

Proceedings of the 11th international conference of the **eu**ropean
society for **p**recision **e**ngineering and **n**anotechnology

May 23rd – 26th 2011
Como, Italy

Volume I

Editors:

H. Spaan
P. Shore
H. Van Brussel
T. Burke

Proceedings Compilation:

D. Nyman



Proceedings of the **euspen** 11th International Conference
Volume I - Volume II

Reviewed by:

Prof. D. Allen	Dr. Y. Kwan
Mr. D. Arneson	Prof. R. Leach
Mr. S. Azcarate	Prof. D. Lucca
Dr. A. Balsamo	Dr. S. Ludwick
Dr. K. Beckstette	Prof. A. G. Mamalis
Prof. L. Blunt	Mr N. Marsilius
Prof. M. Bonis	Prof. L. Mattsson
Dr. H. Bosse	Prof. G. McFarland
Prof. C. Brecher	Prof. P. McKeown
Prof. W. Brenner	Mr. P. Morantz
Prof. E. Brinksmeier	Prof. T. Moriwaki
Dr. T. Burke	Prof. R. Munnig Schmidt
Prof. S. Buttgenbach	Dr. W. Preuss
Mr. K. Carlisle	Dr. A. Rankers
Prof. K. Cheng	Prof. D. Reynaerts
Prof. D. Chetwynd	Dr. O. Riemer
Dr. P. Comley	Prof. E. Savio
Prof. J. Corbett	Prof. R. Schmitt
Prof. G. Davies	Dr. Ing. H. Schwenke
Prof. L. De Chiffre	Prof. P. Shore
Prof. S. Dimov	Prof. A. Slocum
Dr. W. T. Estler	Dr. H. Spaan
Dr. C. During	Dr. S. Spiewak
Dr. C. Evans	Dr. D. Stephenson
Dr. O. Falkenstoerfer	Dr. P. Subrahmanyam
Dr. G. Florussen	Prof. K. Takamasu
Prof. A. Forbes	Prof. Y. Takeuchi
Dr. J. Franse	Dr. G. Tosello
Dr. H. Haitjema	Dr. E. Trapet
Prof. H. Hansen	Mr M. Tricard
Dr. S. Henein	Prof. H. Van Brussel
Prof. R. Hocken	Prof. J. van Eijk
Dr. W. Holzapfel	Dr. M. Verdi
Dr. A. Islam	Dr. D. Walker
Prof. S. Kim	Dr. C. Wenzel
Dr W. Knapp	Mr. M. Zatarain
Dr. L. Kudla	Prof. S. Zelenika

Published by **euspen**
ISBN 13: 978-0-9553082-9-1

Printed in Netherlands May 2011
Sieca Repro
Turbineweg 20
2627 BP, Delft

© euspen Headquarters
Building 30, Cranfield University,
Bedford, MK43 0AL
Tel: 0044 (0) 1234 754154
Fax: 0044 (0) 1234 754080
Website: www.euspen.eu

Foreword

The 11th euspen International Meeting takes place in a context of extremes: while some industry booms, others see challenging times for pursuing their research. Leading knowledge and effective connections is critical to all in such times. One thing is for sure, relying on existing technologies is not enough.

This year we have taken the meeting to the beautiful shores of lake Como. For centuries, Italy has well served its reputation as a centre of cultural and scientific innovation. From its role as the cradle of the Renaissance – when the region produced some of the most enlightened scientific thinking in human history – to its current-day fame for producing some of the highest-performing automobiles in the world, Italy has always had a firm place amongst technology leaders.

The European Society for Precision Engineering and Nanotechnology (**euspen**) has established itself as a globally respected body bringing together leading industrialists and researchers in their field to cooperate, interact and build extended worldwide networks. This meeting offers the best of world-wide industrial innovation, state-of-the-art research and technology developments, delivered by foremost thinkers, shaping the competitive landscape.

Following evaluation and feedback by the International Scientific Committee, over 200 papers have been selected for presentation at the meeting from the very large number submitted. We thank the Committee for their exacting work, defining and implementing today's standards for technical and innovative quality, and welcome those of you successful in this review process.

We thank the conference Session Chairmen for their help and assistance in defining the programme of presentations. We also thank Heidenhain GmbH for their kind provision of student scholarships for the meeting.

Over 40 leading companies working in the field will present themselves within the technical exhibition. The Commercial Session will once again evidence the leading expertise, inventiveness and resilience of these companies, inspiring our future optimism.

On behalf of the Council of **euspen**, it is our great pleasure to invite you to this meeting. As pioneers in the field, we look forward to meeting with you, to the sharing of latest knowledge and capabilities and the formation of valuable new partnerships essential to tomorrow's success.

Cernobbio, Lake Como, Italy,
May 2011

Dr Henny Spaan
euspen President

Dr Theresa Burke
euspen Chief Executive

Contents

Volume I

Keynotes:	Keynotes	1
Session 1:	Ultra Precision Replication Techniques	6
Session 2:	Nano & Micro Metrology	45
Session 3:	Ultra Precision Machines & Control	259

- K2** **Keynote 2:** 'Manufacturing of Precise Grazing Incidence X-ray Optics'
Mr D. Vernani, Media Lario Technologies, IT **2V1**

Oral Session 1: Ultra Precision Replication Techniques

- O1.1** **One-step Production of Superhydrophobic Surfaces Using Laser-based Variothermal Injection Moulding** **7V1**
W. Michaeli, Ch. Hopmann, M. Schoengart
Institute of Plastics Processing at RWTH Aachen University, Germany
- O1.2** **Enabling the Production of Aspheric Glass Lenses with Diffractive Structures** **11V1**
K. Georgiadis^{1,2}, B. Bulla¹, D. Hollstegge¹, O. Dambon¹, F.Klocke^{1,2}
¹ *Fraunhofer Institute for Production Technology, Germany*
² *Fraunhofer Project Center for Coatings in Manufacturing, Germany*
- O1.3** **High Accuracy Three-dimensional Simulation of Micro Injection Moulded Parts** **15V1**
G. Tosello¹, F. S. Costa², H. N. Hansen¹
¹ *Department of Mechanical Engineering, Technical University of Denmark*
² *Autodesk Inc, Moldflow R&D Center, Australia*
- O1.4** **Study on the Influence of the Forming Velocity in Micro Impact Extrusion with Modular Dies** **20V1**
A. Schubert^{1,2}, S. F. Jahn¹, B. Müller¹, M. Hackert-Oschätzchen¹
¹ *Chair Micromanufacturing Technology, Faculty of Mechanical Engineering, Chemnitz University of Technology, Germany*
² *Fraunhofer Institute for Machine Tools and Forming Technology, Germany*

Oral Session 2: Nano & Micro Metrology I

- O2A.1** **Verification of a CT Scanner Using a Miniature Step Gauge** **46V1**
A. Cantatore¹, J. L. Andreasen², S. Carmignato³, P. Müller¹, L. De Chiffre¹
¹ *Department of Mechanical Engineering, Technical University of Denmark, Denmark*
² *Device R&D, Novo Nordisk A/S, Denmark*
³ *Department of Management and Engineering (DTG), University of Padova, Italy*

O2A.2	A Multi-Axis MEMS Sensor with Integrated Carbon Nanotube-Based Piezoresistors for Precision Force Metrology M. A. Cullinan, R. M. Panas, M. L. Culpepper <i>Massachusetts Institute of Technology, Department of Mechanical Engineering, USA</i>	50V1
O2A.3	Multi-channel Optical Fiber Based Displacement Metrology P-F Braun, K. Karrai <i>attocube systems AG, Germany</i>	54V1
O2A.4	Improvements in Self Calibration Methodologies for High Precision Machines S. Petró ¹ , R. J. Hocken ² ¹ <i>Department of Mechanical Engineering, Politecnico di Milano, Italy</i> ² <i>Center for Precision Metrology, University of North Carolina, USA</i>	58V1
O2A.5	An Interpolation Error Measuring System Using a Tuning Fork Stage S. Makinouchi ¹ , A. Watanabe ¹ , M. Takasaki ¹ , S. Wakui ² ¹ <i>Nikon Corporation, Japan</i> ² <i>Tokyo University of Agriculture and Technology, Japan</i>	62V1
O2B.1	Calibration of the Isara 400 Ultra-precision CMM I. Widdershoven, R. Donker, H. A. M. Spaan <i>IBS Precision Engineering, The Netherlands</i>	66V1
O2B.2	Investigations on Sliding Bearings for Micro Actuators F. Pape, S. Cvetković, L. Rissing <i>Institute for Micro Production Technology, Center for Production Technology, Leibniz Universitaet Hannover, Germany</i>	72V1
O2B.3	Measurement of Micro Moulded Parts by Computed Tomography and Comparison to Optical and Tactile Techniques J. A. Yagüe ¹ , G. Tosello ² , S. Carmignato ³ , S. Ontiveros ¹ , R. Jiménez ¹ , S. Gasparin ² , H. N. Hansen ² , A. Pierobon ³ ¹ <i>University of Zaragoza, Spain</i> ² <i>Technical University of Denmark, Denmark</i> ³ <i>University of Padova, Italy</i>	76V1
O2B.4	Development of an Integrated Apparatus of MicroEDM and Micro3D-CMM with a High-accuracy Probe-rotation Mechanism J. Goda, K. Mitsui <i>Keio University, Japan</i>	80V1
O2B.5	First International Intercomparison of Computed Tomography Systems for Dimensional Metrology S. Carmignato ¹ , A. Pierobon ² , E. Savio ² ¹ <i>University of Padova, DTG, Italy</i> ² <i>University of Padova, DIMEG, Italy</i>	84V1

