Using Historical Data to Automatically Identify Air-Traffic Controller Behavior

Investigator(s): Todd Lauderdale (NASA Ames Research Center), Eric Mueller (NASA Ames Research Center) and Yuefeng Wu (University of Missouri, St. Louis)

Purpose

This project seeks to develop statistical-based machine learning models to characterize the types of errors present when using current systems to predict future aircraft states. These models will be data-driven - based on large quantities of historical data. Once these models are developed, they will be used to infer situations in the historical data where an air-traffic controller intervened on an aircraft's route, even when there is no direct recording of this action.

Background

In the current National Airspace System (NAS) air-traffic controllers maintain spatial separation between aircraft – largely without the help of automation tools. This system has proven to be quite safe, but the limits of human cognition restrict the number of aircraft that can be in any given airspace region at a time.

Instead of just using human abilities to control aircraft, trajectory-based automation systems rely on predictions of future states of aircraft (known as trajectories) to plan how to efficiently and safely control aircraft. Some initial systems are currently in use in the NAS in limited roles such as the Traffic Management Advisor (TMA) that provides scheduled arrival times for aircraft to runways.

As automation relying on trajectories becomes more safety critical the accuracy of these predictions needs to be fully understood. Also, it is very important for researchers developing future automation systems to understand, and in some cases mimic, how current operations are conducted by human controllers to ensure that the new systems are at least as efficient as humans and to understand creative solutions used by human controllers.

This project attempts to answer both of these critical questions. First, we will develop novel machine-learning algorithms to characterize aggregate trajectory prediction errors providing an understanding of what factors influence these errors. Using this characterization of the errors, we will look for instances of large, unexplained errors and attempt to correlate these errors with situations where controllers have intervened on an aircraft's path.