

■ 연구논문 요약문1

논문제목	Comparative analysis of pattern-based models for the two-dimensional two-stage guillotine cutting stock problem
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개요	This study presents a theoretical and computational analysis of integer programs based on the concept of the patterns, the so-called pattern-based models, for a two-dimensional two-stage guillotine cutting stock problem. The full-pattern models and the staged-pattern models with the corresponding column generation problems are analyzed and compared. Those pattern-based models have been actively used, however, their LP-relaxations have not been theoretically analyzed and compared. In this paper, we formally establish a hierarchy of the strength of lower bounds that can be obtained from their LP-relaxations. In addition, through computational tests with benchmark instances, we analyze the trade-off between the strength of the lower bounds and the required computation time to solve the LP-relaxations of the models. The quality of integer solutions obtained by an LP-based branch-and-bound algorithm with the columns generated during the process of solving the LP-relaxations of the models are also compared. The results show that one of the staged-pattern models, which has not been well-studied, shows competitive theoretical and computational performance.
연구결과	- Theoretically, the constrained full-pattern model gives the tightest lower bounds among all the pattern-based models, while the basic full-pattern model gives the weakest lower bounds. The quality of lower bounds that can be obtained from the LP-relaxation of the constrained staged-pattern model cannot be better than those obtained from the LP-relaxation of the constrained full-pattern model. - Computational results with benchmark test sets show that the lower bounds provided by the LP-relaxations of FM(d), FM(∞), and SM(d, d) are almost the same. However, the computation time for FM(d) LP was much longer, which confirms the theoretical complexity of the corresponding column generation problem. In terms of the trade-off between the quality of the obtained lower bounds and the amount of computation time, SM(d, d) showed the best performance. In terms of the quality of integer solutions obtained by solving the integer programs with the limited columns, the solutions obtained using SM(d, d) were also the best. Altogether, the constrained staged-pattern model, which has not been well-studied in the existing literature, shows competitive theoretical and computational performance.
활용분야 및 기대효과	- Our results suggest future studies to devise heuristic algorithms and/or exact branch-and-price algorithms based on SM(d, d) for the two-dimensional two-stage guillotine cutting stock problem. - Further in-depth studies together with the results of this study can establish a formal hierarchy of the strength of lower bounds provided by the pattern-based models, the arc-flow model, and the one-cut model.