Oral Session 3: Ultra Precision Machines & Control

- O3.1** **Elements for the Design of Next Generation, High Stiffness and High Accuracy Precision Machines** **260V1**
G. Rothenhöfer¹, A. Slocum¹, Matthew Paone², X. Lu², A. Yui²
¹ *Massachusetts Institute of Technology, USA*
² *University of British Columbia, Canada*
³ *Japan National Defence Academy*
- O3.2** **Ultra-precision, High Speed Micro-machining Spindle** **267V1**
B. Knapp¹, D. Arneson¹, D. Oss¹, M. Liebers¹, R. Vallance², E. Marsh³
¹ *Professional Instruments Company, USA*
² *The George Washington University, USA and nanoPrecision Products Inc., USA*
³ *The Pennsylvania State University, USA*
- O3.3** **Integration of Optical Sensor into UPMC** **271V1**
¹D. Ewert, ¹L. Autschbach, ¹H. Wang, ¹R. Grau, ²H. Thiess, Y. Yuan
¹ *Carl Zeiss Jena GmbH, Germany*
² *Carl Zeiss Laser Optics GmbH, Germany*
- O3.4** **Finishing of Micro Aspheric Molds by Vibration Assisted Polishing Using Magnetostrictive Material** **275V1**
J. Guo¹, H. Suzuki^{2,3}, T. Higuchi¹
¹ *Department of Precision Engineering, University of Tokyo, Japan*
² *Department of Mechanical Engineering, Chubu University, Japan*
³ *Riken (The Institute of Physical and Chemical Research), Japan*

Posters Sessions 1-3

Session 1: Ultra Precision Replication Techniques

- P1.01** **Injection Moulding – Mould Design for High Precision Optical Lenses Without Centering Error** **25V1**
W. Michaeli, C. Hopmann, P. Walach
Institute of Plastics Processing (IKV), Germany
- P1.03** **Fluid Jet and Bonnet Polishing of Optical Moulds for Applications from Visible to X-Ray** **29V1**
A. Beaucamp^{1,2}, R. Freeman¹, A. Matsumoto², Y. Namba²
¹ *Zeeko Ltd, United Kingdom*
² *Chubu University, Japan*

- P1.04** **Validation of Alternative Tooling Process Chains for Nickel Based Glass Moulding** **33V1**
G. Bissacco¹, H. N. Hansen¹, P.T. Tang², C. Holme³
¹ *Department of Mechanical Engineering, Technical University of Denmark, Denmark*
² *IPU, Denmark*
³ *Kaleido Technology, Denmark*
- P1.06** **Establishment of Sub- μ m Structured Polymer Surfaces Texture Using a non-conventional Approach** **37V1**
M. Calaan¹, H.N. Hansen¹, G. Tosello¹, C. Ravn², P.T. Tang²
¹ *Technical University of Denmark, Denmark*
² *IPU, Denmark*
- P1.07** **Numerical Simulation and Replication of Bionic Microstructure for Drag Reduction** **41V1**
H.T. Wang, W.B. Lee, S. To
State Key Laboratory in Ultra-precision Machining Technology, The Hong Kong Polytechnic University, China

Session 2: Nano & Micro Metrology

- P2.01** **Interferometry for the Next Generation of Nanopositioning and Nanomeasuring Machines** **88V1**
H. Baitinger, C. Sternkopf, N. Vorbringer-Dorozhovets, T.Hausotte, B. Percle, E. Manske, G. Jäger
Ilmenau University of Technology, Germany
- P2.02** **Characterization of Multifunctional Surfaces During Fabrication** **92V1**
A. Godi, K. Storgaard Friis, L. De Chiffre
Department of Mechanical Engineering, Technical University of Denmark (DTU), Denmark.
- P2.03** **Comparison of Dimensional Measurements of Microparts Made Using Deep x-ray Lithography (LIGA): First Results** **96V1**
Pascal Meyer¹, James D. Claverley², Konradin Kaiser¹, Jürgen Mohr¹ and Richard K. Leach²
¹ *Institute for Microstructure Technology, Karlsruhe Institute of Technology (KIT), University of the State of Baden Wuerttemberg, National Laboratory of the Helmholtz Association, Germany*
² *Engineering Measurement Division, National Physical Laboratory, UK*
- P2.04** **Development of a High Resolution Positioner for 3D Nanometrology of Microparts** **100V1**
E. Gómez-Acedo, J. Eguia, R. Calvo, X. Rekakoetxea
Tekniker, Spain

P2.05	Probing Behaviour of a Micro CMM R.H. Bergmans, H.J. Nieuwenkamp, M.G.A. van Veghel <i>VSL Dutch Metrology Institute, The Netherlands</i>	104V1
P2.06	A Newly Developed AFM-based Three Dimensional Profile Measuring System H. Sawano, S. Ayada, H. Yoshioka, H. Shinno <i>Tokyo Institute of Technology, Japan</i>	108V1
P2.07	Experimental Investigation on 3D-SEM Reconstructions of a Wire Gauge Using Stereo-pair Technique L. Carli ¹ , G. Genta ² , A. Cantatore ¹ , G. Barbatto ² , L. De Chiffre ¹ , R. Levi ² ¹ <i>Department of Mechanical Engineering, Technical University of Denmark (DTU), Denmark</i> ² <i>Department of Production Systems and Business Economics, Italy</i>	113V1
P2.08	Investigation of the Cutting Behavior of Piezoelectric Ceramics during Grinding with Diamond Pins H.W. Hoffmeister, M. Rüggeberg <i>Institute of Machine Tools and Production Technology, Technische Universität Braunschweig, Germany</i>	117V1
P2.09	Design and Construction of a Laser Scanning Microscope for Surface Metrology L.S. Ginani, R. Theska ¹ <i>Ilmenau University of Technology, Germany</i>	121V1
P2.10	Evaluation of the Capacitive Displacement Measurements in Mechanical Metrology with Cylindrical Artefacts A. Vissière ^{1,3} , H. Nouria ² , G-P. Vaillieu ² , M. Damak ^{1,3} , J.M. David ³ , O. GIBARU ³ ¹ <i>Laboratoire National de Métrologie et d'Essais (LNE), Dimensional Metrology Department, France</i> ² <i>GEOMNIA, Advanced 3D Engineering and Software Solutions, 165 Avenue de Bretagne, France</i> ³ <i>Arts et Métiers ParisTech de Lille, Laboratory of Metrology and Applied Mathematics (L2MA), France</i>	125V1
P2.11	Nanometer Profile Measurement of Large Aspheric Optical Surface by Scanning Deflectometry with Rotatable Devices: Error Analysis and Experiments M. Xiao, S. Jujo, K. Takamasu, S. Takahashi <i>Department of Precision Engineering, The University of Tokyo</i>	129V1

P2.12	<p>Optical Immersed Surface Inspection of Honed Cylinder Bores</p> <p>R. Schmitt^{1,2}, H. Zheng¹, N. König^{1,2}, M. Mally¹</p> <p>¹ <i>Laboratory for Machine Tools and Production Engineering WZL at RWTH Aachen University, Germany</i></p> <p>² <i>Fraunhofer Institute for Production Technology IPT, Germany</i></p>	133V1
P2.13	<p>Real-time Measurement of Two-linear and Three-angular Motion Errors Using a Single Optical Linear Encoder in a High Precision Stage</p> <p>C-B. Lee, G-H. Kim, S-K. Lee</p> <p><i>Gwangju Institute of Sci. & Tech. Republic of Korea</i></p>	137V1
P2.14	<p>Recent Advances in 3-D Tactile Micro- and Nanometrology</p> <p>F.G. Balzer, N. Hofmann, B. Percle, T. Hausotte, E. Manske, G. Jäger</p> <p><i>Ilmenau University of Technology, Germany</i></p>	141V1
P2.15	<p>Investigations of 3D Surface Roughness Characteristic's Accuracy</p> <p>M. Kumermanis, J. Rudzitis, A. Avisane</p> <p><i>Riga Technical University, Latvia</i></p>	145V1
P2.16	<p>A Motion Errors and Profile Measurement System Using Three Laser Interferometers and an Autocollimator for a High-precision Micro-coordinate Measuring Machine</p> <p>P. Yang¹, T. Takamura¹, S. Takahashi¹, K. Takamasu¹, O. Sato², S. Osawa², T. Takatsuji²</p> <p>¹ <i>Department of Precision Engineering, The University of Tokyo, Japan</i></p> <p>² <i>National Metrology Institute of Japan, Advanced Industrial Science and Technology, Japan</i></p>	150V1
P2.19	<p>Flatness Measurements with the Deflectometric Flatness Reference at PTB</p> <p>G. Ehret, M. Schulz, A. Wiegmann, M. Stavridis, C. Elster</p> <p><i>Physikalisch-Technische Bundesanstalt, Germany</i></p>	154V1
P2.22	<p>Research on Nanoparticle Metrology with Differential Mobility Analyzer and Electro-gravitational Aerosol Balance</p> <p>C-J .Chen, H-C. Ho, T-C. Yu, H-F. Weng, S-H. Lai, T-Y. Lin</p> <p><i>Center for Measurement Standards/Industrial Technology Research Institute, Taiwan</i></p>	158V1
P2.24	<p>Characterization of a Capacitive Sensor used in an Indexed Rotary Metrology Platform</p> <p>A. Brau, J. Santolaria, R. M. Gella, J. A. Albajez, J. J. Aguilar</p> <p><i>Dpto. de Ingeniería de Diseño y Fabricación. University of Zaragoza, Spain</i></p>	162V1

- | | | |
|--------------|---|--------------|
| P2.28 | <p>Simultaneous Measurement of Warp and Thickness of Large-Diameter Silicon Wafer Using Three-Point-Support Inverting Method</p> <p>Yukihiro Ito¹, Wataru Natsu¹, Masanori Kunieda²
 ¹ <i>Tokyo University of Agriculture and Technology, Japan</i>
 ² <i>The University of Tokyo, Japan</i></p> | 166V1 |
| P2.29 | <p>Development and Integration of a Method to Support Dynamical Analyses of Micro Gears in Functional Testings</p> <p>A. Albers, C. Becke, D. Pan
 <i>IPEK - Institute of Product Engineering, Karlsruhe Institute of Technology (KIT), Germany</i></p> | 171V1 |
| P2.31 | <p>A Method for Tensile Testing of Delicate Polymeric Specimens</p> <p>D. Xu, D. G. Chetwynd, J. A. Covington
 <i>School of Engineering, University of Warwick, UK</i></p> | 175V1 |
| P2.32 | <p>Analysis and Compensation of Friction Force in High-precision Linear Drive System</p> <p>T. Fujita¹, A. Matsubara²
 ¹ <i>Kyoto University, Japan; JSPS research fellow</i>
 ² <i>Kyoto University, Japan</i></p> | 179V1 |
| P2.34 | <p>Manufacturing and Quality Assurance of Micro Structured Crankshaft Bearings</p> <p>G. Lanza, V. Schulze, S. Stockey, M. Chlipala
 <i>wbk Institute of Production Science, Karlsruhe Institute of Technology (KIT), Germany</i></p> | 183V1 |
| P2.36 | <p>Quantitative Cantilever Near-field Scanning Optical Microscopy</p> <p>F. Marinello¹, P. Schiavuta², M. Balcon¹, S. Carmignato³, E. Savio¹
 ¹ <i>DIMEG, Dip. di Innovazione Meccanica e Gestionale, University of Padua, Italy</i>
 ² <i>CIVEN, Coordinamento Interuniversitario Veneto per le Nanotecnologie, Italy</i>
 ³ <i>DTG, Dip. di Tecnica e Gestione dei Sistemi Industriali, University of Padua, Italy</i></p> | 187V1 |
| P2.37 | <p>Concept and Modelling of a Novel Active Triskelion Low Force Transfer Artefact</p> <p>C. Jones^{1,2}, D. Chetwynd², J. Singh³, R. Leach¹
 ¹ <i>Engineering Measurement Division, National Physical Laboratory, UK</i>
 ² <i>School of Engineering, University of Warwick, UK</i>
 ³ <i>Department of Mathematics, King's College London, UK</i></p> | 191V1 |

