THERE'S MUSIC IN PRECISION ENGINEERING

The 30th ASPE Annual Meeting was held in Austin, Texas, "the live music capital of the world" on 1-6 November 2015. The event was a great mixture of technical presentations, tutorials, exhibition and local adventures, with ample input from Dutch and Belgian participants.

DANNIS BROUWER AND RAYMOND KNAAPEN

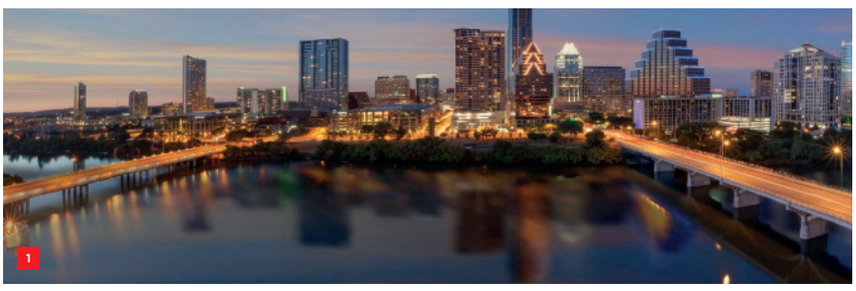
The annual meetings of the American Society for Precision Engineering (ASPE, aspe.net) are aimed at introducing new concepts, processes, equipment, and products while highlighting recent advances in precision measurement, design, control, and fabrication.

Tutorials

The meeting in Austin (Figure 1) started on Sunday with tutorials, with Dutch and Belgian input coming from Gerrit Oosterhuis and Martijn Vanloffelt and their tutorial *Applications of Additive Manufacturing to Precision*. Selected case studies were presented to illustrate specifics aspects of additive manufacturing (AM) and their impact on part performance within the context of precision-engineered systems. Part design, process settings for the AM process and post-processing of the parts were discussed at length.

Piet van Rens and Dannis Brouwer had over 40 participants for their full-day tutorial *Design Principles for Precision Engineering*. This tutorial covered the conceptual approach to designing precision mechanisms like manipulators, scientific instruments, precision equipment, etc. It focussed on the mechanical aspects of precision in the context of a mechatronic system.

Other interesting tutorials included *Introduction to System Identification*, *Practical Aspects of Thermal Control*, and *Introduction to Surface Finish Metrology*.



1 *ASPE Annual Meeting 2015 host city Austin by night. (Photos courtesy of ASPE)*

Student competition

A student competition & mentoring event was held at the same time on the Sunday evening and the Monday afternoon. The competition included mentoring from various precision engineering experts who made themselves available for one-on-one sessions. Companies donated their time and equipment to provide support and tutorials.

Fifteen students arranged in three teams (Figure 2) were challenged with the task of designing and building an XY-stage for a height scanner with 2 x 4 mm travel. The teams had to draw on their precision engineering skills to solve a multidisciplinary challenge covering mechanical, electrical, metrology and control aspects. It was very interesting to see all the different approaches they took and the sophisticated improvements they came up with.

Keynote address

Prof. S.V. Sreenivasan of the University of Texas delivered his keynote speech, *The Role of Precision Systems in Scalable Nanofabrication Based on UV Imprint Lithography,* on the Monday evening. Nanoimprint lithography techniques are known to have remarkable replication capabilities down to a sub-5 nm resolution. Translating this nano-scale resolution to commercially viable manufacturing processes requires carefully designed precision systems that can achieve a variety of process performance, cost and reliability targets.

Prof. Sreenivasan presented a specific form of UV imprint lithography known as Jet and Flash Imprint Lithography (J-FIL). J-FIL technology has been implemented in a stepper format with precision overlay to complement photolithography at sub-20 nm half-pitch nodes for semiconductor ICs.

Presentations and posters

The annual meeting featured a variety of presentation sessions. For instance, Prof. Paul Shore from Cranfield University in the UK gave a very good introduction to the need for precision engineering in solving many of the challenges in the roll-to-roll manufacturing, coating and registration of multi-meter flexible substrates.

The following sessions included some of the Dutch contributions:

- Precision Metrology, with Arjo Bos (Eindhoven University of Technology) presenting *Design of a Nanometer-Accurate Form Measurement Machine for Segmented Large Telescope Mirrors*.
- Control of Precision Mechatronic Systems, with Gijs van der Veen (Delft University of Technology) presenting *Topology Optimization for the Conceptual Design of Precision Mechatronic Systems* and Pieter Wullms (MI-Partners) with *Polymer Damper Technology for Improved System Dynamics*,
- Precision Roll-to-Roll Machine Design and Controls, with Raymond Knaapen of VDL ETG presenting *Equipment for Atmospheric Atomic Layer Deposition in Roll-to-Roll Processes.*
- Precision Mechanical Design, with Dannis Brouwer (University of Twente) presenting *System Behaviour of a Multiple Overconstrained Compliant Four-Bar Mechanism.*

Belgian and Dutch posters were featured in the following sessions:

- Control of Precision Mechatronics Systems, with a poster titled *Interferometric Active Inertial Isolation for Extended Structures* from Université Libre de Bruxelles, CERN and MIT.
- Interferometry and Optics, with a poster titled *Modular Versatile Imaging, Focusing & Illumination for Vision with High Stability and Accuracy* from Settels Savenije van Amelsvoort.
- Micro and Nanometrology and Measurement Uncertainty, with a poster titled *Self-Calibration of the Non-Linear Length Deviation of a Linear Encoder by Using Two Reading Heads* from KU Leuven and a poster titled *Modelling the Effects of Detector Misalignments on the Measurement of a Cylindrical Array of Aluminum Spheres by X-ray Computed Tomography* from NPL and KU Leuven.

2 *Teamwork during the student competition.*

Exhibition

The sold-out exhibition hall had all the areas you could expect to encourage our precision engineers to get the main components they need to build a precision system, including the controlled environment. Over forty participants exhibited their latest and greatest developments and products in the field of precision engineering. In the commercial session, each exhibitor had two and a half minutes to present their products and services.

Tours

On the Tuesday evening, all the participants went to the Circuit of the Americas, a recent addition to the Formula 1 championship in the US. While there, participants were given the opportunity to visit the pits where vintage car racing drivers were getting their cars ready to race on the following days.

On the final day of the conference, there were three technical tours, one of which took in the University of Austin NASCENT (Nanomanufacturing Systems for mobile Computing and Energy Technologies) Center where innovative wafer-scale and R2R manufacturing tools and processes are being developed for scalable fabrication of advanced nanoelectronics, photonics and flexible electronics. One of the NASCENT Center's specific aims is to enable future generations of mobile computing and mobile energy devices.

To conclude

The annual meeting was again a worthwhile interactive knowledge-exchange opportunity for devoted precision professionals. ■

AUTHORS' NOTE

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