Data Mining of Air Traffic Track Data for NGATS
—Abstract—

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The Next Generation Air Traffic Control System (NGATS) heavily relies on the accurate prediction of aircraft trajectories. Tasks like the detection of separation conflicts or planning fuel-efficient and safe descents require the system to predict position, altitude, and speed of an aircraft for up to appr. 20 minutes ahead, based upon the current position and weather data. Simulation of a physical model of the aircraft forms the core of the prediction. In practice, however, there is a number of unknowns to be taken into account. Typically, weight of a specific aircraft as well as other performance data or procedural specifics are not available, but are essential for an accurate prediction.

In this abstract, we describe how the AutoBayes tool can be used to extract parameters of interest from actual track data. Track data are recordings of actual air traffic in 12 second intervals, which contain position, altitude, ground speed, heading, among other data for each aircraft in a specific airspace sector. Typically, a 24 hour recording around a major airport contains thousands of aircraft tracks.

We have been using such data to determine several aircraft parameters and track characteristics, most notably, clustering of different trajectory types, characteristics of CDA (Constant Descent Approaches), and determination of the CAS-mach transition point during ascent. In this abstract, we focus on the CAS-mach transition. When an aircraft climbs toward cruise altitude, it usually starts its climb with a constant (calibrated) airspeed (CAS), measured in knots. At a certain point, the flight management system (FMS) on-board the aircraft switches over to a climb regime, where the mach number (relative speed with respect to the speed of sound) is kept constant. It is obvious that the prediction accuracy can be improved if all parameters of the switch are known; however usually these not available.

We are using the AutoBayes tool for the change-point estimation on large sets of track data. AutoBayes is a tool for the automatic generation of efficient data analysis algorithms (in C/C++), given a compact statistical specification. Internally, AutoBayes constructs a Bayesian network and evaluates the required probabilistic expressions symbolically as far as possible. Using a schema-based program synthesis approach, AutoBayes can generate complicated yet highly
customized algorithms fully automatically. For this analysis, we have used sev-
ereal variants of change-point detection and clustering of mixture models. With
a simple Matlab interface, we have been able to identify suitable ascent trajecto-
tories and to obtain the transition points for different types of aircraft. This
analysis is a first step toward using AutoBayes statistical models for the analysis
of aircraft track data for analysis and verification/validation purposes.