

Guest Editorial

Special Issue: New AI Paradigms for Manufacturing

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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 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, electronic commerce, multi-agent 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.

Collins and Gini address the problem of multi-agent contracting in which an agent must solicit bids for a collection of tasks with complex temporal constraints. Their approach, based on expected utility theory,

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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. This 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.

Ekart and Markus describe an approach that combines decision tree induction and genetic programming for the design of four bar mechanisms, a class of mechanisms which includes 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, Ekart and Markus' 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 process that combines automated and interactive steps. They have applied their technique to the domain of drop hammer forming, a process for sheet metal forming and developed a tool to assist operators in performing this process.

Qin and Regli investigate the use of Case-Based Reasoning (CBR) to the problem of mechanical bearing design. Qin and Regli argue that CBR is a promising technique for problem spaces with 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 author's 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 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.