Preface

The environment of the manufacturing industry has changed impressively during this half century. New theories and technologies in the field of computers, networks, distributed computation, and artificial intelligence are extensively used in the manufacturing area. Integration and intelligence have become the developing trends of future manufacturing systems. These inform the concept of manufacturing change from the narrow sense of fabrication technique to the broad sense of extensive manufacture, that is, from the transformation of raw materials into finished goods, to the whole process of the product life cycle involving product design, fabrication, planning, managing, and distribution. Intelligent manufacturing will become one the most promising manufacturing technologies in the next generation of manufacturing industries.

Manufacturing Intelligence (MI), as a new discipline of manufacturing engineering, focuses on scientific foundations and key technologies for developing, describing, integrating, sharing, and processing intelligent activities in the process of manufacturing. It mainly covers intelligent-control theory and technology for manufacturing equipment, intelligent management and decision making for the manufacturing process, intelligent processing of manufacturing information, representation and reasoning of manufacturing knowledge, as well as intelligent surveillance and diagnosis for manufacturing equipment and systems.

Clearly, MI is different from Artificial Intelligence (AI). AI is one aspect of theoretical research led by the requirements of mimicking human intelligence. It mainly focuses on exploring the mechanism of the process of human intelligent activities and emphasizes general theories, which highlight explorations of theory, as well as having serious logicality and reasoning. By contrast, MI mainly studies the mimicry of human intelligence to solve issues with intelligent computers (including software and hardware), and is a type of foundational research led by the requirements of applications in the manufacturing field. Although these two disciplines are different, they are related each other. AI is one of the main foundations of MI and the development of MI and the solution to the issues unsolved by AI will accelerate the development of AI.

This book consists of four parts with fourteen chapters which include engineering background, foundations, technologies, applications, implementations, case studies, trends of intelligent manufacturing, and prospects for manufacturing intelligence. Part I contains one chapters, viz. chapter 1, which introduces manufacturing intelligence, the development of intelligent manufacturing, and the features of intelligent activities in the process of manufacturing. Part II and Part III including twelve chapters constitute the main part of this book. In these two parts, scientific foundations, key technologies and pragmatic applications of manufacturing intelligence are analyzed. Among them, chapters 2 to 8 composing the Part II offer an extensive presentation of the engineering scientific foundations in manufacturing intelligence. Chapter 2 describes knowledge-based systems which mainly details general approaches for knowledge representation, acquirement, and general techniques for searching and reasoning. Chapter 3 presents
an overview of intelligent agents and multi-agent systems. Chapter 4 contains the principle and techniques of data mining and knowledge discovering. Chapter 5 introduces the principle and applications of computational intelligence in engineering and manufacturing, including neural networks, genetic algorithms, and fuzzy logic. Chapter 6 has an overview of information system modeling, including the general processes and strategies, some different modeling approaches and modeling tools. Chapter 7 includes an overview of multi-sensor integration and data fusion theories. Chapter 8 introduces the principle and approaches to group theory, including coding systems for parts, approaches for grouping parts and applications in manufacturing designing and processing. Chapters 9 to 13 make up Part III of the book: the applications and case studies for manufacturing intelligence. Chapter 9 presents the structure theory of intelligent control, a general architecture of the intelligent controller, and intelligent systems. Chapter 10 contains knowledge-based approaches for designing, beginning with the basic concepts and approaches of conventional computer-aided design (CAD) systems. Chapter 11 includes an overview of computer-aided process planning, including concepts and enabling technologies, and the architecture and decision-making process of intelligent computer-aided process planning is also presented. Chapter 12 presents an overview of remote monitoring and intelligent diagnosis. Chapter 13 consists of the principles and approaches to intelligent management and decision-making in manufacturing. Like Part I, Part VI also contains only one chapter, viz. chapter 14. In chapter 14, first the summarization of the theories, technologies, and applications in the aforementioned chapters is presented, and then these intelligent manufacturing technologies compare to the traditional manufacturing technologies. Last the prospects for manufacturing intelligence and the trends of intelligent manufacturing in the future are discussed.

This book is intended primarily for senior undergraduate and graduate students in mechanical, electro-mechanical and industrial engineering programs. Its integrated treatment of the subject makes it a suitable reference for practicing engineers and other professionals who are interested in pursuing research and development in this field. For professors and students, this book may be used for teaching as well as self-study. It gives them an up-to-date, in-depth source of material on manufacturing intelligence. For researchers, the publication helps them better understand the field as a whole. They will obtain valuable enlightenment for their future research activities.

The book also provides readers with the scientific foundations, theories, and key technologies of manufacturing intelligence. Hence, readers may use this publication achieve two different but overlapping goals. Firstly, it may help readers to understand manufacturing intelligence in a deeper and more comprehensive way. Furthermore, throughout this book numerous references to literature sources are provided, enabling interested readers to further pursue specific aspects of manufacturing intelligence.

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