Oceanic Traffic Optimization

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Aircraft flying in continental airspace are controlled by the mean of radars with a range of about 300 Nautical Miles (1NM= 1852 m). When they enter oceanic airspace they cannot be monitored by radars anymore and typical procedures have been established in order to ensure safe navigation. Such procedures are based on an Organized Track System (OTS) which is set up on a diurnal basis to facilitate a high throughput of traffic by ensuring separation for the entire oceanic crossing. The track networks are built according to the position of the West-East jet stream. The USA-Europe network is located on the jet stream and the Europe-USA network avoid it.

Each network consists of a set, typically 4 to 7, of parallel or nearly parallel tracks (see Figure 1).

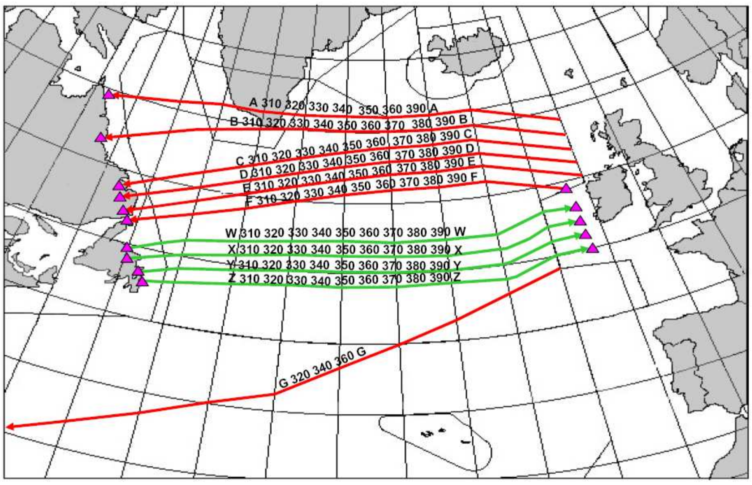

Figure 1: Track network on North Atlantic Ocean

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The separation is maintained with respect to three dimensions:

- Vertical : 1000 feet (1ft $\simeq$ 0.30 m).
- Lateral: the distance between closest tracks is 60 NM.
- Longitudinal : the time separation between subsequent aircraft following the same track is 10 minutes. When an aircraft want to shift from one track to an adjacent track, the separation must be at least 15 minutes with aircraft located on such adjacent track (see Figure 2).

The longitudinal separation is the major factor preventing traffic streaming. Due to the large number of aircraft involved in the Oceanic Airspace, there are few opportunities for an aircraft to shift from one track to another in order to reach its optimum oceanic exit point. As a consequence, the Track Network Exit may be congested when aircraft are allowed to follow the original final destination.

The introduction of the new ADS-B system (Automatic Dependant Surveillance-Broadcast) will enable airborne separation reduction (3 minutes instead of 15). Based on this new separation standard, aircraft will be able to change their tracks more frequently in order to optimize their routes.

The paper presents the problem modeling (objective function, state space and constraints). Due to the induced combinatoric, we have developed a stochastic optimization process based on artificial evolution. Coding, recombination operators have been dedicated to such problem and have been successfully applied to real instances.

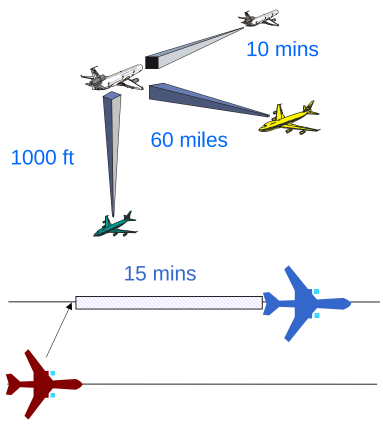

Figure 2: Oceanic Separation Standard