Transportation Seminar Series

Friday, October 17, 2008
4 - 5 p.m. in 240 Bechtel Engineering Center

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Large scale modeling and optimization of en route air traffic

Abstract: The last few decades have witnessed the almost uninterrupted growth of US air traffic. Investigations of air traffic models have been intensively studied to mitigate the imbalance between demand and capacity of the current air traffic control system. Traditional modeling methods of this type of system are classified into two classes: Lagrangian models, which are trajectory-based and identity preserving; Eulerian models, which are control volume based. In general, Eulerian models are computationally efficient, and they are adequate for creating aggregate descriptions of systems, but they lose the identity of individual agents (for example, aircraft in the air traffic control system). In contrast, Lagrangian models keep the identity of each agent but can become computationally intractable or expensive. This seminar presents a new model, Large-capacity Cell Transmission Model, for a large scale air transportation system. The new model takes benefits of both Eulerian and Lagrangian models to achieve accuracy and efficiency at same time. The predictive capabilities of the model are successfully validated against recorded air traffic data by showing an accurate match between predicted and measured aircraft counts in airspace sectors.

The Large-capacity Cell Transmission Model has been used for optimization-based Traffic Flow Management, in which the problem of minimizing the total amount of delay incurred in the National Airspace System is formulated in the form of tractable linear programs with billions of variables and constraints. An optimization algorithm based on a dual decomposition method is designed to efficiently solve the large scale linear programs, resulting in new approaches to real time Traffic Flow Management. Both the model and the algorithm are being implemented in Future Air Traffic Management Concepts Evaluation Tool (FACET), a software developed at the NASA Ames Research Center for nationwide Traffic Flow Management.

Bio: Dengfeng Sun recently completed his Ph.D. degree in Systems Engineering Program, Department of Civil and Environmental Engineering, University of California at Berkeley. Currently he is an Associate Scientist at University Affiliated Research Center, University of California at Santa Cruz. He is going to join School of Aeronautics and Astronautics at Purdue University in August 2009 as an Assistant Professor. His research interests include modeling, simulation and optimization of large scale systems.

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