

**DANIEL J. EPSTEIN DEPARTMENT OF  
INDUSTRIAL AND SYSTEMS ENGINEERING**

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**EPSTEIN INSTITUTE SEMINAR • ISE 651 SEMINAR**

***Detecting Mistakes in Engineering Models:  
The Effects of Experimental Design***

**Dr. Daniel D. Frey**

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and Engineering Systems  
Massachusetts Institute of Technology**

**ABSTRACT**

This seminar will focus on the results of an experiment with human subjects to explore their ability to discover a mistake in a model used for engineering design. For the purpose of this study, a known mistake was intentionally placed into a model that was to be used by engineers in a design process. The treatment condition was the experimental design that the subjects were asked to use to explore the design alternatives available to them. The engineers in the study were asked to improve the performance of the engineering system and were not informed that there was a mistake intentionally placed in the model. Fourteen of the twenty seven engineers who pursued the design by varying one factor at a time independently identified the mistake during debriefing after the design process. Only one of the twenty seven engineers who used a fractional factorial experimental design independently identified the mistake during debriefing. Regression analysis shows that relevant domain knowledge improved the ability of subjects to discover mistakes in models, but experimental design had a larger effect than domain knowledge in this study. Analysis of video tapes provided additional information about the likelihood of subjects to appear surprised by data from a model. This experiment suggests that the complexity of factor changes during the design process is a major consideration influencing the ability of engineers to critically assess models.

**TUESDAY, NOVEMBER 29, 2011  
ELECTRICAL ENGINEERING BLDG ROOM 248  
4:00 – 5:20 PM**

## **Biographical Information**

Daniel D. Frey is an Associate Professor of Mechanical Engineering and Engineering Systems. He currently serves as a Co-director of the Singapore-MIT International Design Center, a large-scale (\$100M) effort to undertake significant design projects and simultaneously to learn from them how to improve the design process. Frey's main research thrust concerns robust design of engineering systems. Robust design is a set of engineering practices whose aim is to ensure that engineering systems function despite variations due to manufacture, wear, deterioration, and environmental conditions. Frey is also actively involved in design of engineering devices for the developing world.

Professor Frey has received an NSF CAREER award, best paper awards from ASME, INCOSE, and IEEE, two R&D 100 Awards, and several teaching awards. He holds a Ph.D. in Mechanical Engineering from MIT, an MS in Mechanical Engineering from the University of Colorado, and a BS in Aeronautical Engineering from Rensselaer Polytechnic Institute.