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GUEST EDITORIAL

Special Issue: Engineering applications of representations of function, Part 1

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In engineering design, the end goal is the creation of an artifact, product, system, or process that fulfills some functional requirements at some desired level of performance. As such, knowledge of functionality is essential in a wide variety of tasks in engineering activities, including modeling, generation, modification, visualization, explanation, evaluation, diagnosis, and repair of these artifacts and processes. A formal representation of functionality is essential for supporting any of these activities on computers. The goal of Parts 1 and 2 of this Special Issue is to bring together the state of knowledge of representing functionality in engineering applications from both the engineering and the artificial intelligence (AI) research communities.

The idea for this Special Issue grew out of common themes that emerged from research reported at ASME Design Engineering Technical Conferences, Design Society International Conference on Engineering Design, and other conferences and workshops focused on engineering design and its applications. Of particular interest, it seemed that the engineering design and AI communities were tackling similar topics and, in some instances, duplicating each other's efforts. In engineering design research, automated concept generation and embodiment problems are the impetus for engineers to delve into the AI domain. For the AI community, engineering design continues to offer a rich source of problems for applying and extending the current state of the art. One underlying theme that both communities wrestle with is how to represent product design information in a way that is not limited to specific componentry or limited domains so that it can be reused in synthesis activities. The notion of product functionality has been extensively studied over the past several decades, and it provides a way to capture design information for reuse in a variety of different works.

The selection of papers in Parts 1 and 2 of this Special Issue highlights the engineering applications of representations of function in the core areas of functional reasoning (Far & Elamy, Part 1), function-based representations (Chakrabarti et al., Part 1; Van Wie et al., Part 1), function-based design methodologies (Umeda et al., Part 2; Wood & Dym, Part 2), and conceptual design AI support (Sridharan & Campbell, Part 2; Wilhems, Part 2). As Editors, we are struck by the underlying similarities in many of these papers, even though they overtly tackle different issues and use different terminology. The invited paper by Chandrasekaran (Part 1) makes this point about the general study of function representations in engineering design. Although much work remains in this interdisciplinary area, this Special Issue suggests that researchers are closing in on the fundamental representations needed to represent function in AI applications of engineering design.

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