Probabilistic 4D Flight Planning in Structured Airspaces through Parallelized Simulation on GPUs

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Abstract— The Air Traffic Management system is evolving to deal with efficiency, capacity, safety and environmental challenges. Progress along these fronts requires the development of trajectory planning and prediction tools that can deal with a complex and uncertain meteorological and operational context and go beyond the deterministic planning paradigm that underlies the technologies currently in place in ATM. In this work, we introduce a novel flight planning methodology to generate weather-optimal 3D flight plans in structured airspaces. By leveraging general-purpose computing on graphics processing units, we can simulate and evaluate multiple trajectory options under multiple scenarios in parallel, allowing us to provide quick iterations to a stochastic optimization algorithm. Our computational experiments show that our implementation can provide efficient solutions in seconds, as required in practical settings, while allowing for simple integration of future extensions thanks to its simulation-based nature.