P2.38	<p>Fabrication and Validation of a Staircase Artefact for 3D-SEM Calibration</p> <p>L. Carli¹, L. De Chiffre¹, F. Marinello², R. S. Eriksen³, P. Bariani⁴, H.N. Hansen¹, A.Horsewell¹</p> <p>¹ <i>Department of Mechanical Engineering, Technical University of Denmark (DTU), Denmark</i></p> <p>² <i>DIMEG, Dipartimento di Innovazione Meccanica e Gestionale, University of Padova, Italy</i></p> <p>³ <i>IPU, Technical University of Denmark (DTU), Denmark</i></p> <p>⁴ <i>Schaefer South-East Europe s.r.l., Italy</i></p>	195V1
P2.39	<p>Development of a Measuring Device to Ascertain the Motion Accuracy of NC Machines</p> <p>K. Kato, K. Matsuno, H. Miyake, K. Mitsui</p> <p><i>Keio University, Japan</i></p>	199V1
P2.40	<p>Realization of a Large Sample 3D Metrology AFM with Differential Jamin Interferometers</p> <p>F. Meli, A. Küng</p> <p><i>Swiss Federal Office of Metrology, METAS, Switzerland</i></p>	203V1
P2.41	<p>Characterisation of Nanoimprinted Line Profile Using Subwavelength Optical Diffraction</p> <p>T. Kehoe¹, V. Reboud¹, N. Kehagias¹, C. M. Sotomayor Torres^{1,2}</p> <p>¹ <i>Institut Catala de Nanotecnologia, Campus de la UAB, Spain</i></p> <p>² <i>Catalan Institute for Research and Advanced Studies ICREA, Spain</i></p>	207V1
P2.42	<p>The Effect of Surface Roughness on Components Size Measurement Errors</p> <p>J. Rudzitis, A. Avishane</p> <p><i>Riga Technical University, Latvia</i></p>	211V1
P2.43	<p>Numerical Simulation of the Contact Area of Smooth Micro-scaled Bodies</p> <p>R. Meeß, F. Löffler</p> <p><i>Physikalisch-Technische Bundesanstalt (PTB), Germany</i></p>	215V1
P2.45	<p>Error Estimation for the Stitched Profile in Straightness Measurement</p> <p>T. Kume, K. Enami, Y. Higashi, K. Ueno</p> <p><i>High Energy Accelerator Research Organization (KEK), Japan</i></p>	219V1
P2.46	<p>Thermally Stable Probe Mount for a Metrological Atomic Force Microscope</p> <p>J. Piot¹, J. Qian¹, H. Pirée², G. Kotte², J. Pétry², J.P. Kruth¹, P. Vanherck¹, C. Van Haesendonck³, D. Reynaerts¹</p> <p>¹ <i>KULeuven, Department of Mechanical Engineering, Belgium</i></p> <p>² <i>FPS Economy, SMEs, Self-employed and Energy, Scientific Metrology–SMD, Belgium</i></p> <p>³ <i>KULeuven, Laboratory of Solid-State Physics and Magnetism, Belgium</i></p>	223V1

P2.47	<p>A study of surface measuring limitation on a laser scanning microscope by the examination of response properties of surface texture and slope detection on a ruby sphere sample</p> <p>H. Suzuki, A. Fujii <i>Olympus Corporation, Japan</i></p>	227V1
P2.48	<p>Ultra-precision Freeform Surface Evaluation Using Genetic Algorithm Optimization</p> <p>J. Zhou, T. Sun, G. Hou <i>Center of Precision Engineering, Harbin Institute of Technology, China</i></p>	231V1
P2.49	<p>Miniaturized Phase Measuring Deflectometry Setup for Machine Integrated Measurement of Specular Surfaces</p> <p>E. Uhlmann¹, G. Häusler², M. Kurz¹, Ch. Faber², E. Olesch², Ch. Röttinger²</p> <p>¹<i>Institut für Werkzeugmaschinen und Fabrikbetrieb (IWF), Technische Universität Berlin, Germany</i> ²<i>Institute of Optics, Information and Photonics, University of Erlangen-Nuremberg, Germany</i></p>	235V1
P2.51	<p>Application of an Optical Geometrical Measurement in Quality Assessment of Micro Gears</p> <p>A. Albers, D. T. Pan, C. Becke <i>IPEK, Institute of Product Engineering, Karlsruhe Institute of Technology (KIT), Germany</i></p>	239V1
P2.53	<p>Geometrical Metrology on Silicone Rubber by Computed Tomography</p> <p>P. Müller¹, R. A. Păcurar², L. De Chiffre¹, A. Cantatore¹, P. Berce²</p> <p>¹<i>Department of Mechanical Engineering, Technical University of Denmark (DTU), Denmark</i> ²<i>Department of Manufacturing Engineering, Technical University of Cluj-Napoca (UTCN), Romania</i></p>	243V1
P2.55	<p>Structured Geometry Surfaces Features for Optimised Function</p> <p>L. Blunt <i>Centre for Precision Technologies University of Huddersfield, UK</i></p>	247V1
P2.56	<p>Parallel Positioning System Integrated Measurement Device</p> <p>G. Olea¹, A. Marschal¹, J. Staud¹, J. Oberfell¹, H. Kramp¹, L. Amelung¹, C. Wachten², T. Heffner², C. Müller²</p> <p>¹<i>miCos GmbH, Germany</i> ²<i>Albert-Ludwigs University/IMTEK, Germany</i></p>	251V1
P2.57	<p>Absolute Surface Topography Measurement of Composite Structures Using Coherence Scanning Interferometry</p> <p>Kanik Palodhi¹, Jeremy Coupland¹, Richard Leach²</p> <p>¹<i>Loughborough University, UK</i> ²<i>National Physical Laboratory, UK</i></p>	255V1

Session 3: Ultra Precision Machines & Control

P3.02	Setting PID Parameters and Notch Filters Using Black's Diagram F. Duquenoy <i>Micro-Contrôle Spectra Physics S.A.S.</i>	279V1
P3.05	Verification of Squareness Measurement Methods on a Machine Image Inspection System H-C. Liou, C-C. Tang, T-Y. Lin <i>Center for Measurement Standards/ Industrial Technology Research Institute, Taiwan</i>	283V1
P3.06	Iterative Learning Control with Least-Square Estimation for the Control of the Electro-Discharge Machining Process I. Furlan, S. Balemi <i>University of Applied Sciences of Southern Switzerland (SUPSI), Switzerland</i>	287V1
P3.08	Thermal Behaviour Improvement of Linear Axis J. Mayr ¹ , M. Ess ² , S. Weikert ² , K. Wegener ² ¹ <i>Institute of machine tools and manufacturing (IWF), Switzerland</i> ² <i>inspire AG, Switzerland</i>	291V1
P3.09	Gauge Block Interferometer Designed for the Calibration of Short and Long Gauge Blocks P. Phuaknoi, J. Buajarem, A. Tonmueanwai ¹ <i>Dimensional metrology department, National institute of metrology (Thailand), Thailand</i>	295V1
P3.11	A Novel Reversal Method to Estimate Horizontal Straightness/Yaw Error of a Linear Axis K.I. Lee, J.C. Lee, S.H. Yang <i>Kyungpook National University, Republic of Korea</i>	299V1
P3.12	Analysis of Control and Servo Drive Systems for the Application in Ultra Precision Machining C. Brecher, D. Lindemann, M. Zavelberg, C. Wenzel <i>Fraunhofer Institute for Production Technology IPT, Germany</i>	303V1
P3.13	Theoretical Study on the Radial Error Motion of High-precision Aerostatic Rotary Tables S. Cappa, T. Waumans, D. Reynaerts, F. Al-Bender <i>KULeuven, Department of Mechanical Engineering, Belgium</i>	307V1
P3.14	Characterisation of the Transfer Function of an Advanced Process Control System for Chemical Mechanical Polishing (CMP) J. Liu, E. Ahearne, G. Byrne <i>Advanced Manufacturing Science (AMS) Research Centre, School of Electronic, Electrical & Mechanical Engineering, University College Dublin, Ireland</i>	311V1

- P3.15** **Miniature 3-DOF Planar Parallel Kinematics with Large Workspace for Precision Positioning of Endeffectors** **315V1**
R. Neugebauer, H. J. Koriath, M. Richter, M. Müller
Institute for Machine Tools and Production Processes, Chemnitz University of Technology, Germany
- P3.16** **Reconfigurable Machine-Tool for Micro Machining** **319V1**
R. Stoeterau¹, W. L. Weingaertner²
¹ *Dept. of Mechatronic Engineering, University of São Paulo, Brazil*
² *Dept. of Mechanical Engineering, Federal University of Santa Catarina, Brazil*
- P3.17** **Ultraprecision Control of A Hydrostatic Bearing Guided Machine with Position Stability Analysis** **323V1**
J.Y. Shim, J.H. Hwang, C.H. Park
Ultraprecision Systems Lab., Korea Institute of Machinery & Materials, Korea
- P3.18** **Performance Evaluation and Improvement of a Dual-frequency Laser Interferometer for Nano Positioning Stage** **327V1**
C. Yonghui, C. Feng, Z. Xiaowen, Z. Zhiping, C. Jianrui, X. Pengfei
Shanghai Micro Electronics Equipment Co., Ltd. (China)
- P3.19** **Flexure Based Feed Unit – A Progress Report** **331V1**
N. Kong, S. Grimske, B. Roehlig, J. P. Wulfsberg
Helmut-Schmidt-University, University of Federal Armed Forces Hamburg, Germany
- P3.20** **Design of Feedback Control System for Water Driven Stage** **335V1**
Y. Nakao, T. Sano, M. Nagashima, K. Suzuki
Kanagawa University, Japan
- P3.22** **Prediction of 5-DOF Motion Errors of Hydrostatic Bearing Tables and Its Experimental Verification** **339V1**
J. S. Oh, G. Khim, C. H. Park
Korea Institute of Machinery & Materials, South Korea
- P3.24** **Positioning Accuracy of a High-precision Planer Multi-joint Mechanism: Measurement and a Method of Link Parameter Calibration for Error Compensation** **343V1**
S. Fukada, A. Nagao, K. Shimizu
Shinshu University, Japan
- P3.25** **High-precision Control System for Piezoelectric Stack Actuators** **347V1**
G. Montù, S. Balemi, G. C. Dozio
University of Applied Sciences of Southern Switzerland (SUPSI), Switzerland

