



## **MMAE SEMINAR**

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E1-104

### **Abstract**

#### **“Pseudo-Hierarchical Multistage Model for System of Systems Optimization”**

System of systems research is an emerging area, particularly in the civilian and military ground vehicle and aircraft applications. However, there is no formal methodology that encompasses the core components beyond the traditional multidisciplinary design optimization methodologies. This presentation describes a multilevel, multistage approach to system of systems design optimization where a system design is linked with system allocation along the multistage decision making horizon. The approach is composed of two parts: pseudo-hierarchical formulation (i.e., how to model the stages of multiple, separate decision making processes), and multistage coordination (i.e., how efficiently the proposed model would perform). The pseudo-hierarchical formulation integrates multilevel optimization and multistage programming to capture level-by-level and stage-by-stage system design optimization. The multistage coordination is based on Lagrangian relaxation utilizing the partial duality theorem. Alternating direction method is incorporated as an efficient means to solve this inherently large-scale optimization problem. An airline example validates the methodology where an airline plans to introduce multiple new aircraft to capture dynamically changing demand of the customers. The proposed methodology is validated against the all-in-one approach and the sequential approach.