

Dynamic Network Approach to Air Traffic Management

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Abstract : Congestion in the Terminal Maneuvering Areas (TMAs) of larger airports impacts all aspects of air traffic flow, not only at national level but may also induce arrival delays at international level. Hence, there is a need to monitor appropriately the air traffic flow in TMAs so that efficient decisions may be taken to manage their occupancy rates. It would be desirable to physically increase the existing airspace to accommodate all existing demands, but this question is entirely utopian and, given this possibility, several studies and analyses have been developed over the past decades to meet the challenges that have arisen due to the dizzying expansion of the aeronautical industry. The main objective of the present paper is to propose concepts to manage and reduce the degree of uncertainty in the air traffic operations, maximizing the interest of all involved, ensuring a balance between demand and supply, and developing and/or adapting resources that enable a rapid and effective adaptation of measures to the current context and the consequent changes perceived in the aeronautical industry. A central task is to emphasize the increase in air traffic flow management capacity to the present day, taking into account not only a wide range of methodologies but also equipment and/or tools already available in the aeronautical industry. The efficient use of these resources is crucial as the human capacity for work is limited and the actors involved in all processes related to air traffic flow management are increasingly overloaded and, as a result, operational safety could be compromised. The methodology used to answer and/or develop the issues listed above is based on the advantages promoted by the application of Markov Chain principles that enable the construction of a simplified model of a dynamic network that describes the air traffic flow behavior anticipating their changes and eventual measures that could better address the impact of increased demand. Through this model, the proposed concepts are shown to have potentials to optimize the air traffic flow management combined with the operation of the existing resources at each moment and the circumstances found in each TMA, using historical data from the air traffic operations and specificities found in the aeronautical industry, namely in the Portuguese context.

Keywords : air traffic flow, terminal maneuvering area, TMA, air traffic management, ATM, Markov chains

Conference Title : ICASA 2019 : International Conference on Aerospace Systems and Avionics

Conference Location : Lisbon, Portugal

Conference Dates : October 30-31, 2019