejada, R. H. Munnig Schmidt
PME: Mechatronic System Design, Delft University of Technology, The Netherlands
- O4.3** **Highly Accurate Passive Actuation System** **283V1**
 S. A. J. Hol¹, J. Huang¹, W. Zhou¹, M. Koot¹, H. Vermeulen¹, J. van Eijk², R. Munnig-Schmidt³
¹*ASML BV, The Netherlands*
²*MICE BV, The Netherlands*
³*Delft University of Technology, Mechatronic Systems Design, The Netherlands*
- O4.4** **Design and Fabrication of a Novel Centimeter Scale Three Dimensional Silicon Tip, Tilt and Piston Mirror Mechanism** **288V1**
 J. Kruis^{1,2}, F. Barrot¹, L. Giriens¹, D. Bayat¹, R. Fournier¹, S. Henein², S. Jeanneret¹
¹*Centre Suisse d'Electronique et de Microtechnique (CSEM), Switzerland*
²*École Polytechnique Fédérale de Lausanne (EPFL), Switzerland*
- O4.5** **Superstructures control with active tie rods** **292V1**
 C. Collette, D. Tshilumba, L. Fueyo-Rosa
University of Brussels, Belgium

Posters Sessions 0 - 4

Session 0: Advanced Optics Technology

P0.01 High Precision Injection Moulding of Freeform Optics with 3D Error Compensation Strategy 43V1
 L. Dick^{1,2}, S. Risse³, A. Tünnemann^{2,3}
¹JENOPTIK Polymer Systems GmbH, Germany
²Friedrich Schiller University Jena, Abbe Center of Photonics, Institute of Applied Physics, Germany
³Fraunhofer Institute for Applied Optics and Precision Engineering IOF, Germany

P0.02 Integration Platform of Dual Wavelength Signal Source for 120GHz Wireless Communication Systems 47V1
 M. Palandöken¹, T. Tekin^{1,2}
¹Forschungsschwerpunkt Technologien der Mikroperipherik, TU-Berlin
²Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration (IZM), Germany

Session 1: Precision Engineering Advancements Enabling Progress in Energy Technologies

P1.01 Fabrication of Freeformed Blazed Gratings by Ultraprecision Machining 65V1
 K. Haskic^{1*}, S. Kühne^{1*}, S. Lemke², M. Schmidt¹
¹Technische Universität Berlin, Institut Für Werkzeugmaschinen und Fabrikbetrieb (IWF), Fachgebiet Mikro- und Feingeräte (MFG), Germany
²Helmholtz-Zentrum Berlin für Materialien und Energie (HZB), Institut Nanometeroptik und Technologie (G-INT), Germany
 *Equally contributing

Session 2: Nano and Micro Metrology

P2.01 3D Shape Measurement Under Multiple Refraction Condition Using Optical Projection Method 87V1
 Y. Uchida, R. Kamei, Y. Higashio
 Department of Mechanical Engineering, Aichi Institute of Technology, Japan

P2.02 Elastic Behaviour of Millimetre-scale Polymeric Triskelion-like Flexures 91V1
 D.G. Chetywnd, Z. Davletzhanova, Y. Kogoshi, H. ur Rashid
 School of Engineering, University of Warwick, UK

P2.03 Scanning Results and Repeatability Testing of the TriNano Ultra Precision CMM 95V1
 A.J.M. Moers¹, M.C.J.M. van Riel^{1,2}, E.J.C. Bos¹
¹Xpress Precision Engineering, The Netherlands
²Eindhoven University of Technology, The Netherlands

P2.04 Distance Ranging Using Original Fiber-optic Interferometer 99V1
 J K. Thurner, P.-F. Braun, K. Karrai
 attocube systems AG, Königinstrasse München, Germany

