Referee report

on the PhD thesis

Tomas Attila Olaj

New results for several rectangle packing and covering problems: Lower bonds and different types of algorithms

Tomas Attila Olaj's doctoral thesis deals with certain placement and packing problems. These problems represent a classic area of combinatorial optimization. Combinatorial optimization is an interdisciplinary field involving discrete mathematics and computer science. It is a rapidly growing area of research and has become very important also from the application point of view during the last forty years. Combinatorial optimization models have been successfully applied in such diverse areas as economics, environmental sciences, public transportation, industrial production and many others.

The packing problems discussed in the thesis are mainly related to the two- dimensional version, which can be generally formulated as follows: smaller rectangles must be placed in a given larger rectangle or rectangles such that certain conditions are met, and the packing is optimal for some objective function.

The thesis, excluding appendices and bibliography, is 101 pages long and can be divided into five distinct chapters. The first chapter contains the introduction, in which the candidate presents the problems examined, their solution methods and practical applications.

The substantive parts of the thesis are found in the second and third chapters. The second chapter discusses the so-called Board Packing Problem, which is a new problem. The chapter is based on a joint paper written by the candidate with four co-authors. It was published in one of the top journals in the field, the European Journal of Operational Research, which has an Impact Factor of 6.365 and a rating of D1. The chapter is also accompanied by a publication in a conference proceeding and two conference presentations. The results described here constitute Thesis 1, which, in addition to theoretical results regarding the complexity of the problem, also includes the definition and empirical comparison of an exact method and a heuristic algorithm.

The third chapter deals with two special problems, a square packing problem and a covering problem. This chapter also includes theoretical results, and a comparison of results obtained using mathematical programming methods and heuristics. The chapter is based on two journal papers, one with five and the other with six authors. The first paper appeared in the journal Annals of Operations Research, while the other has been published in Optimization Letters. The rating of both journals is Q1 and the corresponding impact factors are 4.82 and 1.502. The references also include two conference presentations. The results are listed in Thesis 2 and Thesis 3, which consist of giving new lower bounds and optimum values for different numbers of squares.

The fourth chapter lists the scientific results presented in the thesis. The final chapter summarizes the results of the thesis and mentions some tasks worthy of further investigation.

Evaluation

The dissertation examines an interesting and practically important area. It is clear that the problems examined above a certain size are difficult, as confirmed by theoretical results, but practical studies also indicate that even with the use of advanced computer techniques, a task can easily become unmanageable. Therefore, we can only say that accurate, optimal results are only possible for smaller problems. The dissertation clearly demonstrates what results the methods examined can provide.

The structure of the dissertation is basically good, the text is easy to read and does not contain typos. The figures and tables are nice and help understand the content.

The bibliography contains 122 publications, which indicates that the candidate has a thorough knowledge of the literature on the topic.

The thesis booklet contains three main theses, which are based on a total of seven publications and conference presentations. Three of these have been published in internationally prominent impact factor journals, which are rated D1 and Q1, respectively. The candidate thus meets the requirements of the Doctoral School of Informatics of the University of Pannonia. I accept the results listed in the theses as new scientific results.

Based on the above, I believe that the dissertation is suitable for a doctoral degree based on the scientific results presented, so I support the awarding of the degree in case of successful defense.

Questions:

1. The computational experiments in Chapter 2 shows that CPLEX gives “Out of memory” error in many cases. What is your opinion on the possibilities of using other types of methods, such as Constraint Programming, for the problems examined?
2. The third chapter of the dissertation discusses the square packing problem. What do you think, what kind of computer models or algorithms could be the best to decide whether, for example, small squares of consecutive sizes can be packed into a larger square?

Szeged, 13.10.2025.

József Békési
University of Szeged