- P3.26** **Micro-nano Position Control System Using Interferometric Phenomena** **351V1**
T. Higuchi, T. Kurihara, F. Ozaki, Y. Uchida
Department of Mechanical Engineering, Aichi Institute of Technology, Japan
- P3.27** **Active Control of High-Speed Precision Air-Bearing Spindle** **355V1**
H. Mizumoto¹, Y. Yabuta¹, S. Arii¹, Y. Tazoe², K. Atoji², T. Hirose²
¹ *Tottori University, Koyama, Japan*
² *Nachi-Fujikoshi, Japan*
- P3.29** **Estimation of 5 DOF Motion Errors in Linear Motion Bearing Stage** **359V1**
G. Khim, C. H. Park¹, J. S. Oh
Korea Institute of Machinery and Materials(KIMM), Korea
- P3.31** **Shear Angle Control Method in Turning applying Cutting Force Observer** **363V1**
M. Takei, Y. Kakinuma
Keio University, Japan
- P3.32** **Structural Design of Long Range Sub-Nanometer Positioning System** **367V1**
H. Yoshioka, S. Kuroyama, H. Sawano, H. Shinno
Precision and Intelligence Laboratory, Tokyo Institute of Technology Tokyo
- P3.33** **A Micro Feeding Tool Holder with Bellows-type Hydraulic Displacement Amplification Mechanism** **371V1**
Y-T. Liu, L-L. Chang
Dept. of Mechanical and Automation Engineering, National Kaohsiung First University of Science and Technology (FirstTech), R.O.C.
- P3.34** **Air Bearings by Moldable Congruent Surfaces** **375V1**
P. Langenbeck
Consultant / Retired, Germany
- P3.37** **3D Surface Mapping of Capsule Fill-Tube Assemblies used in Laser-Driven Fusion Targets** **379V1**
E. S. Buice, E. T. Alger¹, N. A. Antipa, S. D. Bhandarkar, T. A. Biesiada, A. D. Conder, E. G. Dzenitis, M. S. Flegel, A. V. Hamza, C. L. Heinbockel, J. Horner, M. A. Johnson, L. M. Kegelmeyer, J. S. Meyer, R. C. Montesanti, J. L. Reynolds, J. S. Taylor, P. J. Wegner
Lawrence Livermore National Laboratory, USA
¹ *General Atomics, USA*

Proceedings of the 11th international conference of the **eu**ropean
society for **p**recision **e**ngineering and **n**anotechnology

May 23rd – 26th 2011
Como, Italy

Volume II

Editors:

H. Spaan
P. Shore
H. Van Brussel
T. Burke

Proceedings Compilation:

D. Nyman



Proceedings of the **euspen** 11th International Conference
Volume I - Volume II

Reviewed by:

Prof. D. Allen	Dr. Y. Kwan
Mr. D. Arneson	Prof. R. Leach
Mr. S. Azcarate	Prof. D. Lucca
Dr. A. Balsamo	Dr. S. Ludwick
Dr. K. Beckstette	Prof. A. G. Mamalis
Prof. L. Blunt	Mr N. Marsilius
Prof. M. Bonis	Prof. L. Mattsson
Dr. H. Bosse	Prof. G. McFarland
Prof. C. Brecher	Prof. P. McKeown
Prof. W. Brenner	Mr. P. Morantz
Prof. E. Brinksmeier	Prof. T. Moriwaki
Dr. T. Burke	Prof. R. Munnig Schmidt
Prof. S. Buttgenbach	Dr. W. Preuss
Mr. K. Carlisle	Dr. A. Rankers
Prof. K. Cheng	Prof. D. Reynaerts
Prof. D. Chetwynd	Dr. O. Riemer
Dr. P. Comley	Prof. E. Savio
Prof. J. Corbett	Prof. R. Schmitt
Prof. G. Davies	Dr. Ing. H. Schwenke
Prof. L. De Chiffre	Prof. P. Shore
Prof. S. Dimov	Prof. A. Slocum
Dr. W. T. Estler	Dr. H. Spaan
Dr. C. During	Dr. S. Spiewak
Dr. C. Evans	Dr. D. Stephenson
Dr. O. Falkenstoerfer	Dr. P. Subrahmanyam
Dr. G. Florussen	Prof. K. Takamasu
Prof. A. Forbes	Prof. Y. Takeuchi
Dr. J. Franse	Dr. G. Tosello
Dr. H. Haitjema	Dr. E. Trapet
Prof. H. Hansen	Mr M. Tricard
Dr. S. Henein	Prof. H. Van Brussel
Prof. R. Hocken	Prof. J. van Eijk
Dr. W. Holzapfel	Dr. M. Verdi
Dr. A. Islam	Dr. D. Walker
Prof. S. Kim	Dr. C. Wenzel
Dr W. Knapp	Mr. M. Zatarain
Dr. L. Kudla	Prof. S. Zelenika

Published by **euspen**
ISBN 13: 978-0-9553082-9-1

Printed in Netherlands May 2011
Sieca Repro
Turbineweg 20
2627 BP, Delft

© euspen Headquarters
Building 30, Cranfield University,
Bedford, MK43 0AL
Tel: 0044 (0) 1234 754154
Fax: 0044 (0) 1234 754080
Website: www.euspen.eu

Contents

Volume II

Session 4:	High Precision Mechatronics	1
Session 5:	Ultra Precision Manufacturing & Assembly Processes	125
Session 6:	Important/Novel Advances in Precision Engineering & Nano Technologies	413
List of Authors		562

Oral Session 4: High Precision Mechatronics

- O4.1** **Evolving Research on a Non-contact Adaptive Optic Actuation Method for Wavefront Correction** **2V2**
R. Saathof, J. W. Spronck, R. H. Munnig Schmidt
Delft University of Technology, The Netherlands
- O4.2** **Silicon Flexures for the Sugar-Cube Delta Robot** **6V2**
S. Henein, F. Barrot, S. Jeanneret, R. Fournier, L. Giriens, M.Gumy, S. Droz, M. Toimil
Centre Suisse d'Electronique et de Microtechnique SA, Switzerland
- O4.3** **Advanced Precision Engineering in Cryogenic Environment** **10V2**
M.A.J. Teuwen, H.L.M.M. Janssen, R. Albers
Janssen Precision Engineering BV, Maastricht-Airport, The Netherlands
- O4.4** **6-DoF Active Vibration Isolation without Tilt-Horizontal Coupling** **15V2**
D. Laro¹, S. van den Berg¹, J. Eisinger¹, J. van Eijk^{2,3}
¹ *MI-Partners*
² *Delft University Technology*
³ *MICEbv, The Netherland*
- O4.5** **A Hybrid Actuator-driven Compact Tilting Motion Table System for Multi-axis Ultraprecision Machine Tool** **19V2**
M. Hayashi, H. Yoshioka, H. Shinno, H. Sawano
Precision and Intelligence Laboratory, Tokyo Institute of Technology, Japan

Oral Session 5: Ultra Precision Manufacturing & Assembly Processes I

- O5A.1** **Diamond Turning of Novel Materials** **126V2**
R.J. Jasinevicius¹, J.G. Duduch¹, A.J.V. Porto¹, P.S. Pizani²
¹ *Depto Eng. Mecânica, EESC, USP, Brazil*
² *Depto, de Física, UFSCar, Brazil*
- O5A.2** **3D Process Simulation for Precision Glass Molding of Freeform and Wafer Optics** **132V2**
F. Klocke¹, Y. Wang¹, F. Wang¹, G. Liu¹, D. Hollstegge¹, O.Dambon¹, A. Y. Yi²
¹ *Fraunhofer Institute for Production Technology, Germany*
² *The Ohio State University, USA*

O5A.3	Development of Composite Abrasives and Epoxy resin Polishing Pads to Reduce the use of CeO₂ Abrasives in Glass Polishing J. Murata ¹ , Y. Tani ¹ , M. Yamada ² , T. Yanagihara ² , N. Nomura ³ , R. Hirokawa ³ , Y. Zhang ¹ , O. Kirino ⁴ ¹ <i>Ritsumeikan University, Japan</i> ² <i>Admatechs Co., Ltd., Japan</i> ³ <i>Kokonoe Electric Co., Ltd., Japan</i> ⁴ <i>Crystal Optics Inc., Japan</i>	136V2
O5A.4	New Approach in MEMS Integration with UV Laser Micro-cutting M. Kagerer, R. Behlert, F. Irlinger, T. C. Lueth <i>MiMed, Institute for Micro Technology and Medical Device Technology, Technische Universität München, Germany</i>	140V2
O5A.5	Fracture-free Precision Machining of Sintered Tungsten Carbide by End-milling M. Arif, M. Rahman, Y.S. Wong <i>Department of Mechanical Engineering, National University of Singapore, Singapore</i>	144V2
O5B.1	Enhanced Optical Functionalities by Integrated Ultraprecision Machining Techniques S. Stoebenau, R. Kleindienst, R. Kampmann, S. Sinzinger <i>Ilmenau University of Technology, Institute for Micro and Nanotechnologies, Department of Optical Engineering, Germany</i>	148V2
O5B.3	DNA Autonomous Joint for Micro-selfassembly T. Hayashi, M. Michihata, M. Yasuda, Y. Takaya <i>Osaka University, Japan</i>	152V2
O5B.4	Structuring of Tribological Active Surfaces for Reduction of Frictional Losses A. Schubert ^{1,2} , J. Edelmann ¹ , D. Sylla ² , M. Hackert-Oschätzchen ² ¹ <i>Fraunhofer Institute for Machine Tools and Forming Technology IWU, Germany</i> ² <i>Chemnitz University of Technology, Chair in Micromanufacturing Technology, Germany</i>	156V2
O5B.5	Corrective Machining of Freeform Molds for Mass Replication C. Brecher, C. Buß, P. Kolb, C. Wenzel <i>Fraunhofer Institute for Production Technology IPT, Germany</i>	160V2

