Human Behavior in Engineering Design: Computational Modeling and Experiments

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Abstract

Complex engineered systems are designed and operated by humans. System performance depends not only on physical phenomena, but also on multilevel interactions between technology and human behavior. This talk will explore human behavior during the design process and its implications on design outcomes. The specific focus will be on information acquisition, which involves decisions such as whether or not to gain more information about a design concept, whether to execute a simulation or to run a physical experiment, and choosing from alternate ways to refine a behavioral model of a system. Information acquisition decisions have a significant effect on the quality of design outcomes and the resources needed to achieve the outcomes. From a normative standpoint, such decisions can be made using the expected utility theory. However, due to their sequential nature, the decisions are challenging to make even within computational design frameworks. To cope with the associated cognitive and computational costs, human designers either deviate from the normative theory or use simpler heuristics to make information acquisition decisions. Currently, there is limited understanding about which deviations from rationality are more common among engineering designers, which deviations have greater impacts on different design problems, what the individual differences are, what the effects of expertise are, how budget and time constraints affect human decisions, and what the consequences of the problem complexity are. The speaker will present an approach based on the synthesis of descriptive theories of decision making from psychological and cognitive sciences with behavioral experiments. An abstraction of the systems design process as a sequential information acquisition process will be presented, which forms the basis for developing multiple descriptive models of information acquisition decisions. Hierarchical Bayesian analysis is used to determine which models and parameters, best describe individuals' decision-making strategies.

Bio: Dr. Jitesh H. Panchal is a Professor and Assistant Head of Mechanical Engineering at Purdue University. He received his BTech (2000) from Indian Institute of Technology (IIT) Guwahati, and MS (2003) and PhD (2005) in Mechanical Engineering from Georgia Institute of Technology. Dr. Panchal's research interests are in (1) design at the interface of social and physical phenomena, (2) computational methods and tools for digital engineering, and (3) secure design and manufacturing. He is a recipient of CAREER award from the National Science Foundation (NSF); Young Engineer Award, Guest Associate Editor Award, and three best paper awards from ASME; and was recognized by the B.F.S. Schaefer Outstanding Young Faculty Scholar Award, the Ruth and Joel Spira Award, and as one of the Most Impactful Faculty Inventors at Purdue University. He received the Distinguished Alumni award from IIT Guwahati. He is a co-author of two books and has co-edited one book on engineering systems design. He has served on the editorial board of international journals including ASME Journal of Mechanical Design, ASME Journal of Computing and Information Science in Engineering. He is a program chair of the ASME IDETC/CIE conference, and the past chair of the ASME Computers and Information in Engineering (CIE) division.

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