- P2.05** **Design of a Nanometer-accurate Air Bearing Rotary Stage for the Next Generation Nano-CT Scanners** **103V1**
 S. Cappa, D. Reynaerts, F. Al-Bender
KU Leuven, Department of Mechanical Engineering, Belgium
- P2.06** **Practical Method for Determining the Metrological Structure Resolution of Dimensional CT** **107V1**
 S. Carnignato¹, P. Rampazzo¹, M. Balcon², M. Parisatto³
¹*University of Padova, Department of Management and Engineering, Italy*
²*University of Padova, Department of Industrial Engineering, Italy*
³*University of Padova, Department of Geosciences, Italy*
- P2.07** **Traceable Profilometer with a Piezoresistive Cantilever for High-aspect-ratio Microstructure Metrology** **111V1**
 M. Xu, U. Brand, J. Kirchhoff
Physikalisch-Technische Bundesanstalt (PTB), Germany
- P2.08** **Verification of Thickness and Surface Roughness of a Thin Film Transparent Coating** **115V1**
 K. Mohaghegh¹, H.N. Hansen¹, H. Pranov², G. Kofod²
¹*University of Denmark, Denmark*
²*InMold Biosystems, Denmark*
- P2.09** **Measurement and Evaluation Processes for Inner Micro Structures** **120V1**
 T. Krah¹, A. Wedmann¹, K. Kniel¹, F. Härtig¹
¹*Physikalisch-Technische Bundesanstalt, Braunschweig und Berlin, Germany*
- P2.10** **Quantitative Assessment of Nano Wear of DLC Coated Samples using AFM and Optical Confocal Microscopy** **124V1**
 G. Dai¹, F. Pohlenz¹, H. Bosse¹, A. Kovalev², D. Spaltmann², M. Woydt²
¹*Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Germany*
²*Federal Institute for Materials Research and Testing (BAM), Berlin, Germany*
- P2.11** **Measurement Setup for the Experimental Lifetime Evaluation of Micro Gears** **128V1**
 G. Lanza¹, B. Haefner¹
¹*wbk Institute of Production Science, Karlsruhe Institute of Technology (KIT), Germany*
- P2.12** **3D-Reconstruction of Microstructures on Cylinder Liners** **132V1**
 F. Engelke, M. Kästner, E. Reithmeier
Institute of Measurement and Automatic Control – Leibniz Universität Hannover

- P2.13** **A Self-calibration Method for the Error Mapping of a 2D Precision Sensor** **136V1**
M. Valenzuela¹, M. Torralba², J.A. Albajez¹, J.A. Yagüe¹, J.J. Aguilar¹
¹ISA, University of Zaragoza, Spain
²Centro Universitario de la Defensa, Zaragoza, Spain
- P2.14** **Reaming in Microscale of Titanium and Titanium Alloys** **140V1**
D. Biermann, J. Schlenker
Department of Machining Technology, Technische Universität Dortmund, Germany
- P2.15** **Investigation of Stylus Tip-size Effects in Surface Contact Profilometry** **144V1**
K. T. Althagafy^{1,2}, D G Chetwynd¹
¹School of Engineering, University of Warwick, Coventry, UK
²Umm AlQura University, Saudi Arabia
- P2.16** **ISO Compliant Reference Artefacts for the Verification of Focus Variation-based Optical Micro-co-ordinate Measuring Machines** **148V1**
F. Hiersemenzel¹, J. D. Claverley²; J. Singh¹, J. N. Petzing¹, F. Helmlí³, R. K. Leach²
¹Loughborough University, Loughborough, UK;
²National Physical Laboratory, Teddington, UK;
³Alicona Imaging GmbH, Graz, Austria
- P2.17** **Acoustic Emission-based Micro Milling Tool Contact Detection as an Integrated Machine Tool Function** **152V1**
E. Uhlmann, N. Raue, C. Gabriel
Department of Machine Tools and Factory Management, Chair for Manufacturing Technology, Technische Universität Berlin, Germany
- P2.19** **Dimensional verification of high aspect ratio micro structures using FIB-SEM** **156V1**
Y. Zhang¹, H.N. Hansen¹
¹ Department of Mechanical Engineering, Technical University of Denmark, Denmark (DTU)
- P2.20** **Setting-up Kriging-based Adaptive Sampling in Metrology** **160V1**
D. Romano¹, R. Ascione²
¹University of Cagliari, Italy
²ENEA, Italy

Session 3: Ultra Precision Machines and Control

- P3.01** **A New Approach on Reducing Thermal Impacts on High Precision Machine Tools** **188V1**
M. Fritz¹, Dr. D. Janitzka¹
¹KERN Microtechnik GmbH, Germany

