International Civil Aviation Organization

MIDANPIRG Sub Group

Second Meeting (ATM SG/2)
(Cairo, Egypt, 30 November - 03 December 2015)

Agenda Item 6: RVSM Operations and Monitoring Activities in the MID Region

MIDRMA AIRSPACE COLLISION RISK HOT-SPOT ANALYSIS SOFTWARE

(Presented by MIDRMA)

SUMMARY

This working paper details information concerning the MIDRMA Airspace Collision Risk Hot-spot Analysis Software developed to identify bottlenecks/hot-spots in the ICAO Middle East RVSM Airspace, to ensure that the risk of collision is not increased under certain traffic conditions.

Action by the meeting is at paragraph 3.

1. INTRODUCTION

1.1 The airlines of the Middle East and the Asia/Pacific regions are expected to experience the highest growth in passenger traffic at 5.8% per annum through to the year 2025. Air freight traffic of the airlines of the Asia/Pacific region is expected to remain the fastest growing at 8.0 % per annum, followed by the Middle East region (7.8 %). At the crossroads between Asia, Africa, and Europe, the Middle East is well positioned to compete for traffic connecting these regions.

2. DISCUSSION

2.1 There are several key challenges in the Middle East Region, large sections of airspace remain under military control, reducing the airspace available for commercial traffic. The region's air traffic control systems are not centralized, leading to coordination challenges for air navigation service providers (ANSPs). This situation is worsened by conflict zone in the region which leads to frequent closure of large airspaces which in turn creates congestion pockets in the detour airspaces.

2.2 As a result of this, innovative and effective capabilities are required towards airspace management and air traffic safety. One of the drivers for managing air traffic growth is to increase airspace capacity without reducing safety. This requires identification of bottlenecks/hot-spots in airspace and traffic flow, to ensure that the risk of collision is not increased under certain traffic conditions.

2.3 Present day Collision Risk Models (CRMs) focus more on statistical distribution of deviation from planned path, rather than on the nature and characteristic of traffic events that lead to collision risk. This numeric approach provides little understanding of the key indicators that might leads to high risk scenario. An understanding of interaction between traffic flow and airspace features and its impact on collision risk can be valuable information for ANSPs. This insight may also reflect the robustness of an airspace, in terms of how much traffic, and of what nature, an airspace can accommodate while still remaining below the safety threshold. This may not only aid in the design/re-design of airspace/sectors, but may also assist ATCs in identifying traffic flow management strategies that might lead to increased collision risk under various traffic and sector characteristics.

2.4 Such capabilities require a comprehensive suite of a spatial-temporal software system that can perform a variety of complex computations and collision risk analysis while presenting the results in clear and unambiguous fashion. It is also desirable that such capability transform into a visual decision making tool that can advise, both pre and post events, the regions of high collision risk in an airspace.

2.5 Proposed Methodology

The proposed methodology is divided into two key stages:

a) **Integrated Collision Risk**: Design and development of a comprehensive software suite which can model and asses air traffic data and various collision risk parameters and;

b) **Hot-spot Analysis**: Design and development of a collision risk Hot-spot assessment software system with graphical interface and analysis capabilities.

2.5.1 **Integrated Collision Risk Modelling**

The software designed to compute the Total Vertical Error (TVE) by independent modelling of Altimetry System Error (ASE) and Assigned Altitude Deviation (AAD). The integrated modelling of the two key parameters along with ICAO Collison Risk model parameters will enable detailed analysis of collision risk parameters. It will make use of ASE, AAD databases as well as large Height deviation report (LHD) from the member states.