Oral Session 6: Important / Novel Advances in Precision Engineering & Nano Technologies

- O6.1** **Manufacturing and Characterisation of a Wettability Controlled Microvalve with Darkness/UV Actuation** **414V2**
A.G. Demir¹, B. Previtali¹, M. Bestetti²
¹ *Politecnico di Milano, Dipartimento di Meccanica, Italy*
² *Politecnico di Milano, Dipartimento di Chimica, Materiali e Ingegneria Chimica "G.Natta" Italy*
- O6.2** **Precise Alignment of Precision Forged Crankshafts in a Grinding Machine** **418V2**
B. Denkena¹, O.Gümmer¹, R. Gillhaus², M. Kästner², E. Reithmeier²
¹ *Institute of Production Engineering and Machine Tools (IFW), Leibniz Universität Hannover, An der Universität 2, Germany*
² *Institute of Measurement and Automatic Control (IMR), Leibniz Universität Hannover, Germany*
- O6.3** **High-integrity Finishing of Reaction Sintered SiC by Plasma Assisted Polishing Using Ceria Abrasive** **422V2**
K. Yamamura, M. Ueda, H. Deng, N. Zettsu
Research Center for Ultra-precision Science and Technology, Graduate School of Engineering, Osaka University, Japan
- O6.4** **Microscale Turbine/generator Unit for Energy Harvesting in Fluidic Mechatronic Systems** **427V2**
J. Fleischer, M. Weis, S. Herder, U. Leberle
Karlsruhe Institute of Technology (KIT), wbk Institute for Production Science, Germany
- O6.5** **Sensitivity Analysis of Piezoelectric Scavenging of Vibration Energy** **431V2**
D. Blažević, S. Zelenika
University of Rijeka, Centre for Micro and Nano Sciences and Technologies & Faculty of Engineering, Croatia

Posters Sessions 4-6

Session 4: High Precision Mechatronics

- P4.01** **Performance Limits of Active Vibration Isolation Systems for Precision Equipment** **23V2**
D. Tjepkema¹, J. van Dijk¹, H. M. J. R. Soemers^{1,2}
¹ *Mechanical Automation and Mechatronics, University of Twente, The Netherlands*
² *Philips Applied Technologies, The Netherlands*

P4.02	Air Film Based Contactless Planar Positioning System with Sub-micron Precision J. Wesselingh, J. W. Spronck, R. A. J. van Ostayen, J. van Eijk <i>Delft University of Technology, 3mE – PME – Mechatronic System Design</i>	27V2
P4.04	First Results from PRIGO III, the Parallel Robotics Inspired Goniometer for Protein Crystallography W. Glettig ¹ , M. Vitins ² , A. Schwarb ² , S. Maag ² , C. Schulze-Briese ² ¹ CSEM SA, Centre Suisse d'Electronique et de Microtechnique, Switzerland ² Paul Scherrer Institut, Swiss Light Source, Switzerland	31V2
P4.05	Design of a Novel 3-DOF Spherical Actuator Using VCM H. Y. Kim, D. G. Gweon <i>Mechanical Engineering Departments, KAIST, Korea</i>	35V2
P4.06	Development of Laser Scattering System and Inspection of Micro Defects in Crystalline Silicon Wafer of Solar Cell G.B. Kim ¹ , J.S. Yeon ² ¹ Aeronautical & Mechanical Design Eng., Chungju National University, Korea ² Graduate school, Chungju National University, Korea	39V2
P4.07	Experimental Investigation in the Friction Characteristics of High Precision Planar Ball Guides M. Heyne, H. Mehner, T. Erbe, R. Theska <i>Ilmenau University of Technology, Germany</i>	43V2
P4.08	Prototype Development of an Optical Element Curvature Manipulator with Controlled Piezoelectric Actuator C. L. Valentin ^{1,2} , B. Festen ¹ , J. P. M. Vermeulen ² , B. C. T. van Bree ³ , D. J. Rixen ¹ , R. H. Munnig Schmidt ¹ ¹ Delft University of Technology, Faculty 3mE, Department of PME, The Netherlands ² ASML BV, Research Mechatronics, Veldhoven, The Netherlands ³ Janssen Precision Engineering BV, Maastricht, The Netherlands	47V2
P4.09	Micro Positioning Systems for High Vacuum Applications F. Kiesel, R. Degen <i>Micromotion GmbH, Germany</i>	51V2
P4.10	A 2-DOF Linear-Rotary Electromagnetic Actuator for High Precision Positioning Tasks T. J. Teo, G. L. Yang, <i>Mechatronics Group, Singapore Institute of Manufacturing Technology, Singapore</i>	55V2

P4.11	Development of an Innovative Z-Θ Direct Drive Actuator M. van Lent ¹ , J. Smeltink ¹ , J. Theeuwes ¹ , R. Knaapen ¹ , K. Meessen ² , J. Paulides ² ¹ <i>TNO, The Netherlands</i> ² <i>Eindhoven University of Technology, The Netherlands</i>	59V2
P4.12	Reliability of Multilayer Piezoelectric Actuators in Precise Positioning Applications P. Pertsch ¹ , B. Broich ¹ , H. Marth ² ¹ <i>PI Ceramic GmbH, Germany</i> ² <i>Physik Instrumente (PI) GmbH & Co. KG, Germany</i>	64V2
P4.15	Development of Non-contact 3D Measurement System for Parts of Accelerator Cavities K. Enami, T.Kume, Y.Higashi, K.Ueno <i>High Energy Accelerator Research Organization, Japan</i>	68V2
P4.17	Sub-nanometer Resolution Linear Encoder with Polarization Insensitive Laser Doppler Displacement Meter Technology and Multi-reflection Optics G. Liotto ¹ , C. Wang ² , D. Shu ³ ¹ <i>Optodyne Laser Metrology, Bernareggio, Italy</i> ² <i>Optodyne, Inc, USA</i> ³ <i>Advanced Photon Source, Argonne National Laboratory, USA</i>	72V2
P4.18	Self-tuning of Hybrid Position and Velocity Feedback of 6-DOF Vibration Isolation System F. Liao ^{1,2} , X. Li ¹ , Z. Yuan ² ¹ <i>State Key Laboratory of Digital Manufacturing Equipment and Technology, Huazhong University of Science and Technology, China</i> ² <i>Shanghai Micro Electronics Equipment Co., Ltd, China</i>	76V2
P4.19	Hexapod Systems for UHV Applications with Active Vibration Damping C. Rudolf, C. Mock, R. Gloess <i>Physik Instrumente (PI) GmbH & Co. KG, Karlsruhe, Germany</i>	80V2
P4.20	An Inchworm-type Microactuator Using Levitation Mechanisms A. Torii, S. Kengaku, T. Yamada, A. Ueda <i>Dept. of Electrical and Electronics Eng., Aichi Institute of Technology, Japan</i>	85V2
P4.21	Design and Optimization of a Novel Compact and Long-range 3-DOF Flexure Stage H-C. Kim, D-G. Gweon <i>NanoOptoMechatronics Lab., Dept. of Mech. Eng., South Korea</i>	89V2

P4.22	<p>Development of Micro-Object Position Detection System for the Automation of Robot Hand</p> <p>T. Yoshida, T. Mizoguchi, Y. Kobayashi, K. Shirai <i>College of Engineering, Nihon University, Japan</i></p>	93V2
P4.23	<p>New Concept for Simplified Recalibration of Hexapod Positioning Units in Industrial Environment</p> <p>A. v. Daake¹, C. Vetter¹, E. Böhm², O. Zirn¹ ¹ <i>Technische Universität Clausthal, Germany</i> ² <i>Böhm Feinmechanik und Elektrotechnik Betriebs GmbH, Germany</i></p>	97V2
P4.24	<p>New Approach to Overcome the Limitations in Small Torque Realization</p> <p>A. Wagner¹, R. Theska¹, A. C. P. Bitencourt², H. A. Lepikson³, W. L. Weingaertner⁴ ¹ <i>Technische Universität Ilmenau, Germany</i> ² <i>Instituto Federal de Educação, Ciência e Tecnologia da Bahia, Brazil</i> ³ <i>Universidade Federal da Bahia, Brazil</i> ⁴ <i>Universidade Federal de Santa Catarina, Brazil</i></p>	101V2
P4.25	<p>Position Control of a MEMS Stage with Integrated Sensor</p> <p>B. Krijnen^{1,2}, D. M. Brouwer^{1,2} ¹ <i>DEMCON Advanced Mechatronics, Oldenzaal, The Netherlands</i> ² <i>Mechanical Automation, IMPACT, University of Twente, The Netherlands</i></p>	105V2
P4.26	<p>A Novel Approach in the Application of Flexure Bearings in Primary Torque Standard Machines</p> <p>A. C. P. Bitencourt¹, R. Theska², A. Wagner², H. A. Lepikson³, L. A. G. Junior³, W. L. Weingaertner⁴ ¹ <i>Instituto Federal de Educação, Ciência e Tecnologia da Bahia, Brazil</i> ² <i>Technische Universität Ilmenau, Germany</i> ³ <i>Universidade Federal da Bahia, Brazil</i> ⁴ <i>Universidade Federal de Santa Catarina, Brazil</i></p>	109V2
P4.27	<p>Precision Pointing and Stability Control of the Future Linear Collider Quadrupoles</p> <p>C. Collette^{1,2}, S. Janssens^{1,2}, K. Artoos¹, P. Fernandez-Carmona¹, A. Preumont² ¹ <i>European Organization for Nuclear Research (CERN, Switzerland)</i> ² <i>Université Libre de Bruxelles (ULB, Belgium)</i></p>	113V2
P4.28	<p>Active Guides for Precision Micro-systems</p> <p>B. Denkena, H. C. Möhring, H. Kayapinar <i>Institute of Production Engineering and Machine Tools, Leibniz Universität Hannover, Germany</i></p>	117V2