- P3.02 Long Range Precision Stage Using Multi Bar Mirrors** 192V1
 S. Woo, D. Ahn, J. Park, D. Gweon
*Korea Advanced Institute of Science and Technology (KAIST),
 Republic of Korea*
- P3.03 Feasibility Study on a Spindle Supported by High Stiffness Water Hydrostatic Bearings for Ultra-precision Machine Tool** 196V1
 Y. Nakao¹, K. Yamada¹, K. Wakabayashi¹, K. Suzuki¹
¹ *Kanagawa University, Japan*
- P3.04 Investigations of a Small Machine Tool with CFRP-frame** 200V1
¹H.-W. Hoffmeister, ¹A. Gerdes, ²A.Verl, ²K.-H. Wurst, ²T. Heinze, ²C. Batke
¹*TU Braunschweig, Institute of Machine Tools and Production Technology, Braunschweig, Germany*
²*Universität Stuttgart, Institute for Control Engineering of Machine Tools and Manufacturing Units, Stuttgart, Germany*
- P3.05 The Dynamic Design of an Ultra-precision Machine Tool Used for Larger KDP Crystal Machining** 204V1
 Y. Liang, W. Chen*, Y. Sun, Q. Zhang, F. Zhang
Center for Precision Engineering, Harbin Institute of Technology, Harbin, China
- P3.06 Investigation of Micro-optic Polishing Characteristics by Vibration-assisted Polishing** 208V1
 J. Guo¹, Y. Yamagata¹, H. Suzuki^{1,2}, S. Morita¹, T. Higuchi³
¹*The Institute of Physical and Chemical Research (RIKEN), Wako, Saitama, Japan*
²*Department of Mechanical Engineering, Chubu University, Kasugai, Aichi, Japan*
³*Department of Precision Engineering, The University of Tokyo, Tokyo, Japan*
- P3.07 Parameter Determination for an Electromechanical Model of a Displacement-Amplified Piezoelectric Actuator** 212V1
 J.H. Liu¹, W. O'Connor¹, E. Aheame¹ and G. Byrne¹
¹ *School of Mechanical and Materials Engineering, University College Dublin, Ireland*
- P3.08 Ultraprecise Positioning Mechanism with 3-DOF Over a One-millimeter Stroke Using Monolithic Flexure Guide and Electromagnetic Actuator** 216V1
 S. Fukada¹, T. Matsuda, Y. Aoyama, T. Kirihara
¹*Shinshu University, Japan*
- P3.09 Design and construction of a novel assisted tool-holder** 220V1
 L. Javarez Jr¹, J.G. Duduch¹, R.G. Jasinevicius¹, A.M. Gonçalves¹
¹*University of São Paulo, Brazil*

P3.11	<p>Development of a Vertical-spindle Rotary Surface Grinding Machine for Large Scale Silicon-wafers – Machine Specifications and Performance of Rotary Work Table</p> <p>A.Yui¹, A.Honda¹, S.Okuyama¹, T.Kitajima¹, G.Okahata¹, H.Saito², A.H.Slocum³</p> <p>¹<i>National Defense Academy, Japan</i> ²<i>Okamoto Machine Tool, Japan</i> ³<i>Massachusetts Institute of Technology, USA</i></p>	224V1
P3.12	<p>Band-limited Cutting Force Control in Ultra-precision Turning</p> <p>K. Enomoto¹, Y. Kakinuma¹</p> <p>¹<i>Department of System Design Engineering, Keio University, Japan</i></p>	228V1
P3.13	<p>Ultra Precision Process Monitoring</p> <p>C. Brecher¹, D. Lindemann¹, A. Merz¹, C. Wenzel¹</p> <p>¹<i>Fraunhofer Institute for Production Technology IPT Germany</i></p>	232V1
P3.14	<p>Analysis of Mutual Influences of Control, Feedback and Servo Drive Systems for Ultra Precision Machining</p> <p>C. Brecher¹, D. Lindemann¹, C. Wenzel¹</p> <p>¹<i>Fraunhofer Institute for Production Technology IPT, Germany</i></p>	236V1
P3.15	<p>Determining the Random Measurement Errors of a Novel Moving-scale Measurement System with Nanometre Uncertainty</p> <p>J. N.Bosmans¹, J. Qian¹, D. Reynaerts¹</p> <p>¹<i>KU Leuven, Department of Mechanical Engineering, Belgium</i></p>	240V1
P3.16	<p>An Approach to the Optimal Observer Design with Selectable Bandwidth</p> <p>I. Furlan, M. Bianchi, M. Caminiti, G. Montù</p> <p><i>University of Applied Sciences of Southern Switzerland, Manno, Switzerland</i></p>	244V1
P3.17	<p>Bandwidth Increase for Plate-like Structures by Adding Mechanical Dampers</p> <p>C.A.M. Verbaan¹, P.C.J.N. Rosielle¹, M. Steinbuch¹</p> <p>¹<i>Control Systems Technology group, Department of Mechanical Engineering, Eindhoven University of Technology, The Netherlands</i></p>	248V1
P3.18	<p>A Parallelism Alignment Mechanism for Nanoimprint Lithograph with Large Imprinting Force</p> <p>W.J. Chen, W. Lin, G.L. Yang</p> <p><i>Singapore Institute of Manufacturing Technology (SIMTech), Singapore</i></p>	252V1
P3.19	<p>Design and Performance of a 6 DOF Hybrid Hexapod</p> <p>N.L. Brown¹, C.W. Hennessey¹</p> <p>¹<i>ALIO Industries, USA</i></p>	256V1

