EDITORIAL

Intelligent and Precision Manufacturing with Automation Technology

Guest Editor

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Over the last few decades, an obvious trend for manufacturing industry has shifted from traditional labor intensive production to automated production by machines. Advanced technology in robotic and automation development extensively increases the productivity of manufacturing. To achieve rapid, waste-free, and zero-defect production of customized complex products with reduced energy consumption is an important issue in current manufacturing research. Intelligent automation technology has offered substantial benefits to manufacturing from ultra-precision to mass production with higher quality and better performance. For instance, on-line monitoring and diagnosis of the machining process provided by sensors enables autonomous decision making, which increases machine reliability and efficiency. A dynamic fusion of automation, manufacturing knowledge, control scheme, and state-of-the-art design techniques to accomplish not only ultra-precision workpieces but self-healing during production process has an urgent demand for advanced manufacturing in the near future.

The aim of this special issue of the international Journal of Automation and Smart Technology is to present several promising technology in manufacturing. The presented papers focus on enhancing the efficiency, reliability, and accuracy of manufacturing process by developing intelligent and precision machining technology. Green manufacturing, advanced

monitoring technology, precision measurement, fabrication of nanostructures, and process control to facilitate the intelligent manufacturing are included. An introduction to this special issue is provided below.

Green manufacturing technology is becoming an important research topic. The paper entitled **"Using the Zero-Resistance Spark Circuit on the Wire Cut Electric Discharge Machine to Realize Energy Savings"** co-authored by Shao-Hsien Chen and Chen-Peng Wang, introduced an improved discharge circuit for use in wire cut electric discharge machines. They use DC-DC and electronic voltage regulation technology to convert the energy originally dissipated in the resistor directly into the energy for use in machining. Experimental results indicate energy savings of 10 to 15%.

Continuous monitoring of manufacturing machinery allows industrial firms to prevent production line downtime. The paper entitled **"Design of Wireless Sensors for Intelligent Manufacture Monitoring"** co-authored by Chia-Chan Chang, Chung-Yi Liu, Kui-Hua Huang, and Guo-Hua Feng, presented a wireless sensing system composed of a temperature sensor module and a Wi-Fi transceiver module to monitor the status of ball screws used in industrial machinery. Temperature data are successfully measured and transmitted to a central computer, verifying the feasibility of this proposed system.

The paper entitled **"Ball Nut Preload Diagnosis of the Hollow Ball Screw through Sensed Current Signals"** co-authored by Yi-Cheng Huang, Shi-Lun Sun, and Kuan-Heng Peng, proposed a valuable method for diagnosing hollow ball screws with different ball nut preload levels through the

Hilbert-Huang transform (HHT) and multiscale entropy (MSE) process. Experimental results show that the proposed approach can successfully predict the prognostic status of ball nut preload.

Wen-Yang Chang and Chih-Ping Tsai proposed the paper entitled **“Automatic Inspection and Processing of Accessory Based on Vision Stitching and Spectral Illumination”**, which investigates the automatic inspection and processing of bicycle components based on vision stitching and spectral illumination. The presented approach can be widely applied in modern industrial manufacturing and provides useful information for automatic inspection and image stitching.

The paper entitled **“Automatic Calibration System for Precision Angle Measurement Devices”** co-authored by Yung-Cheng Wang, Lih-Horng Shyu, Eberhard Manske, Chung-Ping Chang, and Shih-Syun Lin, presented an optomechatronic module to achieve automatic and efficient calibration of a compact autocollimators for high precision angle measurement. With the proposed system, the measuring characteristics of a calibrated compact autocollimator can be determined in a few minutes thus producing low-cost, high-precision angle measurements without commercial autocollimators.

Chia Wang, Wei-Yen Lin, and Hong-Tsu Young proposed the paper entitled **“An Intelligent Fault Diagnosis System for Machine Tools”**, where an automatic intelligent system is developed to diagnose shaft fault types. Features related to shaft faults are extracted from vibration signals to effectively identify the corresponding fault condition. The automatic intelligent monitoring system has been implemented in a machine tool manufacturing company to verify its performance.

The paper entitled **“Using Focused Electron Beams to Drill Straight Nanopores on a Membrane”** co-authored by Yung-Cheng Wang, Dau-Chung Wang, and Yung-Cheng Wang, where a high-resolution focused electron beam is used for the fabrication of metal nanostructures and devices. A method is proposed to improve the membranes’ thermal conductivity to rapidly produce straight nanopores, and is experimentally confirmed and has significant potential for use in nano-sensors or nano-devices.

Manufacturing solar cells can be taken advantage of nanoimprinting technique. The paper entitled **“Fabrication of sub-wavelength antireflective structure to enhance the efficiency of InGaAs solar cells”** co-authored by Yen-Yu Chou, Che-Chun Chang, and Yeeu-Chang Lee, presented a cost-effective roller nanoimprinting technique for the fabrication of sub-wavelength structures (SWSs) as an alternative to conventional anti-reflective coatings used to reduce reflectance in triple-junction InGaP/InGaAs/Ge solar cells. Simulation results demonstrated a considerable reduction in reflectance resulting from a gradual change in the refractive index provided by SWSs.

Finally, Viacheslav R. Shulunov reported the improved accuracy, performance, and cost characteristics of a novel roll powder sintering (RPS) process developed to manufacture components from a CAD model. The paper entitled **“A high performance, high precision, low cost rapid prototyping and manufacturing technology”**, which describes the RPS utilizing commercially-available inexpensive components, while simultaneously improving element accuracy, surface quality, and construction time. The proposed RPS can manufacture 1m³ objects in about 17 hours or less. 🦉

Guo-Hua Feng received an MS degree in mechanical engineering from the National Central University, Taiwan, and the University of California at Los Angeles, USA, in 1995 and 2000, respectively, and a PhD degree in electrical engineering from the University of Southern California, USA, in 2004. In 2005 he joined the National Chung Cheng University, Taiwan, and is currently a professor in the Department of Mechanical Engineering. He worked as a graduate research assistant with the Department of Electrical Engineering at University of Southern California, in the MEMS Group from 2000 to 2004. Before coming to the United States, he was a lecturer in the Department of Mechanical Engineering at Chin-Ming College, Taiwan. His research interests include MEMS industrial applications, machine health monitoring, sensing technologies, microfluidic devices, soft robotics, microfabrication processing technology and acoustic bio-MEMS devices. Dr. Feng is a member of IEEE. He is also the recipient of Dr. Da-Yu Wu Memorial Award (Outstanding Young Research Award) of the National Science Council.