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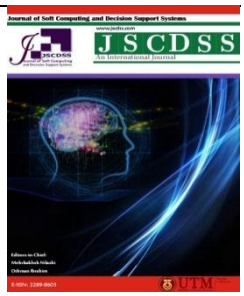

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A New Intelligent Approach to Aircrafts Take-off/Landing Planning at Congested Single Runway Airports

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Abstract

Nowadays, air transportation has gained a significant growth due to its advantages in transporting goods and passengers. The rapid growth of this activity and some limitations in different parts of aviation operation often cause traffic congestion the mismanagement and proper planning of which can lead to a lot of flight delays; accompanied by different problems. In order to appropriately systematize air traffic congestion various researches have been done during the recent two decades the major part of which is dealing with planning of aircrafts taking-off and landing. Thus, in the current study; and for the first time, the two algorithms Biogeography-Based Optimization (BBO) and Particle Swarm Optimization with Constriction Coefficient (CPSO) deal with a feasible planning of aircrafts take-off /landing, taking modern conditions and limitations into account. Simulations prove that adding rich and effective knowledge to optimization process can, to a large extent, undue and redundant outcomes; and increase convergence rate of the above algorithms. This can be followed by over 50% of total flight delays compared with First-Come/First-Serve (FCFS) plan. Besides, comparing the results of applying the two new optimization algorithms showed that BBO can be more effective than CPSO because of its better research domain.

Keywords: Take-off/landing, Total flight delays, ROT, CPSO, BBO

1. INTRODUCTION

In recent decades, because of various advantages of air trips including comfort, cost reduction, high speed and great safety, requests for air transportation services have increasingly grown. The imbalance between this growth and the air traffic capacity in routes, sectors, terminal areas and airports has brought about air traffic congestion (Yifei & Kai, 2010). Unless air and ground traffic congestion in airports is properly controlled, it can lead to diverse negative results including lots of flight delays, passengers' dissatisfaction, decrease of airlines' profitability , increase in operational errors on the part of traffic control personnel (controllers), increase of fuel consumption of aircrafts, and increase of ecological pollutants.

These problems made those in charge of and specialists in aviation industry search for appropriate practical solutions to introduce optimal control on air traffic in different domains. One most important domain of these is systematizing traffic in air routes and airports. The initial approaches to control traffic congestion and decrease of flight interference in air routes included the presentation of new air routes (Zhang et al., 2011; Yuan & Min, 2010). Not being economical of the new routes regarding distance and consumed fuel of aircrafts, as well as the high cost of constructing and maintaining of navigation and radar sites for them had some researchers use simulators and flight planning systems so as to decrease traffic congestion and remove probable flight interference. Another domain that could specifically impact on traffic congestion in the air routes and terminal control area (TCA) was systematizing traffic congestion in the arrival/departure operation of flights.

Although, initially, some tentative solutions including the construction of new runways or airports were presented in this respect, they were faced with a lot of economical and geographical limitations. Thus, as the computer science developed, planning systems came into use. In spite of being useful, the systems were not able to reach the optimal or nearly optimal solutions. Such problems and the non-linear and non-convex nature of the NP-hard problem of aircraft landing planning (ALP) led to the usage of different heuristic and meta-heuristic algorithms by many researchers of the field in the two recent years (Amrahov & Ibrahim Alsalihe, 2011; Hancerliogullari et al., 2013).

Cheng et al. (1999) presented four genetic search methods for 12 aircrafts and 3 parallel runways. Then,