- P4.29** **Compensating High Precision Positioning Machine Tools by a Self Learning Capable Controller** **121V2**
M. Silvestri^{1,2}, P. Pedrazzoli², C. Boër², D. Rovere²
¹ *Università degli Studi di Parma, Italy*
² *University of Applied Sciences of Southern Switzerland (SUPSI), Switzerland*

Session 5: Ultra Precision Manufacturing & Assembly Processes

- P5.02** **Shape Accuracy and Burr Formation during Micromilling of Titanium** **164V2**
D. Biermann, J. Schlenker
Institute of Machining Technology, Technische Universität Dortmund, Germany
- P5.03** **Redesign and Fabrication of a Magnetic Head for Gentelligent™ Products** **168V2**
A. Belski, M. C. Wurz, L. Rissing
Institute for Micro Production Technology, Center for Production Technology, Leibniz Universitaet Hannover, Germany
- P5.04** **Micro Grinding Technologies** **172V2**
E. Brinksmeier, C. Brandao, R. Gläbe, L. Schönemann
LFM – Laboratory for Precision Machining, University of Bremen, Germany
- P5.06** **An Investigation on the Cutting Physics and Mechanisms in Two-dimensional Vibration-assisted Micro-end-milling** **176V2**
H. Ding¹, K. Cheng², S-J. Chen¹
¹ *School of Mechatronics Engineering, Harbin Institute of Technology, China*
² *School of Engineering and Design, Brunel University, UK*
- P5.07** **Development of SMA Thin Film with Buffer Layer for Liquid Transportation Medical Device** **180V2**
K. Tsuchiya¹, T. Sato¹, S. Davies²
¹ *Department of Precision Engineering, Tokai University, Japan*
² *School of Engineering University of Warwick, UK*
- P5.08** **A New Pair of Hard-soft Plastic Combination for Precision Manufacturing of Two Component Plastic Parts** **184V2**
A. Islam^{1,2}, H. N. Hansen¹, M. Marhöfer¹, M. Bondo²
¹ *Department of Mechanical Engineering, Technical University of Denmark.*
² *SONION Roskilde A/S, Denmark*
- P5.09** **Planarization of Refrigerated Material Composites for MEMS** **188V2**
S. Cvetković, L. Rissing
Institute for Micro Production Technology, Center for Production Technology, Leibniz Universitaet Hannover, Germany

- P5.10** **Dynamic Modelling of the Cusp Error Reduction Phenomenon in High Speed Micro/meso-scale Milling Processes with Ultrasonic Vibration Assistance** **192V2**
J. H. Ko¹, K. C. Shaw¹, K. F. Ehmann²
¹ *Singapore Institute of Manufacturing Technology, Singapore*
² *Department of Mechanical Engineering, Northwestern University, USA*
- P5.11** **Lapping of EDM Processed Tool Steel Surfaces Using Modified Figure-8 Tool Motion** **196V2**
M. Mizuno, D. Tanaka, T. Iyama, N. Yoshihara, N. Nishikawa
Iwate University, Japan
- P5.12** **Surface Characteristics of a Micro-channel by Hybrid Micro-EDM** **200V2**
J-M. Kim¹, C-S. Lee², B. Sharavsambuu³, M-G. Lee³, M-S. Hong³
¹ *Sogang Institute of Advanced Technology, Sogang University, Korea*
² *Department of Mechanical Engineering, Sogang University, Korea*
³ *Department of Mechanical Engineering, Ajou University, Korea*
- P5.13** **Tooling System for Diamond Turning of Hardened Steel Moulds with Apsheric or non Rotational Symmetrical Geometries** **204V2**
F. Klocke¹, O. Dambon¹, B. Bulla²
¹ *Fraunhofer IPT, Germany*
² *Son-x GmbH, Germany*
- P5.14** **Optimization of Nano-topography Distribution by Compensation of Grinding Conditions** **208V2**
N. Yoshihara¹, N. Nishikawa¹, M. Mizuno¹, T. Iyama¹, T. Kuriyagawa²
¹ *Iwate University, Japan*
² *Tohoku University, Japan*
- P5.15** **A Study on Reduction of the Top Burr During Planing of Micro Channel Patterns** **212V2**
T-J. Je, E-C. Jeon, E-S. Park, D-S. Choi, K-H. Whang
Dept. of Nano Manufacturing Technology, Korea Institute of Machinery & Materials (KIMM), South Korea
- P5.16** **Study on Diamond Cutting of Steel in an Inert Gas Atmosphere** **216V2**
H. Shizuka, K. Okuda, M. Nunobiki, T. Sakuta
¹ *University of Hyogo, Japan*
- P5.17** **Measurement of Machining Force in Lathe Type Electro-chemical Discharge Machine** **220V2**
K. Furutani, K. Arai
Toyota Technological Institute, Japan

P5.19	<p>Study on Tool Wear and Cutting Force in Micro Ball-end Milling with High-speed Spindle K. Hamaguchi¹, H. Shizuka², K. Okuda² ¹ <i>Hyogo Prefectural Institute of Technology, Japan</i> ² <i>Graduate School of Engineering, University of Hyogo, Japan</i></p>	224V2
P5.20	<p>Development of Minimized-Assembly System for Camera Phone Lens Module J.Y. Song, T. H. Ha, C.W. Lee, J.H. Lee, D.H. Kim <i>Korea Institute of Machinery and Materials, Republic of Korea</i></p>	228V2
P5.21	<p>Potentials of Combining Different Manufacturing Techniques in one Machine for Ultra Precision Machining C. Brecher, C. Wenzel, J. M. Ellinghaus <i>Fraunhofer IPT, Germany</i></p>	232V2
P5.22	<p>Precision WEDM of Fir-Tree Root Slots in Udimet 720 M. T. Antar¹, S. L. Soo¹, D. K. Aspinwall¹, D. Jones², R. Perez³, M. Stucki³ ¹ <i>Machining Research Group, University of Birmingham, UK</i> ² <i>Rotatives, Rolls-Royce Plc., UK</i> ³ <i>GF Agie-Charmilles, Switzerland</i></p>	236V2
P5.23	<p>Automated Alignment of Laser Resonators C. Brecher, N. Pyschny, V. Guerrero <i>Fraunhofer-Institute for Production Technologies IPT, Germany</i></p>	240V2
P5.24	<p>Monitoring of Contact Pressure of Solid-Solid Interface using Acoustic Nonlinearity N. Kim¹, T. Lee², S. Kim² ¹ <i>Department of Mechatronic Engineering, Korea University of Technology and Education, South Korea</i> ² <i>Graduate School of Mechatronic Engineering, Korea University of Technology and Education, South Korea</i></p>	244V2
P5.25	<p>Studies on the Dynamic Behavior of Milling Tools for the HSC Machining D. Biermann, T. Brüggemann <i>Institute of Machining Technology, Technische Universität Dortmund, Germany</i></p>	248V2
P5.26	<p>SimPGM – A Commercial Simulation Tool for Precision Glass Molding Industry F. Klocke¹, F. Wang¹, G. Liu¹, K. Georgiadis¹, O. Dambon¹, A. Y. Yi² ¹ <i>Fraunhofer Institute for Production Technology (IPT), Germany</i> ² <i>The Ohio State University, USA</i></p>	252V2

- P5.27** **Systematic Influence Investigation of Key Parameters for Precision Glass Moulding Process Based on Self-developed Simulation Tool - SimPGM** **256V2**
F. Klocke¹, G. Liu¹, F. Wang¹, Y. Wang¹, D. Hollstegge¹, O. Dambon¹, A. Y. Yi²
¹ *Fraunhofer Institute for Production Technology, Germany*
² *The Ohio State University, USA*
- P5.28** **Micro Pencil Grinding Tools: Manufacturing, Application, and Results** **260V2**
M. Walk, M. Carrella, G. M. Schueler, J. Engmann, J. C. Aurich
University of Kaiserslautern; Institute for Manufacturing Technology and Production Systems
- P5.29** **Optimal Strategy for Producing a High Quality Relay in a Machining-assembly Production System Applied a Corrective Assembly Approach** **265V2**
T. Iyama, M. Mizuno, N.Yoshihara, N. Nisikawa
Iwate University, Japan
- P5.30** **Impact Analysis on Auto Focusing Actuator for Mobile Electronic Devices** **269V2**
Y-W. Sung^{1,2}, M. G. Lee¹, H-J. Lee², Min-Sung Hong¹
¹ *Department of Mechanical Engineering, Ajou University, Korea*
² *Korea Institute of Industrial Technology, Department of Manufacturing Convergence Technology, Korea*
- P5.31** **Research of Influence of Collected Details Form Deviation on the Accuracy of Precision Assembly** **273V2**
N. Mozga, I. Grinevichs, I. Brensons
Riga Technical University, Institute of Mechanical Engineering, Latvia
- P5.32** **High Resolution and Accuracy Powder Dispenser Using Metal Filter.** **277V2**
C. W. Lee, J. Y. Song, T. H. Ha, J. H. Lee
KIMM (Korea Institute of Machinery and Materials)
- P5.35** **Development of a Process for Stacking Planar Functional Materials with μm -overlay Accuracy** **281V2**
M. Mohaupt, E. Beckert, R.Eberhardt, A. Tünnermann
Fraunhofer Institute for Applied Optics and Precision Engineering, Germany

