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Decision Support Systems for Tankering within the Airline Industry

Barry McCollum • Graham Kendall • Paul McMullan • Joe Mc Goldrick

1 Introduction

In recent years, the aircraft industry has attracted the interest of optimisation and scheduling researchers [1]. As with most real world problems there are many issues that have to be addressed in order to capture the complexities of the real world, and this is true of many of the problems faced by the airline industry. In this work we are particularly interested in the optimisation of fuel usage by airlines. This problem is known as tankering.

Aircraft fuel represents a significant cost to the industry and, for some airlines, it is their largest operating cost. The fuel costs for British Airways, for example, for the financial year ending in 2007 was £1,931M [2]. This represented a 22.1% increase over the previous year, which had already seen a 44.7% increase from the preceding year. In comparison, BA's employee costs were only slightly higher (£2,227M), with the increase over the previous year being only 0.8%. This suggests that although airlines have control over employee costs, the market dictates their fuel costs. Based on a 2007 US report on the aviation industry, it is estimated that the factors surrounding tankering are responsible for an annual wastage of 5% of aircraft fuel in the United States alone. The annual US usage of fuel was 21 billion gallons (80 billion litres) in 2006. Currently the cost of the fuel is £2.75 a gallon. Assuming current fuel usage is on a similar scale to 2006, within the US, tanking represents wastage of £2.89 Billion. Worldwide, it is estimated this could be as much as ten times this figure [3].

Operational data such as flight routes, when and where to re-fuel, how much fuel to take on at any given service point, landing charges and potential passenger load etc. are all routinely collected by airline companies. However, current software used within the airline industry is unable to offer effective optimisation of fuel usage. In addition, no effective decision support system is able to offer advice on route planning, advice on speed/altitude and where to refuel.

Takering encompasses how airlines seek to minimise their fuel costs by attempting to optimise various operational factors. For example, flight routes, when and where to re-fuel,

Barry McCollum
Queen's University Belfast
E-mail: B.McCollum@qub.ac.uk

Graham Kendall
The University of Nottingham
E-mail: gxk@cs.nott.ac.uk

Paul McMullan
Queen's University Belfast
E-mail: p.mcmullan@qub.ac.uk

Joe Mc Goldrick
Aircraft Management Technologies
E-mail: Joe.McGoldrick@flightman.com

how much fuel to take on at any given service point, landing charges and potential passenger load. It is considered essential by the industry that any optimisation approach should also provide robust solutions allowing for unforeseen circumstances such as aircraft availability, breakdown etc.

Currently, decisions relating to the amount of fuel carried and where and when to refuel are based on only a small proportion of the information available i.e. the captain can choose to refuel at various scheduled stops, which may not lead to the most efficient fuel usage. When considered across the entire industry, this suboptimal approach leads to massive fuel waste through burn off and financial waste though differential fuel pricing. In addition, it suggests that there is a need to optimise routes in the future based on minimising fuel costs, while considering all other objectives e.g. maximising passenger load etc.

Our industrial collaborator, Aircraft Management Technologies (AMT), is an award winning provider of software technology to automate and streamline operations within the aviation industry. Their flagship product, Flightman™, offers a family of products comprising innovative software technology which synchronises an extensive data model between the aircraft and various airline ground systems. It also provides forms and workflow tailored to various users to enable dramatic process improvement in the cockpit, cabin and on the ramp, thus reducing costs and enhancing efficiency in aircraft operations and maintenance.

Our research plans, working in collaboration with AMT, aims to address the tankering problem, by defining it as an optimisation problem where the objective is to minimise fuel costs. In its simplest form, the problem is one of accurately balancing fuel load against distance to the next location. However, the real world problem provides more complex scenarios. One important factor, which currently exists, is the captain's overestimate of the amount of fuel required due to the existence of a *comfort factor*. When an aircraft is taking fuel on board, in addition to price, factors which must also be considered are location, fuel availability, loading, charges and planned future routing (which includes the countries which are flown over as this has implications for charging).

The present state of our research is to fully understand the problem, by consultation with our industrial partner. At the conference we will further define the problem, and present any modeling and solution methodologies we have considered. We will also plan to undertake a data collection phase so that we can evaluate our proposed methodologies on real world data, rather than generated data which might not accurately reflect the real world.

References

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