Chapter 10
A Case Study of Advanced Airborne Technology Impacting Air Traffic Management

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ABSTRACT

Great advance is expected from the CNS/ATM (Communication, Navigation, Surveillance / Air Traffic Management) paradigm. It provides significant support of a seamless global air traffic management system. Its key technical elements are the Global Navigation Satellite System (GNSS), and the Aeronautical Telecommunication Network (ATN), which will support digital applications such as the Automatic Dependent Surveillance Broadcast (ADS-B) and the Airborne Separation Assistance System (ASAS). ADS-B will greatly increase surveillance precision and availability, and ASAS is aimed to increase traffic efficiency. This chapter provides an overview of the CNS/ATM infrastructure, the specific airborne technologies, and details of an example advanced air traffic management concept. For this example advanced concept, the chapter applies an advanced approach in dynamical safety risk modeling and Monte Carlo

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INTRODUCTION

The advent of ubiquitous distributed computing, communication and sensing systems has created an environment in which we have ability to access, process and communicate huge amounts of data. This environment could be mentioned as the major enable for new applications of control for large-scale, complex systems (Murray et al, 2003). Currently, energy and water distribution and manufacturing processes are some application areas that use the integration of distributed computing and communication in supervision and control systems to optimize their processes performance and to increase their service capacity.

This phenomenon can be noticed in one of the key services upon which our global society is build: air transportation. As a way to increase the air transportation capacity, changes in the air traffic management paradigm are agreed by the International Civil Aviation Organization (ICAO) to critically depend on joint international improvements at many levels of Communication, Navigation, Surveillance and Air Traffic Management (CNS/ATM). More specifically, CNS/ATM has been defined as follows: “Communications, Navigation, and Surveillance systems, employing digital technologies, including satellite systems together with various levels of automation, applied in support of a seamless global air traffic management system” (ICAO, 2000). Compared to conventional CNS/ATM approach, the key improvements cover the following elements of CNS/ATM:

- **Communication**: increasing the coverage, accessibility, capacity, integrity, performance and security of aeronautical communication systems, in accordance with future ATM requirements;
- **Navigation**: increasing the coverage and capacity of air operations in any weather conditions and airspace types, including approaches and landings, while maintaining or increasing the levels of integrity, accuracy and performance, in accordance with future ATM requirements;
- **Surveillance**: expansion in the effective coverage over oceans and remote areas, and the increment of situational awareness levels for pilots, in accordance with future ATM requirements.

In order to achieve these desired improvements for each of these three system elements, ICAO has developed the following evolution plan for the technologies applied to the elements of Communication, Navigation and Surveillance of the air traffic system, as shown in Figure 1, based on (Vismari, 2007).

The framework of technology enhancements, pictured in Figure 1, aims to provide, in a systematic way, higher levels of automation and accuracy to the air transportation system, and minimizes the current restrictions to air capacity growth. It will contribute to the completion of the CNS/ATM main mission, which is to develop a comprehensive and unified system to Air Traffic Services (ATS) that comply with the demand growth for this modal of transportation, and with improvements in the levels of safety, efficiency and regularity of air traffic, providing the use of the routes desired by users and minimizing the differences in use of equipment currently seen different regions of the planet.

Simulation based mid air collision risk estimation. The dynamical model covers the advanced airborne technologies and the cognitive contributions by the pilots and controllers involved. These initial results show the value of advanced airborne technologies for future air traffic management.