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Block Scheduling at Magnetic Resonance Imaging Labs

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Abstract

This paper considers a tactical block scheduling problem at a major Norwegian hospital. Here, specific patient groups are reserved time blocks for scanning at a heterogeneous set of Magnetic Resonance Imaging (MRI) labs. The time blocks consist of several time slots, and one or more patients from the same group are scanned in a block. A total weekly number of time slots for each specific patient group is given through demand forecast and negotiations, and several restrictions apply to the allocation of time blocks. Only part of the week is allocated to blocks for the specific patient groups. The rest is classified as open time. Thus, the MRI block scheduling problem consists of finding a cyclic weekly plan where one or more time blocks are to be allocated to each specific patient group, by deciding the day, start time and length, to minimise unfavourable patient group allocations, as well as allocations of open time. For the problem, we propose an integer programming model with an objective function that combines penalties for allocating time blocks to patient groups at unfavourable time slots and labs, and rewards for advantageous positioning of open time slots. The aim of the optimisation model is to facilitate the coordination of the MRI resources between the hospital departments, that are responsible for the specific patient groups, to achieve a fair distribution of time slots to the specific patient groups and open time blocks. The computational study is based on the real problem as well as artificially generated instances. Real-sized instances for our case hospital can be solved in short time. We illustrate how the model can be used to produce Pareto optimal solutions, and how these solutions can provide the decision makers with managerial insight.

Keywords— block scheduling; MRI scheduling; tactical planning; integer programming

1 Introduction

The demand for health care services is increasing worldwide, and the demand for MRI (magnetic resonance imaging) scans is no exception. According to the Organisation for Economic Collaboration and Development (OECD) [19, 20], the number of MRI scans performed in western countries has increased dramatically in the last decade (see Figure 1). The number of MRI scans has grown at a higher rate than the number of MRI units, indicating a better utilisation of the MRI units by time. However, the pressure on good utilisation of such facilities is increasing because the MRI units are often major bottlenecks for the patient flow at hospitals.

Several external factors influence operations management decision making at public hospitals [27]. These external factors include budgetary targets, demographic changes, medical technological advances, and public's increased access to information. Public hospitals need to

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