Editorial

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Biographical notes: Qingjin Peng is an Associate Professor of the Department of Mechanical and Manufacturing Engineering at the University of Manitoba in Canada. He received his Bachelor and Master Degrees in Mechanical Engineering from Xiao Jiaoting University of China, and Doctorate from the University of Birmingham in UK. He was a visiting scholar at the University of Manchester Institute of Science and Technology and a Lecturer at the University of Wolverhampton in UK. His current research interests cover integrated manufacturing systems, virtual manufacturing and reverse engineering. He has extensive publications in these research areas. He is a registered professional engineer and a member of ASME.

Virtual Manufacturing (VM) is the use of Virtual Reality (VR) technologies in the product design and manufacturing. VM provides a cost-effective tool for the investigation of real-world multi-dimensional and dynamic characteristics of product development in virtual environments. The application of VR in manufacturing has been identified as new opportunities for industry to increase the efficiency of product design and manufacturing. Manufacturing systems and users can be integrated completely in virtual environments using VM.

VM technologies can be enhanced using internet technologies. The advancement of Internet technologies has enabled the possibility of manufacturing industries to achieve effective and efficient operations with the features of resources sharing, distribution and the viable collaboration. A web-based VM system could provide shared usage of the latest integrated design and manufacturing facilities. Manufacturing companies can access the latest equipment and technology without having to tie up huge amounts of capital investment. Concurrent planning, sharing information, and user involvement are three major features of web-based VM systems.

The purpose of this special issue is to recognise the current state-of-the-art of web-based VM development and applications. Papers are invited on following topics of interests.

- virtual prototyping and virtual representation of preliminary design in web-based environments
- the use of VR for product assembly and disassembly analysis in web-based environments
- integration of VR and product developments in web-based environments

- industrial problems solving with VR in web-based environments
- customisation of products using VR in web-based environments
- VR modelling in distributed manufacturing systems
- VR methods for identifying relevant variables, behaviours and knowledge of manufacturing systems in web-based environments
- VR model interoperability in web-based VM systems
- interfaces of supporting VR modelling in web-based VM systems
- VR support systems for web-based VM.

Seven papers are selected for this special issue based on reviewers' comments and papers' quality covering the topics of web-based VM in robot operations, product design, virtual prototyping, engineering training, digital factory, fixture planning and VM support systems.

The first paper, titled 'A web-based approach for real-time robot operations', by L. Wang, describes the use of computer graphics augmented with real sensor data for reducing data transmission over the network for web-based robot operations. The system concept, architecture and mechanism are discussed for data sharing and prototype implementation of the enabling technology.

Reducing required network bandwidth and increasing system performance are the major concerns in developing web-based systems. Effective remote robot operations in a decentralised environment require both real-time monitoring and remote control capabilities. A Wise-ShopFloor framework is proposed in this paper for only sending the updated sensor data to a client site where the real-time monitoring is locally rendered in Java 3D scenes. The combination of web-based and sensor-driven approach is to reduce network traffic. It integrates sensor data with Java 3D models for off-site real-time monitoring, while still provides remote users with an intuitive environment. The application potential of this research may include the control simulation, virtual machining, operator training, facility touring, off-site trouble-shooting and collaborative design verification in addition to the remote real-time monitoring and robot control.

The second paper is entitled 'A virtual prototyping framework to facilitate fluid power systems realisation', authored by S.C. Fok. It introduces a virtual prototype in a computer-generated environment for designers to investigate multiple design changes through interactive visualisation. A virtual prototyping framework is proposed for designers to search for appropriate components in the development of fluid power systems. An internet-enabled virtual prototyping workbench is developed for the acceleration of developing fluid power systems using the suitable components. The components are searched through virtual catalogues. It would allow designers to effectively utilise electronic component data from vendors for the quick assembly of a virtual prototype or the evaluation of the product performance.

The third paper, titled 'Development of an Electrical Discharge Machining learning system for manufacturing engineering education', by J.S. Liang, is for the development of an electrical discharge machining learning system for manufacturing engineering education. A web-based learning framework is developed for the electrical discharge machining process. The system uses CAD modelling software, 3D animation program, VR functions and object-oriented programming for an interactive EDM training platform.

The developed system provides references for developing virtual and interactive courses or learning platforms. Open-source software tools and virtual interactive technology are integrated for an emulated, effective and learning environment. It is a remote operation of the virtual workshop to replace physical equipment, which can overcome time and space limitations of traditional education to complement the lack of interaction in distance learning.

The fourth paper, titled 'Category theory-based Object-Oriented data management for Virtual Manufacturing', by Xu et al., discusses a graph-based semantic data model using the category theory for a knowledge-based Virtual Surface Texture Analysis (VSTA) system. The paper aims to automatically implement surface texture parameters relating to surface characteristics defined in the geometric product specification and verification standards (GPS). The paper investigates the approach to facilitate the adoption of GPS standards for manufacturing designers and engineers in a networked environment. Researchers of this paper attempt to build a novel data model using category theory for an OO database that can store arbitrary complexity level of data for the VSTA system and to be effectively shared over the Internet to support VM activities.

The fifth paper, entitled 'An integrated approach to the analysis of automotive assembly activities using digital manufacturing tools', by Lambiase and Lambiase, examines the step for the development of an integrated digital factory. The analysis aims to reduce businesses productivity loss and to increase system performances. A three-steps concurrent approach, namely activities balancing, task ergonomic improvement and devices redesign, is applied in 3D virtual environments for an automotive industry. A cost analysis is reported for the economical feasibility of the improvement.

The sixth paper, titled 'Fixture assembly planning in a web-based collaborative environment', by Kang and Peng, discusses the use of web-based environments for fixture planners to communicate and perform functionalities with geographically distributed partners. Fixture assembly planning considers geometrical and functional constraints of the fixture in a working environment. This paper presents a fastener-based geometrical approach to fixture assembly planning in a distributed environment. The topological disassemblability of fixture elements and fasteners, the assembly tool feasibility, and fixture functionality are analysed and simulated in a collaborative 3D visualised environment.

The last paper in this special issue, titled 'Investigation to Peer-to-Peer based collaborative working platform for product development', by Wang et al. introduces a preliminary research on Peer-to-Peer based collaborative environment to support 3D product design. It proposes a way of WYSIWIS, What You See Is What I see. A prototype is developed based on JXTA platform for the document co-sharing and editing, draft co-drawing, instant message, and VRML-based visualisation. A collaborative model modification can be performed by the cooperation between the document co-editing space and VRML visualisation space.

The guest editor would like to thank all the authors for the time and effort in contributing their papers and in incorporating referees' comments in revising their manuscripts. Thanks are especially extended to the paper reviewers for their insightful and thorough reviews of the submitted papers in a very short review period. Finally, the special thanks give to Professor Pingyu Jiang, the Editor-in-Chief, for his advice and support to make this special issue success.