Humpty Dumpty and the Challenge of Designing Large-Scale Engineered Systems

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Abstract
Humpty Dumpty is a character, typically depicted as an anthropomorphized egg, from an English-language nursery rhyme. In the story, Humpty Dumpty falls from his perch atop a wall. Despite the efforts of many (“all the king’s horses and all the king’s men”), it proves impossible to reassemble him.

What does this have to do with the design of large-scale engineered systems? Practicality dictates that we break such design problems into pieces, solve the pieces and then combine the solved parts. However, much like the king’s horses and king’s men, we do not have a particularly good track record of putting the pieces together. Most large-scale systems engineering projects (e.g., F-22, F-35, the Boeing 787, the Mars Science Laboratory programs) exhibit significant cost overruns or schedule slippages.

In this talk, Dr. Malak will present ongoing research into how engineers can better integrate their knowledge in pursuit of a solution to a systems design problem. In particular, the focus of this work is on the decision-based informational interfaces between abstraction levels in an engineered system. Theoretical results, based on normative decision theory, show that it is possible to encapsulate all lower-level knowledge needed for system-level decision making. In principle, this means designers can make decisions that lead to an optimal system design through an information-driven process. This has led to new numerical techniques for generating the needed information efficiently and an overall methodology for solving systems design problems. The ultimate goal is to achieve a design process that ensures the final re-integrated solution to a systems design problem actually is a good solution to the original problem—much the way that we wish to reassemble our friend Humpty Dumpty.

Speaker Bio
Dr. Richard J. Malak Jr. is an Assistant Professor in the Department of Mechanical Engineering and Director of the Design Systems Laboratory at Texas A&M University. Dr. Malak’s research goals are to discover and describe new principles and methods for the design of complex engineered systems. A majority of his work revolves around quantitative methods for design optimization, decision making and uncertainty analysis. The underlying motivation for his work is to improve society by helping designers realize systems that are better performing, more efficient and more sustainable than those we have today. Dr. Malak has a multidisciplinary, systems-oriented background. He received his Ph.D. in Mechanical Engineering from Georgia Tech in December 2008. He also holds M.S. degrees in Mechanical Engineering (Georgia Tech) and Electrical and Computer Engineering (Carnegie Mellon) and a B.S. degree in Electrical Engineering (Stony Brook University).

Speaker website: http://meen-apps1.tamu.edu/FacultyProfiles/facultyinformation.asp?LastName=rmalak

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3–4 PM, COVELL 117 (MIME LIBRARY)
(Please join us at 2:30 for refreshments and social time prior to the presentation.)