

Chapter 6.5

Balance Modelling and Implementation of Flow Balance for Application in Air Traffic Management

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ABSTRACT

This work describes a decision making support system with Graph Theory and Artificial Intelligence methodologies applied to the Brazilian Air Traffic Flow Management. It consists of a flow management model based on graphs with heuristic adaptations for the dynamic regulation of the air traffic flow. The model lays the foundation of the architecture of the Flow Balancing Model (FBM) which integrates the Distributed Decision Support System applied to the Tactical Management of the Traffic Flow (SISCONFLUX), under

development, and has the objective of improving the national airspace management. The FBM was proposed to give support to the system in operation at the First Air Defence and Air Traffic Control Integrated Centre (CINDACTA I), by providing additional information to the process applied by the controllers, in order to mitigate the workload and improve the results of their actions. Using flow maximization techniques adapted from Graph Theory, FBM was developed as a model of analysis which determines the separation time between departures from terminals integrating the Brasilia Flight Information Region (FIR-BS), and distributes the slack capacity along the controlled airspace, in order to prevent or reduce

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traffic congestion in various sectors of FIR-BS. The FBM gives support to traffic flow regulation, assisting the controllers and other units within the SISCONFLUX.

INTRODUCTION

Both the FAA (Federal Aviation Administration) and the aviation industry had forecast a growth of air traffic from 150% to 250% along the next two decades (Swenson et al., 2006). With the airline companies crisis in the USA and fuel prices bump those estimates were reduced, but Airbus still forecasts an average growth of 4.9% all over the world. According to Rafael Alonso, vice-president of the European aircraft manufacturer Airbus, even with the financial crisis in the United States, this increase will not be seriously affected (EFE, 2008). Todd Benson and Chris Aspin (2008) highlight the development of the airlines in Latin America even with raising fuel prices.

In Brazil, even after two serious accidents together with an air traffic crisis in less than two years, the aviation market remains hot and foreign companies view Brazil as a good investment opportunity (Benson & Aspin, 2008). Foreign enterprises, such as Lufthansa (Germany), LAN (Peru), and TAP (Portugal) signed code share agreements with TAM, which is considered the main Brazilian airline company, and, similarly, KLM Royal Dutch Airlines and Air France made an agreement with GOL company. Besides, David Neeleman, founder of JetBlue Airways, is interested in opening a new low cost company in Brazil.

The hardships faced by North American airline companies contrast with the Brazilian reality. In the USA, Delta Air Lines and Northwest Airlines announced a joint loss of 10.5 billion dollars in the first quarter of 2008 on account of the fuel price raising. In Brazil, despite bankruptcy of BRA, as well as OceanAir and Varig financial constraints, TAM and GOL continue profiting.

Due to this increase in demand, Air Traffic Flow Management (ATFM) has become an even more critical activity. Ensuring the safety of aircraft in flight and, at the same time, controlling operational costs is a complex task which requires accurate and fast decisions to be made.

Existing ATFM service in Brazil provides visualization of data treated by fixed and transportable radars, visualization of multi-radar synthesis, and flight plans treatment. This kind of service allows information exchange among adjacent control centres, emission of air-to-ground and air-to-air collision alerts, visualization of meteorological images combined with video-maps, and electronic strips containing information about flight plans. This mass of data is under the responsibility of air traffic controllers (Dib, 2004; Crespo et al., 2007), who make proper decisions according to flight plans. The workload laid on these professionals is high and there are operational and legal directives regulating operators working conditions. Consequent restrictive measures concerning air traffic flow control are applied to prevent established limits from being exceeded.

One of the factors related to Brazilian air transport sector crisis is associated with the empirical manner with which air traffic flow techniques are conducted (Crespo et al., 2007). The selection of these techniques and the proportion of the associated restrictive measures are established according to the personal experience of controllers in the roles of operator and supervisor. The number of variables involved in this process renders the empirical decision partially ineffective. Therefore, there is room for improvement by means of efficiency increment of restrictive measures applied. The systematic selection of adequate measures may contribute to the increase of system effectiveness.

The Air Navigation Management Centre (CGNA) already possesses tools to perform various analyses based on statistical studies and forecasts from the Air Traffic Flow Management System (SYNCROMAX). The SYNCROMAX solution, developed by Atech Technologies company, is in

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