On Solving the Railway Cyclic Crew Rostering and Rerostering Problem

I-Chiao Lin

Department of Industrial and Information Management

National Cheng Kung University

The Cyclic Crew Rostering Problem (CCRP) aims at ordering a set of duties to determine a roster of shortest cycle time. Previous solution methods usually treat CCRP as a Specific Travelling Salesman Problem (STSP). Although the STSP model can schedule all the duties, it cannot deal with some difficult operational regulations that restrict the schedules of off-duty periods in a rolling base. To this end, we design a Multi-level Rostering Network (MRN) to illustrate the CCRP and then solve it by a Full Integer Programming model (FIP). Since FIP usually consumes too much computational time to determine an optimal roster, we develop the Fix-and-Search Algorithm (FSA) that calculates a suitable roster in very short time. Starting with a lower bound on the length of a roster cycle, FSA tries to connect a feasible roster path by three major steps: First, it determines a feasible setting for two classes of duties by solving a subproblem of PIP so that the operational regulations can be easily satisfied; Second, the schedules for the key duties are fixed; Third, a modified Depth First Search (DFS) algorithm is used to find a feasible roster path. If no feasible roster path can be connected, FSA then increases the lower bound by one and repeats the steps until a feasible roster path is connected. The results of our computational experiments indicate FSA usually gives an optimal roster and is much more efficient than the STSP model in literature.

If some crew members cannot be on duty, the Cyclic Crew Rerostering Problem (CCRSP) to rebuild a new roster starting from a given date (usually the first date of absence) has to be solved to the end of the current roster such that the interference is minimized. In a sense, CCRSP can be viewed as seeking another optimal roster to the original CCRP, and these two rosters should be identical before a given date of interference and as similar to each other as possible after that interference. To this end, we propose the Integer Programming (IP) model based on a Multi-commodity Network Flow (MNF) network.

***Keywords*:** Cyclic Crew Rostering Problem, Cyclic Crew Rerostering Problem, Integer Programming, Depth First Search, Multi-commodity Network Flow

Thesis advisor: *I-Lin Wang*, ilinwang@mail.ncku.edu.tw
http://ilin.iim.ncku.edu.tw
***I-Chiao Lin* entered IIM of NCKU in 2008, graduated in 2010.**