The ATS Route Planning Problem for Airplanes

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Abstract: The goal of the ATS (air traffic service) route planning problem for airplanes is to compute a feasible minimum-cost 4D-trajectory between two airports in an ATS network for an aircraft (departing at a given time) and its starting amount of fuel fast. The total cost is the sum of fuel cost, overflight cost, and possibly time cost. Weather forecasts, aircraft properties as well as security and operative constraints regulating air traffic, called traffic flow restrictions (TFR), have to be considered.

From the mathematical perspective it is a shortest path problem with complex constraints and dynamic edge costs on a large graph. While the overflight cost is non-additive on edges, the fuel consumption on each edge depends on the present weight of the airplane as well as the weather condition of the area where the airplane is located. The TFRs can be reduced to the so-called forbidden pairs, i.e., pairs of nodes that cannot be visited both, and binding pairs, i.e., pair of nodes that must be visited both or none of them. It is however NP-hard just to answer whether such constraints are feasible.

In this talk we present a discrete-continuous approach for the problem. Due to the requirement of real world aviation operations our algorithm need to deliver a good solution within less than a minute.

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