MAE Seminar Series

Decentralized Air Traffic Flow Control Using a Communications Network Model

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A communications network model of air traffic is introduced for tactical air traffic flow control. Airports are represented as source and destination nodes, and centers are represented as routers in the communications network model. An aircraft is modeled as a data packet, and the flight from the airport of origin to the airport of destination is modeled as packet transport from the source-node to the destination-node via routers. The path of each packet though the links connecting the sequence of routers is specified by the sequence of corresponding centers that the aircraft would transit according to its flight-plan. Time spent by a packet in a router is specified by the time taken to transit though the corresponding center. Aircraft trajectory data, simulated using the Airspace Concept Evaluation System, were used for determining the sequence of centers and transit-times. Results are presented for combinations of first-come-first-served, round-robin, fair-queuing, most-delayed-first and departures-first decentralized control policies in the network elements constrained to model arrival and departure rate constraints at the airports and capacity constraints in the Atlanta Center. The effect of control policies on traffic at center, local and system-wide levels is shown. Ground, airborne and total delays computed by the communications network model, and by the Airspace Concept Evaluation System are compared. The center capacity based model is compared with the sector capacity based model to show these models are not comparable. Communications network model delays are compared with delays recorded in the Aviation System Performance Metrics database. Numerical results presented in the paper show that the communications network model is a flexible computational model for the study and development of decentralized control algorithms for traffic flow management. Of the five control policies studied in this paper, the most-delayed-first control policy yields the least system-wide delay. The greedy policy of departures-first leads to least delay in the constrained center and most delay in the system. The first-come-first-served policy results in 11% larger system-wide delay compared to the most-delayed-first policy.

Bio

Gano received the B. Tech. degree in mechanical engineering from the Indian Institute of Technology, Kanpur, India. He received the M.S. degree in mechanical engineering from the University of Mississippi, Mississippi. He received the Ph.D. degree in mechanical engineering from the Santa Clara University, Santa Clara, California. Gano currently works in the area of air traffic management as a Scientist for the University of California Santa Cruz's University Affiliated Research Center (UARC) at the NASA Ames Research Center. Dr. Chatterji specializes in the areas of air traffic management, machine vision and pattern recognition, and flight dynamics and control. He is an Associate Fellow of the American Institute of Aeronautics and Astronautics (AIAA). Gano is a recipient of the IEEE M. Barry Carlton Award, and numerous Raytheon and NASA awards.

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Please contact Dr. Puneet Singla at psingla@eng.buffalo.edu for more information or to request a meeting with Dr. Chatterji.