Predicting the Propagation of Trajectory Uncertainty during Climb

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Abstract— Robust Trajectory Prediction is one of the key enablers for the aspiring development towards Trajectory-based Operations. With increasing look-ahead times and the need for automation, the impact of uncertain input variables to the Trajectory Prediction must be understood. In this study, some uncertain input variables are provided as input probability density functions for the aircraft mass and speed intent (multiple phases with constant Calibrated Air Speed or Mach number) by a neural network. A Monte-Carlo simulation is used to predict 10,000 climb phases with a look-ahead time of 600 seconds for six different aircraft types. The resulting Trajectory Uncertainty is analyzed to proof that the stochastic characteristics of the input can be used to predict the Trajectory Uncertainty. Despite the moderate look-ahead time, about 80% of the resulting trajectory uncertainty fails the test for normality. However, the cross-over altitude is Normal distributed with the given input. The findings are applicable to decision support tools, if the uncertainty in the Trajectory Prediction shall be included.