P3.21 **Concept Design of a 5-axis Portable Milling Machine for the In- 260V1**
situ Processing of Large Pieces
 J. Eguia¹, O. Gonzalo¹, M. San Martín¹, S. Ilhenfeldt²
¹*IK4 - TEKNIKER, Spain*
²*Fraunhofer IWU – Germany*

P3.23 **Using Boron Doped Diamond Foils for Fabrication of Micro 264V1**
Cavities with EDM
 K. E. Uhlmann¹, M. Langmack¹, J. Fecher², S. M. Rosiwal²,
 R. F. Singer²
¹*Institute for Machine Tools and Factory Management,*
Technische Universität Berlin, Germany
²*Institute of Science and Technology of Metals (WTM), University of*
Erlangen-Nuremberg, Erlangen, Germany

P3.24 **Design and Optimization of Flexure-Based Micro-manipulator 268V1**
for Optics Alignment
 C. Brecher, N. Pyschny, T. Bastuck
Fraunhofer Institute for Production Technology IPT, Germany

Session 4: Ultra Precision Machines & Control

P4.01 **Modelling Lateral Web Dynamics for R2R Equipment Design 296V1**
 B. J. de Kruif, H. E. Schouten
TNO, The Netherlands

P4.02 **Design of an Active Magnetic Stabilizer of the Dynamic 300V1**
Behaviour of High Speed Rotors
 E. Brusa
Dept. Mechanical and Aerospace Engineering, Politecnico di
Torino, Italy

P4.03 **Physical and Phenomenological Simulation Models for the 304V1**
Thermal Compensation of Rotary Axes of Machine Tools
 M. Gebhardt, S. Capparelli, M. Ess, W. Knapp, K. Wegener
Institute of Machine Tools and Manufacturing (IWF), ETH Zurich,
Switzerland

P4.04 **Compact Translatory Actuator with Moving Magnets and 310V1**
Flexure Guide for Versatile Applications
 T. Bödrich, F. Ehle, J. Lienig
Technische Universität Dresden, Institute of Electromechanical
and Electronic Design, Germany

P4.05 **Displacement of a 6-DOF Inchworm-based Parallel Kinematic 314V1**
Stage
 A. Torii, R. Kamiya, K. Doki, A. Ueda
Dept. of Electrical and Electronics Eng., Aichi Institute of
Technology, Japan

- P4.07** **Increased Productivity due to Jerk-decoupled Feed Axes of the 5-Axes Milling Machine “Neximo”** **318V1**
 B. Denkena, K. Litwinski, O. Gümmer
Institute of Production Engineering and Machine Tools (IFW), Leibniz Universitaet Hannover, Germany
- P4.08** **Design and Optimization of a 3-DOF Planar MEMS Stage with Integrated Thermal Position Sensors** **322V1**
 B. Krijnen^{1,2}, K. R. Swinkels^{1,2}, D. M. Brouwer^{1,2}, J. L. Herder²
¹*DEMCON Advanced Mechatronics, The Netherlands*
²*Mechanical Automation & Mechatronics, University of Twente, The Netherlands*
- P4.10** **Sensorless Monitoring of Machining Torque on Tilting Platform Driven by Hybrid Actuator** **326V1**
 H. Yoshioka¹, M. Hayashi², H. Sawano¹, H. Shinno¹
¹*Tokyo Institute of Technology, Japan*
²*The University of Tokyo, Japan*
- P4.11** **Self-tuning Dynamic Vibration Absorber for Machine Tool Chatter Suppression** **330V1**
 G. Aguirre¹, M. Gorostiaga¹, T. Porchez², J. Muñoz¹
¹*JK4-IDEKO, Spain*
²*CEDRAT TECHNOLOGIES, France*
- P4.12** **Design and Control of a Through Wall 450 mm Vacuum Compatible Wafer Stage** **334V1**
 D. Laro¹, E. Boots², J. van Eijk^{2,3}, L. Sanders¹
¹*MI-Partners, The Netherlands*
²*TU Delft, The Netherlands*
³*MICE BV, The Netherlands*
- P4.13** **Driving a Femtosecond Machined Tactile Scanning Probe Stage in the 100 µm Range** **338V1**
 D. F. Vles, F. G. A. Hornburg
Eindhoven University of Technology, The Netherlands