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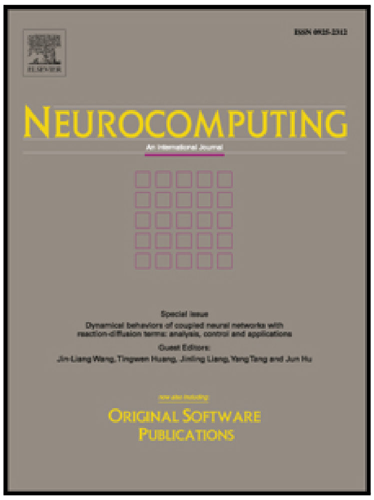

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Solving Long Haul Airline Disruption Problem Caused by Groundings Using A Distributed Fixed-Point Computational Approach to Integer Programming

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Abstract

Disruptions are prevalent phenomenons that prevent airline from operating as original scheduled. This paper adopts the iterative fixed-point method for integer programming proposed by Dang and Ye [1] to generate feasible flight routes that are used to construct an aircraft reassignment in response to the grounding of one aircraft. Two division methods are proposed with which the solution space can be divided into several independent segments and implemented a distributed computation. The second division method is emphasized in this paper for the good performance of partial feasible flight routes which are generated by this division approach. Comparison with CPLEX CP Optimizer [2] shows that less partial feasible flight routes which are generated by Dang's algorithm [1] are required to find an aircraft reassignment when disruptions happen, and this division method is more promising when dealing with long haul airline disruption problem.

Keywords:
Airline Disruption Management, Irregular Operation, Fixed-Point Method, Integer Programming, Distributed Computation, Lexicographical Order, MPI

1. Introduction

1.1. Brief about airline disruption problem

Travel by aircrafts is the most convenient way of transportation, especially for long distance travels. The operation of an airline requires the development of their flight schedules by creating flight scheduling, fleet assignment, aircraft routing and crew scheduling, and the execution of airline operation is identical with the flight schedules [3]. But frequently there are disruptions that prevent these schedules from operating as original planned. These disruptions mainly caused by unanticipated incidents such as severe weather, crew absence, aircraft breakdowns, airport & air traffic restrictions and so on. Disruptions of one flight or airport may spread to the following flights and airports causing massive flight cancelations and delays [4], and the European airline punctuality report [5] reveals that only 3.6% of flights are delayed by severe weather condition while 15.1% of fights are delayed due to the propagation of the delayed flights [4]. That is to say, the solution methods and efficiency of the airline disruption problem affect the whole planned-schedule more than sources of disruptions. So an airline must be able to return to the original schedule from disruptions by producing recovery plan as quickly as possible.

The recovery plan is produced by reassigning crews, aircrafts, passengers and other related resources, resulting some flights are canceled and some are delays according to the recovery plan. The recovery plan is required to be less deviated from original plan and it can be recovered from disruption to original schedule quickly. An inefficient recovery plan causes propagation that more aircrafts are delayed or canceled. It is a complex task to produce recovery plans because many resources such as passengers, aircraft and crew have to be reassigned. When a disruption occurs in the day of operation, large airlines always respond by calculating the problem in a sequential fashion concerning the problem components: passengers, crews, ground operations and aircrafts. The whole process is iterated until a

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