Dr. Tibor Dulai, senior lecturer

Review of the PhD thesis titled
"New results for several rectangle packing and covering problems – Lower bounds and different types of algorithms"
written by Tomas Attila Olaj

Content

In his thesis, Tomas Attila Olaj deals with classic combinatorial optimization problems: these are special variants of board packing and covering problems. The topic of the thesis has significant practical relevance in a wide range of domains, like, e.g., VLSI design, scheduling, optimization of production lines, facility location applications (e.g., telecommunications, energy sectors), cutting stock and pallet loading problems, etc.

The thesis has three main chapters (followed by the brief presentation of the new scientific results and the conclusion of the work) and refers 122 relevant publications.

In the Introduction chapter, the author summarizes the related scientific literature in appropriate details. Here, the investigated and related problem classes and the possible methods for solving them are introduced. From this chapter the readers get picture also about the candidate's additional work, for example, he developed a Python-based GUI for the analysis of the used methods and their results.

The second chapter deals with the Board Packing Problem (BoPP) that was founded by the Candidate and his co-authors. It is shown that the problem is NP-hard. A mixed integer programming model was written up and an evolutionary algorithm developed to solve the problem. Benchmark instances were created for the investigation of the effect of several variants of the problem on the solution quality and the two solution methods were compared on them. The results of this chapter are summarized in the first thesis point and are supported by a journal paper with IF = 6.365 and two conference proceedings.

In the third chapter a classic problem, packing of consecutive squares on a square, and a newly introduced problem, its covering version were investigated. The Candidate ingeniously gave a lower bound (LB_2) with a nice proof for the square packing problem, moreover, the first asymptotic results were also given. Additionally, he performed the first investigation of the covering problem defined for consecutive squares. To solve the problem, a mathematical programming model was written up, a heuristic algorithm was developed and an expansion-like algorithm was introduced. Thesis points 2 and 3 are based on the results of this chapter. Both of them are supported by one IF journal paper (IF = 1.502 and IF = 4.82), and one conference presentation, separately.

It is worth to mention that in many cases the author goes beyond the characteristics of the problem under consideration to more general cases and their proposed solutions, which puts the topic of the thesis in a broader context.

Notes

Prior to the Candidate's home defence, I was one of the invited reviewers, so I had already evaluated the thesis, which gave me the opportunity to follow the further development of what was already an excellent dissertation. In my preliminary review, in addition to my general summary opinion, I pointed out in detail (on 7 pages) the points where, in my opinion, the dissertation needed to be supplemented or corrected. The candidate provided constructive responses to these points already during the home defence event, and my comments were taken into account almost entirely in the final version of the thesis. I would like to express my special thanks for the version in which the Candidate indicated the changes in detail, which greatly facilitated the preparation of the review.

Style

The consistency and accuracy of the content is exemplary.

The figures and tables illustrate accurately the content, making understanding easier. Compared to the previous version, the improvement in the illustration of combinatorial optimization methods is particularly noteworthy.

Structure

The structure of the thesis follows the covered topics and is well segmented to help structuring in mind the presented content.

Chapter 2.4. – that presents the developed evolutionary algorithm – deserves special mention, as its previous confusion has been eliminated thanks to the candidate's work, and it has been developed into a precise, detailed, and easily understandable chapter.

It has to be noted that it is unusual that the Introduction chapter begins with the subchapter "Structure of the thesis," which is typically placed at the end of the Introduction. However, this change is probably the result of the misunderstanding of one point of my review given on the original version of the thesis.

Opinion

The author has introduced the investigated problems well detailed and thoroughly by reviewing of the relevant scientific literature. The Candidate has done nice and valuable research on different methods to solve the problems and investigated deeply how the certain factors influence the difficulty of solving the dealt problems. It is also important to note, that the obtained results can be used in a wide range of applications.

The Candidate's research activity presented in his doctoral thesis is acknowledged by the international scientific community. This is supported by a publication activity that exceeds the requirements of the Doctoral School of Information Science and Technology of the University of Pannonia.

As a summary, the thesis represents a great deal of work and meets the requirements laid down for the degree of Ph.D. I appreciate the Candidate expertise in the field and I can accept his contributions. Based on the above, I recommend organizing the public defense of this thesis. In case of a successful defense procedure, I recommend awarding the Ph.D. degree to the Candidate.

Question:

Can your solutions to the BoPPs and Square Packing problems be modified to solve 3D problems? If so, how?

Veszprém, 22nd Oct 2025.

Tibor Dulai
University of Pannonia