Research Context
This PhD research will involve developing a formal model of the different types of information used in a trajectory prediction process, focusing on the stochastic factors affecting such process. A stochastic factor is defined as a source of trajectory prediction uncertainty, i.e. of random deviations between a nominal predicted trajectory and the actual observed trajectory flown by the aircraft, usually referred to as trajectory prediction errors. To develop the model of the stochastic factors affecting trajectory prediction, it is proposed to apply concepts from the Theory of Formal Languages [1]. Thus, a formal language approach will be proposed to characterize the sources of trajectory prediction uncertainty. The results of the proposed PhD research will contribute to evaluate the impact of trajectory prediction uncertainty on future trajectory-based operations, supporting the design of advanced automation tools to enable advanced trajectory management functions.

Operational uncertainty, e.g. differences between the pilot/FMS behavior models used in trajectory prediction and that actual guidance strategy of the pilot/FMS.

Main Research Objectives
• Develop a formal theoretical framework for the analysis of trajectory prediction uncertainty in the context future trajectory management applications.
• Detailed study and classification of the stochastic factors affecting trajectory prediction in ATM.
• Definition of robust strategies for managing uncertainty effectively accordingly to the confidence required by the future DSTs.
• Provide practical methods and tools to evaluate the impact of the different stochastic factors on trajectory prediction accuracy, with a view to facilitating the development of requirements for advanced automation tools regarding uncertainty management in future TBO.
• Identification of high level requirements for trajectory prediction tools capable of taking into account uncertainty in a rigorous manner and of generating stochastic trajectory prediction outputs.

Formal Languages
The proposed framework will provide the means to model the different stochastic factors affecting the aircraft trajectory (considering their mutual correlations) based on the Theory of Formal Languages and leveraging the trajectory modeling paradigm defined by the AIDL [2].

The AIDL is a formal language intended to express aircraft intent in a univocal, rigorous, and standardized manner.

As a formal language, the AIDL is defined over the finite set of instructions which comprise the AIDL alphabet. In addition to being the alphabet symbols, the AIDL instructions also have certain features employed by the language grammar.

References