Free Route Air Traffic Flow Manager

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Abstract

As the world moves towards the era of Globalization and as the business world continues to revolutionize, meeting the expectations of a timely and safe air transportation system has become major challenge to the field of aviation.

Most of the existing air traffic control systems primarily focus on generating pre-defined routes for aircrafts based on the 'Fixed Route Model'. But with the advancement of technologies in the field of aviation an effective and practical mechanism called 'Free Route Modeling' has been introduced.

The few test beds that exist worldwide based on this concept, have been implemented for certain specific airspaces eliminating the possibility of using this strategy at any location worldwide. This paper presents the design and implementation of the 'Free Route Air Traffic Flow Manager' project which proposes a framework which can be used as a generic tool to over come this limitation.

This tool will allow the user to dynamically create a free route modeling system for a certain airspace by configuring a 3D airspace according to the given requirements for that airspace. The dynamically developed free route modeling system will facilitate the functionalities of generating the initial free route for an aircraft & provide dynamic re-planning for the configured air space when a conflicting scenario is reported.

1. Introduction

The need for a timely and safe air transportation system has become a vital requirement as the number of aircrafts that enter the air space increase day by day. This number is predicted to increase at a very rapid rate in the mere future. Thus air traffic flow management has become a major challenge in the field of aviation.

The main purpose of an air traffic control system is to facilitate a conflict free environment for the aircrafts, utilize the limited air space for a large number of aircrafts and provide maximum comfort to its passengers [1] [3]. At present air traffic flow management is carried out manually and therefore increases the risk of air disasters with the increase of air traffic.

Most of the existing systems primarily focus on generating pre-defined routes for the aircrafts. Thus these air traffic control systems are based on the 'Fixed Route Model'. This enables the route planning process to be done adhering to a network model that assumes a fixed network of corridors within the airspace [1]. However with the increase in air traffic this conventional methodology of routing does not seem to function efficiently [1] [2].

The main drawback of the fixed route concept is that it is not possible to utilize airspace effectively by adjusting the routes according to factors such as flights that need to be rescheduled and weather restrictions. Also it is not possible to define a global set of 'fixed routes' with minimum travel distance, which can cater for all the necessary flight schedules [1] [5] [6].

The re-planning process under this concept is also not efficient in terms of fuel & distance due to the rigid fixed route structure that has to be followed in the re- planning process. Also providing the maximum comfort to the passengers cannot be fulfilled due to constraints set by the route network. Thus it is clear that the existing "Fixed Route" air traffic control systems will not be able to cater to the increasing traffic demand in the future.

With the advancement of technologies in the field of aviation an effective and practical mechanism for air traffic control called 'Free Route Modeling' has been introduced [1]. 'Free Route Model' is one of the newest research concepts that have been introduced, which allows the users to freely plan the routes between an entry & exit point of the airspace with out reference to a route network [1] [2]. Thus this method is capable of providing more accurate route planning in an efficient manner.

The main benefit of the "Free Route" model is that the routes can be selected freely to optimize the utilization of available airspace according to dynamically changing factors such as number of flights, weather, etc. Also it is possible to define the shortest possible route between an entry & exit point because this concept does not adhere to a route network & thus can define arbitrary routes as preferred which may change from one schedule to another [1] [5]. Since this concept does not adhere to a network structure a more optimal route can be proposed for an aircraft in re-planning in terms of fuel and distance [6]. Thus a "Free Route" air traffic control system will be the ideal solution to cater to the increasing requirements and trends in the field of aviation.

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