P5.36	<p>High Precision Alignment and Packaging of Silicon Microsystems L. Naegele¹, S. Andreas¹, M. Claas¹, Reinecke Holger^{1,2} ¹ <i>University of Freiburg, Department of Microsystems Engineering – IMTEK, Germany</i> ² <i>HSG-IMIT, Institut für Mikro- und Informationstechnik der Hahn-Schickard-Gesellschaft, Germany</i></p>	285V2
P5.37	<p>Abrasive Vibration Polishing of Complex Molds E. Brinksmeier, O. Riemer, M. Krause, H. Schulte <i>Laboratory for Precision Machining, University of Bremen, Germany</i></p>	289V2
P5.38	<p>Manufacturing of a Hybrid Piezo-actuator for a Micro-diaphragm Pump by Micro Assembly Injection Moulding W. Michaeli, Ch. Hopmann, T. Fischer, T. Kamps <i>Institute of Plastics Processing (IKV) at RWTH Aachen University, Germany</i></p>	293V2
P5.39	<p>Micro Pin Fabrication by ECM with Ultra-low Concentration Electrolyte N. Shibuya, W. Natsu <i>Tokyo University of Agriculture and Technology, Japan</i></p>	297V2
P5.40	<p>Study on the passivation layer in ELID-grinding B. Kersschot, J. Qian, D. Reynaerts <i>K.U.Leuven, Department of Mechanical Engineering, Belgium</i></p>	301V2
P5.41	<p>Atomic-scale Processing of Sputter-deposited Pt-Pd Alloy Film Surface Using AFM Diamond Tips Y. Ichida¹, Y. Iitsuka², R. Sato² ¹ <i>CBN & Diamond Nanomachining Institute/ Utsunomiya University, Japan</i> ² <i>Graduate School of Engineering, Utsunomiya University, Japan</i></p>	305V2
P5.42	<p>Advanced Characterization of Free-form Surfaces in High Precision Machining A. Cerardi, R. Meneghello, G. Concheri, G. Savio <i>Laboratory of Design Tools and Methods in Industrial Engineering – DAUR – Università degli Studi di Padova, Italy</i></p>	309V2
P5.43	<p>Verification of the Square Foot Manufacturing Concept Through the Process of Micro Milling and Drilling with a Flexure Based Feed Unit B. Röhlig, P. Kohrs, S. Grimske, J.P. Wulfsberg <i>Helmut-Schmidt-University, University of the Federal Armed Forces Hamburg, Germany</i></p>	313V2
P5.44	<p>A Novel Method for Rapid Part Inspection and Verification V. Dhokia, S. Newman, Z. Zhu, A. Shokrani <i>The University of Bath, UK</i></p>	317V2

P5.45	Studying the Force Exerted on the Tool-electrode During Machining: A Key Element for Force Feedback Micro-machining Using Spark Assisted Chemical Engraving J. D. Abou Ziki, R. Wüthrich <i>Concordia University, Canada</i>	321V2
P5.46	Precision Grinding of SF57 Glass with Engineered Grinding Wheels Y. Mutlugünes, O. Riemer <i>Laboratory for Precision Machining LFM, University of Bremen, Germany</i>	325V2
P5.47	Precision Grinding with CVD Diamond Coated Dicing Blades D. Miletic ¹ , J. Gäbler ² , L. Rissing ¹ ¹ <i>Institute for Micro Production Technology, Center for Production Technology, Leibniz Universität Hannover, Germany</i> ² <i>Fraunhofer Institute for Surface Engineering and Thin Films, Germany</i>	329V2
P5.48	Blade Wear and Sidewall Quality by Dicing of Sintered Silicon Carbide (SSiC) M. Stompe, S. Cvetković, and L. Rissing <i>Institute for Micro Production Technology, Center for Production Technology, Leibniz Universität Hannover, Germany</i>	333V2
P5.49	Ultra-precise Optical Mirrors with Thick Amorphous Silicon Layer S. Risse, A. Gebhardt, A. Kolbmüller, R. Steinkopf, M. Schürmann, J. Jobst, N. Kaiser, R. Eberhardt <i>Fraunhofer Institute for Applied Optics and Precision Engineering IOF, Germany</i>	337V2
P5.50	Guideline for Ultra-precision Machining of Silicon Carbide Based on Molecular Dynamics Analysis H. Tanaka, S. Shimada <i>Osaka Electro-Communication University, Japan</i>	341V2
P5.52	Square Foot Manufacturing – Advanced Design and Implementation of Mechanical Interfaces S. Grimske, N. Kong, B. Röhlig, J. P. Wulfsberg <i>Helmut-Schmidt-University, University of Federal Armed Forces Hamburg, Germany</i>	345V2
P5.54	Patterned Self-assembly of Fine Particles and their Transfer/replication to Produce Complex Microstructures N. Moronuki, K. Narita, and A. Kaneko <i>Tokyo Metropolitan University, Japan</i>	349V2

P5.56	A Study on the Material Removal Mechanisms in Ball Polishing G. Savio, R. Meneghello, G. Concheri, A. Cerardi <i>Laboratory of Design Tools and Methods in Industrial Engineering – DAUR – University of Padova, Italy</i>	353V2
P5.57	Mechanical Characterization of Machining Results for Sintered Silicon-Carbide (SSiC) M. Stompe, S. Cvetković, F. Pape, L. Rissing <i>Institute for Micro Production Technology, Center for Production Technology, Leibniz Universität Hannover, Germany</i>	357V2
P5.59	Cutting Characteristics and Machined Surface Properties of Co-Cr-Mo Alloy Plate with Cemented Carbide and cBN Tools for Artificial Hip Joints T. Kaneeda ¹ , H. Iwashita ¹ , L. Anthony ² ¹ <i>Okayama University of Science, Japan</i> ² <i>Waseda University, Japan</i>	361V2
P5.60	Experimental Research of Cutting Forces in Microdrilling L. Kudła <i>Division for Precision and Electronic Products Technology, Warsaw University of Technology, Poland</i>	365V2
P5.62	Development and Experimental Testing of CBN Inserts I. Mészáros, B. Z. Farkas, A. Keszenheimer <i>Budapest University of Technology and Economic, Dept. of Manufacturing Science and Engineering, Hungary</i>	369V2
P5.65	Planarization of Long and Narrow Materials by Oscillation-Speed-Control Polishing A. Une ¹ , K. Yoshitomi ¹ , M. Mochida ¹ , and M. Yoshida ² ¹ <i>Dept. of Mechanical Engineering, National Defense Academy, Japan</i> ² <i>Technical Department, Okamoto Machine Tool Works, LTD, Japan</i>	373V2
P5.66	Experimental Study on Surface Texture and Coefficient of Friction in Sliding Friction Test Y. Mizugaki ¹ , K. Kikkawa ¹ , W. Nakashima ² , M. Hao ³ ¹ <i>Kyushu Institute of Technology, Japan</i> ² <i>Mazda Motor Corporation, Japan</i> ³ <i>Harbin Institute of Technology, P.R. China</i>	378V2
P5.67	Development of Indentation Machining Technology for Precise Discontinuous Micro Pattern E-C. Jeon, T-J. Je, D-S. Choi <i>Dept. of Nano Manufacturing Technology, Korea Institute of Machinery and Materials (KIMM), Korea</i>	382V2

- | | | |
|--------------|---|--------------|
| P5.69 | <p>Development of a Planar Resonant Piezostepper
 R. Donose, M. Houben, H. Van Brussel, D. Reynaerts
 <i>Katholieke Universiteit Leuven, Department of Mechanical Engineering, Belgium</i></p> | 386V2 |
| P5.70 | <p>Acoustic Emission analysis of Diamond Turning Process of CNT Composite
 E. J. T. Chicuta¹, Ph. Demont², P. Puech², A. J. V. Porto¹, R. G. Jasinevicius¹
 ¹ <i>Depto Eng. Mecânica, EESC, USP, C.P. 359, CEP 13566-590, São Carlos, São Paulo, Brazil</i>
 ² <i>Laboratoire de Physique des Polymères, Université Paul Sabatier Toulouse III, France</i></p> | 390V2 |
| P5.71 | <p>Single Point Diamond Turning of Tungsten Carbide
 A. da Motta Gonçalves, J. G. Duduch, R. G. Jasinevicius, L. Montanari, A. José Vieira Porto, C. L. Chao¹.
 <i>University of São Paulo, Brazil</i>
 ¹ <i>Tam-Kang University, Taiwan</i></p> | 394V2 |
| P5.72 | <p>On the Fabrication of Fresnel Lens Array in Soft Semiconductor Crystal by use of Ultraprecision Diamond Turning
 R. G. Jasinevicius¹, A. J. V. Porto¹, J. G. Duduch¹, P. S. Pizani²
 ¹ <i>Departamento de Eng. Mecânica, EESC, USP, C.P. 359, CEP 13566-590, São Carlos, São Paulo, Brazil</i>
 ² <i>Departamento de Física, Universidade Federal de São Carlos, Caixa Postal 676, 13 565-905 São Carlos, SP, Brazil</i></p> | 398V2 |
| P5.73 | <p>Precise Machining of Micro Prisms in Large Scale Areas
 H. C. Kim¹, S. W. Lee², D. Y. Lee³
 ¹ <i>High Safety Vehicle Core Technology Research Center, Department of Mechanical and Automotive Engineering, Inje University, Korea</i>
 ² <i>Manufacturing System R&D Group, Korea Institute of Industrial Technology, Korea</i>
 ³ <i>Convergent manufacturing technology research group, Korea Institute of Industrial Technology, Korea</i></p> | 402V2 |
| P5.75 | <p>Figuring of Large Optical Surfaces Using Reactive Atom Plasma (RAP) Processing
 R. Jourdain, M. Castelli, P. Morantz, P. Shore
 <i>Cranfield University Precision Engineering, UK</i></p> | 406V2 |
| P5.76 | <p>A Framework of a Process Modelling and Optimization System for the Design, Fabrication and Evaluation of Progressive Lenses
 C.F. Cheung¹, L.T. Ho¹, L.B. Kong¹, S.To¹, K.T. Lai¹
 ¹ <i>State Key Laboratory in Ultra-precision Machining Technology, Department of Industrial and Systems Engineering, The Hong Kong Polytechnic University, HK</i></p> | 409V2 |

Session 6: Important / Novel Advances in Precision Engineering & Nano Technologies