2.5.2 **Hot-spot Analysis**

2.5.2.1 Definition:

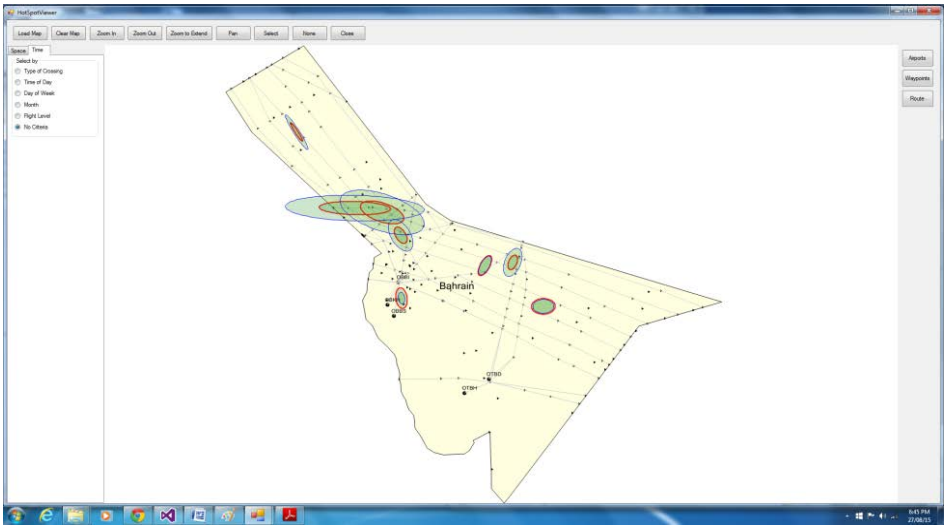
Near mid-air collisions (NMAC) FAA defines NMAC as either an incident in which the possibility of collision occurs as a result of an aircraft's proximity of less than 500 feet to another aircraft or an official report from an air crew member stating that a collision hazard existed between two or more aircraft. Hot-spots are often located where different traffic flows converged, both in space and time, in the same airspace.

2.5.2.2 Hot-spot Modelling

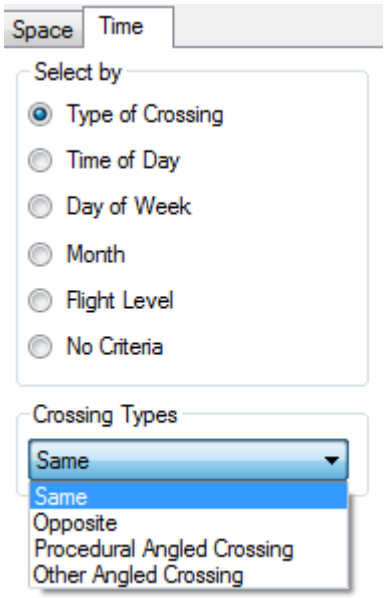
A number of techniques will be used to identify areas in the Middle East airspaces where the Total Vertical Collision risk is high (i.e. hot-spots). For example, the crossing trajectories (at an angle θ, where $\theta = 0$ or 180o in cases of two flights travelling in the same direction or opposite directions on the same flight route, and $0 < \theta < 180$o otherwise) and the risk probabilities associated with the crossing points is visualized in 3D with color/weight codes to show the distribution of high risk areas in the different airspaces. Scientific clustering methods, such as spatio-temporal statistical clustering, density-based clustering or methods borrowed from network analysis, can be used to identify areas with high density of high collision risk.

2.6 The MIDRMA Airspace Collision Risk Hot-spot Analysis Software was developed by the IT Research Team in the University of New South Wales (Canberra – Australia) and was supervised by the MIDRMA, the software is still in the test phase, the MIDRMA and the research team is planning to test excessively to ensure the results are very close to reality and according to the traffic data fed in the software.

2.7 The traffic data for Bahrain FIR was used to develop the software as it's always easier for the MIDRMA to request the data from Bahrain ATM according to the software format, the pictures below explains some of the features of the Hot-spot Software and the outcome of the analysis:



2.8 The software has the capability to analyze the data for a certain period of time and type of crossing and within certain flight levels (the plan is to make use of the software even below the RVSM airspace).



2.9 The MIDRMA will include an appendix about the analysis of this software in the SMR 2015 for each FIR in the ICAO Middle East Region which can help all MIDRMA Member States to identify their bottlenecks/hot-spots according to the submitted traffic data.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) propose additional features/feedback that would enhance the software; and

b) urge States to provide the MIDRMA with their amended AIP ENR Sections 3 and 4, in a timely manner, in order to ensure that the results reflect the effective/updated airway structure.

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