

DOI: 10.3901/CJME.2016.0909.110, available online at www.springerlink.com; www.cjmenet.com

Special Issue on Future Digital Design and Manufacturing: Embracing Industry 4.0 and Beyond

Industry 4.0 as referred to the fourth industrial revolution has endorsed in several national manufacturing initiatives or development plans such as in Germany, the UK, USA and China. A set of important pervasive and secondary technologies for future manufacturing activities have been identified such as additive manufacturing, sensor technology, big data analytics, Internet of things, robotics, smart manufacturing, cloud computing, and nanotechnology. These exponentially growing technologies are radically changing industrial processes, accelerating them and making them more flexible and smarter. The interplay among “Internet of Things, services, data and people” will transform the future of manufacturing.

On 12–13 April 2016, we organized an International Workshop on Digital Design and Manufacturing Technologies—Embracing Industry 4.0 and Beyond at Northumbria University in Newcastle, UK (<https://www.northumbria.ac.uk/about-us/news-events/events/2016/04/digital-design-manufacturing-technologies-workshop/>) and issued a special issue call in the Chinese Journal of Mechanical Engineering on Future Digital Design and Manufacturing: Embracing Industry 4.0 (<http://www.cjmenet.com/EN/column/item91.shtml>). Both events aim to provide an overview of current research in digital design and manufacturing and gain the common understanding of challenges and opportunities of applying the exponentially growing technologies in the future digital design and manufacturing and requirements for the application of industry 4.0 and consequences in manufacturing. We have received 46 submissions to the special issue so far, albeit more submissions are expected to arrive by the deadline at the end of May 2016. In order to publish selected papers timely, the Journal has decided to publish peer-reviewed papers in two issues.

In this first issue, 13 papers are accepted including a keynote paper by Professor HARRISON Robert on “Cyber-physical system(CPSs) and automation for industry 4.0”. In the Industry 4.0 environment, products need to be designed and manufactured in a smart way in order to meet requirements of mass customization, personalization and flexible smart manufacturing. Customers should be able to actively engage in product design and development, individually specify goods and services, and create new system applications with modular devices. The emerging crowdsourcing technology is regarded as a technical enabler for crowdsourcing-based product design and manufacturing, especially for manufacturing SMEs. QIN Shengfeng, et al present a paper to explore the barriers and opportunities in adopting crowdsourcing in new product development of manufacturing SMEs and further identify guidelines for developing effective crowdsourcing platforms for new product development in manufacturing SMEs. The paper by HUSSEIN Abdullahi and CHENG Kai discusses the challenges faced by aerospace manufacturing SMEs on managing their supply chains and complying with the aerospace quality standard requirement in an automated ERP manner. The development of an ERP based supply chain quality management system is investigated and its implementation perspectives are discussed.

Simulation-driven design and manufacturing technologies accelerate the transition from traditional manufacturing into future digital design and smart manufacturing. The paper authored by ZOU Yisheng and his co-workers investigates the simulation-based design challenges in complex mechatronic systems. An entire system could involve complex multi-disciplinary subsystems and the dynamic behaviors of each individual subsystem are different and coupled within the whole system. The challenge in spatial and time unsynchronizations among subsystem simulation is identified. A collaborative simulation method with spatiotemporal synchronization process control as a solution to meet the challenge is proposed. In order to make manufacturing processes with higher energy efficiency toward sustainable manufacturing, the need for developing an energy-resource efficient manufacturing system is identified by the KATCHASUWANMANEE and CHENG's paper. They propose a simulation based energy-resource efficient manufacturing integrated within in-process virtual management. Simulation of the interplay among product, user, machining process and machine tools is an important aspect in smart manufacturing and factories. The paper by CHEN Wanqun, et al discusses an integrated and simplified method to simulate the interplay between manufacturing processes and machine tools in order to improve the overall manufacturing quality. While the paper by TAO Qing, et al explores an integrated approach for digital evaluation of sitting posture comfort in human-vehicle system which takes advantages from all experimental methods in real environment and virtual environments for effective digital design. TIAN Huaiwen and QIN Shengfeng in their paper explore 3D object recognition techniques with local regularities for enabling smart robotics in future smart factories.

Nanotechnology and information techniques play an increasingly important role in the new product development. The paper by WU Qibai, et al investigates a way of improving fabrication and thermal conductivity of adsorbents with added nanoparticles. YANG Guangwu and his colleagues study the relationships among a large set of product design parameters and the product performances by sensitivity analysis, which enable the identification of key design parameters and provide a rapid and effective testing method during the product development process. Furthermore, the paper by WANG Meili, et al discusses a way of digital relief generation from 3D models for digital product development. CHEN Dengkai and his colleagues in their paper introduce a form gene clustering method for pan-ethnic-group product development.

In the smart system design and integration field, how to provide non-expert users better user experience(UX) when connecting multiple devices with interoperability is a system design challenge. The research on user interaction for device connection is still limited. SONG Ji-Won, et al study wireless device connection problems and utilize the Research-Through-Design(RTD) research method to identify possible design solutions.

Overall, this first issue attempts to provide a collective view on the state-of-the-art research in future digital design and manufacturing in the Industry 4.0 context. The underlying think and philosophy is towards the forward-looking, systematic and industrial-feasible approach, which is indispensable a continuous process to be endorsed and engaged by design engineering and manufacturing community.

30th May 2016

Professor QIN Shengfeng
School of Design, Northumbria University, Newcastle upon Tyne, NE1 8ST, UK

Professor CHENG Kai
Institute of Materials & Manufacturing, College of Engineering, Design and Physical Sciences,
Brunel University London, Uxbridge UB8 3PH, UK