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GUEST EDITORIAL

Special Issue: New artificial intelligence paradigms for manufacturing

DANIEL M. GAINES[1] AND WILLIAM C. REGLI[2]

[1]Jet Propulsion Laboratory, Pasadena, California 91109, USA
[2]Department of Computer Science, College of Engineering, Drexel University, Philadelphia, Pennsylvania 19104, USA

This Special Issue was motivated in part by the success of the 2001 American Association for Artificial Intelligence's Special Interest Group on Manufacturing (SIGMAN) workshop. SIGMAN has organized a series of these workshops that highlight significant advances in academic research and industrial practice. New manufacturing concepts such as agile/lean manufacturing and virtual manufacturing place increasing emphasis on the need for more intelligent manufacturing systems. It is no longer a question of whether artificial intelligence (AI) technologies will have an impact on manufacturing but one of better understanding and exploiting the broad potential of AI in this domain.

Toward this end, a specific focus of the 2001 SIGMAN meeting was an analysis of new AI paradigms for manufacturing. During the workshop, participants discussed the use of evolutionary techniques for design and manufacturing, the impact of e-commerce on AI and manufacturing, and the potential for cross-fertilization from other research areas such as genetics research, game theory, and economics. Similarly, papers in this Special Issue were selected to reflect this theme of recent innovations in AI and manufacturing and include topics such as genetic programming, e-commerce, multiagent systems, and decision theory. These techniques are being used to address important and complex problems including mechanism and bearing design, sheet metal manufacturing analysis, and business to business interaction.

Babanov et al. address the problem of multiagent contracting in which an agent must solicit bids for a collection of tasks with complex temporal constraints. Their approach, based on expected utility theory, enables a customer agent to formulate a request for quotes that takes into account the risk posture of the agent and the temporal constraints among the tasks in the auction.

Two papers in this issue address the problem of manufacturing analysis for sheet metal forming. Soman et al. present a tool for assisting in the design of sheet metal parts. Their paper presents an innovative approach to predicting the time and energy requirements of sheet metal operations to produce cost estimates that provide critical information in supporting design decisions.

Ekárt and Márkus describe an approach that combines decision tree induction and genetic programming for the design of four bar mechanisms, a class of mechanisms that extends from relatively simple devices such as a windshield wiper to more complex devices such as a sewing machine. A unique aspect of this work is that, rather than producing a single four bar mechanism as a solution, Ekárt and Márkus' technique generates the structural constraints on the set of mechanisms that will satisfy the input requirements, providing the user with a wider range of solutions.

One of the more challenging aspects of developing a manufacturing analysis tool is building the knowledge base to support decision making. Xing et al. introduce an approach for acquiring domain knowledge through a combination of automated and interactive steps. They have applied their technique to the domain of drop hammer forming, a process for sheet metal forming, and have developed a tool to assist operators in performing this process.

Qin and Regli investigate the use of case-based reasoning (CBR) in the problem of mechanical bearing design. They argue that CBR is a promising technique for problem spaces that have incomplete domain theories but for which a collection of example solutions is available.

Kulvatunyou et al. consider the problem of sharing product process information in support of business to business environments. The authors point out that current options for the exchange of product data do not extend the process information because this data is tied to specific manufacturing resources that are not usually known during product development. In the authors' approach, this reliance on specific resources is avoided through the use of a resource-independent description of manufacturing operations. As a result, their Integrated Product and Process Data approach supports the exchange of both product and process data.

These papers are representative of recent advances in the use of AI for manufacturing and illustrative of the continuing impact AI techniques have in addressing challenging problems in this field. We thank our authors for contributing to this Special Issue and our reviewers for increasing the quality of the work presented here.

Reprint requests to: Daniel M. Gaines, Jet Propulsion Laboratory, 4800 Oak Grove Drive, M/S 126-347, Pasadena, CA 91109. E-mail: daniel.m.gaines@jpl.nasa.gov