Decision Support Tools for Dynamic Fleet Management
- applications in airline planning and ambulance logistics

Tobias Andersson

Abstract

In this work, decision support tools for dynamic fleet management problems are developed. The operational management tasks include dispatching, supervising and sometimes reconstructing the vehicle schedule. These tasks are often complex, while the time available to complete them is short. Therefore, decision support tools assisting the controller can be of great service.

Two studies on dynamic fleet management problems are presented. The first concerns airline planning and the problem of how to handle schedule perturbations. The second study is within the field of ambulance logistics, with focus on operational ambulance control.

For an airline, the flight perturbation problem arises when it is impossible to continue executing the original aircraft schedule, e.g. due to an aircraft breakdown. The flight controller then has to decide whether some flights have to be delayed or cancelled, or perhaps flights have to be reassigned to new aircraft. This is done in order to find an attainable, cost effective solution, where the airline can continue to serve the passengers. In this work, a decision support tool that can repair the aircraft schedule is suggested. The tool is based on a multicommodity network flow model with side constraints. A number of different solution strategies are suggested for the model, including heuristics based on column generation and meta heuristics utilizing path relinking. Computational tests show that several of the solution algorithms find near optimal solutions within a few seconds.

Ambulance logistics comprises most aspects of managing an efficient ambulance health care. This involves both emergency medical services and patient transportsations. Controlling a fleet of ambulances includes deciding which ambulance to dispatch to a call. The controller also has to ensure that most or all parts of the area of responsibility can be reached by an ambulance in a short time. This is referred to as maintaining an adequate level of preparedness in the area. In this work, a way of calculating the preparedness is presented. It is incorporated into a number of decision support tools, including a dispatch tool and a relocation tool. The dispatch tool can suggest which ambulance to assign to a new call. The relocation tool suggests a way of relocating the ambulances, i.e. sending them to new locations, to increase the level of preparedness in the area. A simulation tool is also developed and used to study the effect of dynamically relocating ambulances. Furthermore, it is used to test if new locations for the ambulance stations will affect the waiting periods for the patients. The results show that the decision support tools have a positive effect on the system performance.