- P6.01** **Crack Initiation for Kerf-Loss-Free Wafering** **435V2**
J. Qian¹, B. Kersschot¹, A. Masolin², J. Vaes², F. Dross²,
D. Reynaerts¹
¹ *Department of Mechanical Engineering, Katholieke Universiteit Leuven, Belgium*
² *Solar Cell Technology, IMEC, Belgium*
- P6.03** **Precise Manufacturing of Micro Structures by Spark Erosion in Electrically non-conductive Zirconia.** **439V2**
P. Čvančara, T. Ganz, T. Hösel, C. Müller, H. Reinecke
University of Freiburg – IMTEK, Department of Microsystems Technology, Laboratory for Process Technology
- P6.06** **Design of Flexure-based Precision Transmission Mechanisms using Screw Theory** **443V2**
J. B. Hopkins¹, R. M. Panas²
¹ *Lawrence Livermore National Laboratories, USA*
² *Massachusetts Institute of Technology, USA*
- P6.07** **Development of an Active Work Piece Holder for Vibration Assisted Micro Milling** **447V2**
E. Uhlmann^{1,2}, F. Mahr¹, D. Oberschmidt²
¹ *Institute for Machine Tools and Factory Management Technische Universität Berlin, Germany*
² *Fraunhofer Institute for Production Systems and Design Technology, Germany*
- P6.08** **High-Aspect-Ratio Nanofabrication of Carbon Materials Using CNT Probe and TEM *in-situ* Observations of Their Process** **451V2**
A. Matsumuro, M. Takagi
Department of Mechanical Engineering, Aichi Institute of Technology, Japan
- P6.10** **Energy efficient MEMS Using Collinear-Type Statically Balanced Compliant Micro Mechanisms (SB-CMM): Experimental Results** **455V2**
N. Tolou¹, P. Estevez², J. L. Herder¹
¹ *Department of Biomechanical Engineering*
² *Department of Precision and Microsystems Engineering Delft University of Technology, Faculty of Mechanical, Maritime and Materials Engineering, The Netherlands*
- P6.14** **Cutting Process in Turning of Super Heat-Resistant Alloy Inconel 718 under Oil Mist Application** **459V2**
T. Yatsuzaki
Kyushu Polytechnic College, Japan

- P6.15** **Questionnaire Survey on Ultra-precision Positioning** **463V2**
T. Oiwa¹, M. Katsuki², M. Karita³, W. Gao⁴, S. Makinouchi⁵,
K. Sato⁶, Y. Oohashi⁷
¹ *Shizuoka University, Japan*
² *Toshiba Machine Co., Ltd., Japan*
³ *Japan Science and Technology Agency, Japan*
⁴ *Tohoku University, Japan*
⁵ *Nikon Corporation, Japan*
⁶ *Tokyo Institute of Technology, Japan*
⁷ *KSS Co., Ltd., Japan*
- P6.17** **Data Mining Approach for Identifying Optimal Process Parameters in Micro-Manufacturing** **467V2**
G. Lanza, J. Fleischer, B. Viering, K. Klimscha, K. Kippenbrock, S. Stockey
wbk Institute of Production Science, Karlsruhe Institute of Technology (KIT), Germany
- P6.18** **A Novel Method for the Design and Ultra-precision Machining of the Hybrid Optical Surface of Single BD/CBHD Compatible Objective Lens** **471V2**
L. H. Li, W. B. Lee, S. To, W. K. Wang, M. S. Yip
Advanced Optics Manufacturing Centre, The State Key Laboratory in Ultra-precision Machining Technology, The Hong Kong Polytechnic University, Hong Kong
- P6.20** **Evaluation of a UV-activated Adhesive Chuck for Double Sided Machining** **476V2**
N. Balabanava, S. Sempels, J. Qian, D. Reynaerts
PMA Division, Katholieke Universiteit Leuven, Belgium
- P6.21** **Influence of Kinematics on the Surface Integrity in Orthogonal Turn-Milling of Aluminium Matrix Composites** **480V2**
A. Schubert^{1,2}, R. Funke¹, A. Nestler¹
¹ *Chair Micromanufacturing Technology, Department of Mechanical Engineering, Chemnitz University of Technology, Germany*
² *Fraunhofer Institute for Machine Tools and Forming Technology, Germany*
- P6.22** **2D and 3D Interconnect Fabrication by Picosecond Laser Induced Forward Transfer** **484V2**
G. Oosterhuis¹, B. Huis in't Veld^{1,3}, P. Chall²
¹ *TNO Science and Industry, The Netherlands*
² *Advanced Laser Separation International, The Netherlands*
³ *University of Twente, Applied Laser Technologies*
- P6.23** **A new Approach for the Simultaneous Grinding of Cubic Microstructures in Brittle-Hard Materials** **488V2**
B. Denkena, J. Köhler, D. Hahmann
Institute of Production Engineering and Machine Tools, Leibniz Universität Hannover, Germany

P6.24	<p>Using Diamond Coated Tool-electrodes for Drilling Micro Holes with EDM E. Uhlmann^{1,2}, M. Langmack¹, R. Garn³, D. Oberschmidt², J. Fecher⁴, S. M. Rosiwal⁴, R. F. Singer⁴ ¹ <i>Institute for Machine Tools and Factory Management, Technische Universität Berlin, Germany</i> ² <i>Fraunhofer Institute for Production Systems and Design Technology, Germany</i> ³ <i>Continental Automotive GmbH, Germany</i> ⁴ <i>Institute of Science and Technology of Metals (WTM), University of Erlangen-Nuremberg, Germany</i></p>	492V2
P6.26	<p>Reduction of 2D/3D Image Cross-talks with Micro-optical Elements by Nano-imprint C-H. Yeh¹, F-Y. Chang², H-C. Wang², E.Chung¹, H-T. Young¹ ¹ <i>Department of Mechanical Engineering, National Taiwan University, ROC</i> ² <i>Department of Mechanical Engineering, National Taiwan University of Science and Technology</i></p>	497V2
P6.28	<p>Wear Behaviour of PCD Micro-tool While Vertical Micro-grinding of BK7 Glass A. Perveen, Y.S.Wong, M.Rahman <i>National University of Singapore, Singapore</i></p>	501V2
P6.29	<p>Precision Complex Machining of Glass Lens Mold with Fresnel Shape T. Fujii, K. Nakamoto, T. Ishida, Y. Takeuchi <i>Department of Mechanical Engineering, Osaka University, Japan</i></p>	505V2
P6.30	<p>New Hybrid Machine Tool with an Automated Clamping System for Drilling Micro Holes by Laser Helical Drilling and μEDM E. Uhlmann^{1,2}, M. Langmack¹, A. Löwenstein¹, D. Oberschmidt² ¹ <i>Institute for Machine Tools and Factory Management, Technische Universität Berlin, Germany</i> ² <i>Fraunhofer Institute for Production Systems and Design Technology, Germany</i></p>	509V2
P6.31	<p>Precision Turning with Localized Anodic Dissolution M. Hackert-Oschätzchen¹, G. Meichsner², M. Zinecker¹, A. Schubert^{1,2} ¹ <i>Chair Micromanufacturing Technology, Faculty of Mechanical Engineering, Chemnitz University of Technology, Germany</i> ² <i>Fraunhofer Institute for Machine Tools and Forming Technology, Germany</i></p>	513V2
P6.32	<p>Investigation of Micro-EDM in Deionized Water Using Nanosecond Pulse Power Supply M. D. Nguyen, M. Rahman, Y.S. Wong <i>National University of Singapore (NUS), Singapore</i></p>	518V2

- P6.33** **Fabrication of Dye-Sensitised Solar Cell Utilizing PELID (Patterning with Electrostatically-Injected Droplet) Method** **522V2**
S. Umezu^{1,2}, Y. Kunugi², H. Ohmori¹, Y. Yano², A. Fukasawa², S. Tokunaga², A. Ishii²
¹ *Material Fabrication Lab., Riken, The Institute of Physical and Chemical Research*
² *School of Engineering, Tokai University*
- P6.34** **Mechatronic Design of a Seismic Shaker** **526V2**
R. Jenneskens¹, D. Laro¹, R. Schneider¹, G. Drijkoningen², A. Veltman^{3,4}, B. v. d. Broek⁵
¹ *MI-Partners*
² *TU Delft*
³ *PIAK*
⁴ *TU Eindhoven*
⁵ *Magnetic Innovations*
- P6.35** **Design, Fabrication, and Testing of a Modular Concentrated Solar Power Trough System** **530V2**
A. Slocum¹, R. Campbell¹, S. Ziegehegaen², W. Miskoe², De Vita Lorenzo Ippolito³, N. De Blasio³
¹ *Massachusetts Institute of Technology, USA*
² *Iron Dragon Corporation, USA*
³ *ENI, Corporation, Italy*
- P6.36** **A Study of the Isolation Performance and the Influence of Long-period Ground Motion to Semiconductor Lithograph Machine.** **534V2**
M.Takahashi, K.Yamamoto
Nikon Corporation Japan
- P6.37** **Creating Controlled Features Underneath Metal Surfaces Through Laser-induced Melt Volume Expulsion** **538V2**
Z. L. Li¹, H. Y. Zheng¹, T. Liu¹, Y. C. Guan², W. Zhou²
¹ *Singapore Institute of Manufacturing Technology and Singapore*
² *Nanyang Technological University and Singapore*
- P6.39** **Support for Micro-Tolerancing Through the Feedback of Existing Quality-Related Data to Product Developers** **542V2**
G. Lanza¹, A. Albers², K. Kippenbrock¹, P. Börsting²
¹ *wbk Institute of Production Science,*
² *IPEK Institute of Product Engineering, Karlsruhe Institute of Technology (KIT), Germany*
- P6.40** **Micro – EDM: Process Effects on the Tool Wear Ratio** **546V2**
A. Schubert^{1,2}, N. Wolf¹, H. Zeidler²
¹ *Fraunhofer Institute for Machine Tools and Forming Technology IWU, Department Micro- and High-Precision Manufacturing, Germany*
² *Chemnitz University of Technology, Chair Micromanufacturing Technology, Germany*

- P6.41** **Dynamic Thermal Center for High Precision Applications** **550V2**
A.H. Koevoets, J. Dekkers
Philips Innovation Services, The Netherlands
- P6.42** **Grinding Performance of a Grain-Arranged Diamond Wheel and a GC Wheel against CFRP** **554V2**
S.Okuyama, A.Yui, T.Kitajima
National Defense Academy, Japan
- P6.43** **Micro-patterned Biological Interfaces Manufactured by Diamond Turning with CVD Diamond Micro-tools** **558V2**
S. Marson¹, R. Villa², I. Cardenas-Durazo³, R. W. Evans¹,
A. Storti¹, A. Heaume¹, F. Marinello⁴, S. Carmignato⁵, D. M. Allen¹
¹ *Precision Engineering Centre, Cranfield University, UK*
² *Centre for Energy and Resource Technologies, Cranfield University, UK*
³ *Materials Department, Cranfield University, UK*
⁴ *DIMEG, Dip. di Innovazione Meccanica e Gestionale, University of Padova, Italy*
⁵ *DTG, Dip. di Tecnica e Gestione dei Sistemi Industriali, University of Padova, Italy*