Technological advances in measurements and intelligent instrumentation

2017 Meas. Sci. Technol. 28 050101

(http://iopscience.iop.org/0957-0233/28/5/050101)

IOP Publishing
Measurement Science and Technology
Meas. Sci. Technol. **28** (2017) 050101 (2pp)
https://doi.org/10.1088/1361-6501/aa6182

CrossMark

Editorial

Technological advances in measurements and intelligent instrumentation

Liang-Chia Chen
Distinguished Professor, Department of Mechanical Engineering, National Taiwan University, Taipei, Taiwan

E-mail: lchen@ntu.edu.tw

Under the guidance of the international committee of measurements and instrumentation (ICMI), the International Symposium on Measurement Technology and Intelligent Instruments (ISMTII) has become a prestigious biyearly international symposium in measurements. Following the previous successful symposium in many international cities, the ISMTII 2015 was held in Taipei, Taiwan as the first time from the 22th to 25th September, 2015. With more than 300 participants from research institutes, universities and industrial sectors, the symposium was held to promote scientific and engineering breakthroughs in measurement sciences and technologies by providing a forum for exchange of innovative research ideas, latest research outcomes, state-of art technologies in modern measurement technologies, as well as intensive discussions on future emerging directions. With enthusiastic interests and contributions from 13 counties worldwide, the ISMTII 2015 had been focusing on technical exchanges of the current state-of-the art and future perspectives in measurements and intelligent instrumentation. From more than 340 submissions, we have undergone an independent peer-review process with great contribution from the international and local experts to selected 234 papers to be presented in oral and poster sessions. More importantly, only around 30 selected papers were recommended to *Measurement Science and Technology* (MST) for possible review and consideration in a special issue of MST. With thorough review, 15 papers were finally accepted and published in this special section. These work has presented some of outstanding and important research outcomes in the field of measurements and instrumentation.

The 15 selected papers cover a wide range in modern technological advances in measurements and intelligent instrumentation. Surface profilometry is an important focus in the issue, especially in optical measurement techniques. Two-staged trained Zernike polynomials were applied as an inline measuring tool to solve the optical surface measurement problem in membrane mirror manufacturing process. To avoid the problem of ill-conditioned matrix inversion induced by the least squares method, the coefficients of each model term were approximated by modified elitist teaching-learning-based optimization (ETLBO). A new method for precise and contactless profile measurement of rough-surfaced objects using an optical frequency combs can achieve a relative uncertainty of 10-10 in evaluating the frequency beats of the comb. To gear profile measurement, a new evaluation method for helix measurement using a wedge artifact (WA) whose plane is used as the tooth flank was achieved with a satisfactory result. For contact profile metrology, on-line qualification of a micro probing system using of a micro-stylus with a nominal tip ball diameter of 52.6 μm was realized by Gao's group for precision length measurement of micro-features on precision parts. To enhance micro measurement accuracy to a nano-scale level, a 3D fiber probe utilizing two mutually orthogonal collimation optical paths for the radial probing measurement was successfully developed for the precision measurement of micro parts with high aspect ratios. Profile measurement of a bent neutron mirror using a non-contact autofocus measurement system can achieve a nanometer measurement resolution. For automated optical inspection (AOI), a real-time surface inspection system using machine vision for precision steel balls can achieve a minimum detectable surface flaw area down to 0.01 mm^2.

Apart from these, several advanced measurement or simulation techniques were developed for machine accuracy measurement. To minimize laser beam drifts in laser collimation measuring systems, influence of beam radii was detected and compensated by a common-path method with a best 36% improvement. Simultaneous multiple degrees of freedom (DoF) measurement is realized by developing highly accurate interferometric

1361-6501/17/050101+2$33.00

system based on a modified homodyne Twyman–Green interferometer concept. Wang *et al* [1] also developed on-machine error identification and compensation methods for micro machine tools while Mildner *et al* [2] successfully advanced a dual-frequency comb generation with differing GHz repetition rates by parallel Fabry–Perot cavity filtering of a single broadband frequency comb source. Meanwhile, Lu *et al* [3] proposed a two-degree-of-freedom (2-DOF) displacement measurement system based on double diffraction gratings for precise displacement measurement. For theoretical measurement simulation, Juang and Chen [4] conducted 3D finite element simulations on conductive multilayer films to study the relationship between the reading of the four-point probe and the conductivity of the individual layers. The resistivity of each layer sequentially can be determined with the original correction factor $\pi/\ln(2)$, after deposition of each layer.

References

[1] Wang S-M *et al* 2016 *Meas. Sci. Technol.* **27** 084001
[2] Mildner J *et al* 2016 *Meas. Sci. Technol.* **27** 074011
[3] Lu Z *et al* 2016 *Meas. Sci. Technol.* **27** 074012
[4] Chen Y-Y and Juang J-Y 2016 *Meas. Sci. Technol.* **27** 074006