二維物件排列問題之啟發式求解研究

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摘 要

二維物件的排列與切割問題在工業界是很常見的一種問題。 諸如製鞋業、皮革業、鋼鐵業、成衣業等，雖然各個工業材料的 成本不盡相同，不過其物料成本均在總成本中佔有相當大的比 例。因此，找到一個有效的排列方法以達成成本最小化便成為各 企業極力追求的目標之一。 本研究主要目的在於建立一模擬退火演算模式來求解二維物 件的排列問題，配合IBH 擺放邏輯，以及有效的移步法則，提出 合適的演算模式—IBH2。此外，加入平行處理的概念而提出平行 模擬退火演算法。 為了驗證演算法之穩健性，以文獻中例題做測試，並比較二 者的演算結果。研究結果顯示，本研究所建構之模擬退火演算模 式，具有相當不錯的求解效能。相信也可提供工業界處理此類問 題的參考，達到節省營運成本之企業目標。

關鍵詞 : 排列問題、模擬退火演算法、平行處理

目錄

參考文獻

[1] 張幼蘭，「動態平行模擬退火法」，清華大學工業工程學系碩士班碩士論文，2002。

[2] 田邦廷，「長方體物件排列問題解法之研究」，大葉大學工業工程學系碩士班碩士論文，2002。

[3] 陳瑋昶，「平行模擬退火法之改進」，清華大學工業工程學系碩士班碩士論文，2003。

[4] 陳其揚，「使用平行模擬退火演算法於功能性核磁共振造影影像分析之研究」，大葉大學工業工 程學系碩士班碩士論文，2004。

[5] 吳泰熙、駱景堯、林東養，「多尺寸方形排列問題啟發式解法之研究」，工業工程學刊，第17 卷，75-85，2000。

[6] 鄭守成，「MPI 平行計算程式設計」，國家高速電腦中心，2001。

[7] Aarts, E., Bont, J., and Laarhoven, P.“ Parallel implementations of the statistical cooling algorithm,” Integration, 4, pp.209-238 (1986).

[8] Aarts, E. and Korst, J. “ Simulated annealing and boltzmann machines, ” Wisely, New York, USA, (1989).
[9] Azencott, “ Simulated Annealing:Parallelization Techniques, ” Wisely, (1992).
[10] Babu, A.R. and R. Babu, “ Effective nesting of rectangular parts in multiple rectangular sheets using genetic and heuristic algorithms, ” International Journal of the Production Research, 37, pp.1625-1643 (1999).
[11] Beasley, J. E., “ Algorithms for unconstrained two-dimensional guillotine cutting, ” Journal of the Operational Research Society, 36, 297-306 (1985).
[12] Biro, M. and E. Borors, “ Network flows and non-guillotine cutting patterns, ” European Journal of Operational Research, 16, pp.215-221 (1984).
[13] Chen, C. S., S. Sarin, and B. Ram, “ The pallet packing for non-uniform box sizes, ” International Journal of Production Research Society, 29, 1963-1968 (1991).
[14] Christofides, N. and C. Whitlock, “ An algorithm for two dimensional cutting problems, ” Operationsl Research, 25, 30-44 (1977).
[15] Dagli, C. H. and A. Hajakbari, “ Simulated annealing approach for solving stock cutting problem, ” IEEE Transactions on Systems, Man, and Cybernetics, pp.221-223 (1990).
[16] Dagli, C. H. and M. Y. Tatoglu, “ An approach to twodimensional cutting stock problem, ” International Journal Production Research, 25, pp.175-190 (1987).
[17] Dowsland, K. A. and W. Dowsland, “ Packing problem, ” European Journal of Operational Research, 56, 2-14 (1992).
[18] Dowsland, K. A. “ Some experiments with simulated annealing techniques for packing problems, ” European Journal of Operational Research, 68, 389-399 (1993).
[19] Gilmore, P. C. and R. E. Gomory, “ A linear programming approach to the cutting stock problem (Part 1), ” Operations Research, 9, 849-855 (1961).
[20] Gilmore, P. C. and R. E. Gomory, “ A linear programming approach to the cutting stock problem (Part 2), ” Operations Research, 11, 863-888 (1963).
[21] Gilmore, P. C. and R. E. Gomory, “ A linear programming approach to the cutting stock problem (Part 2), ” Operations Research, 11, 863-888 (1963).
[22] Goulimis, C., “ Optimal solution for the cutting stock problem, ” European Journal of Operational Research, 44, 197-208 (1990).
[23] Hopper, E. and B. C. H. Turton, “ An empirical investigation of meta-heuristic and heuristic algorithms for a 2D packing problem, ” European Journal of Operational Research, 128, pp34-57, (2001).
[24] Ismail, H. S. and K. K. B. Hon, “ The nesting of 2-dimensional shapes using genetic algorithm, ” Proceedings of the Institution of Mechanical Engineers Part B-Journal of Engineering Manufacture, 209, 115-124 (1995).
[25] Jakobs, S., “ On genetic algorithms for the packing of polygons, ” European Journal of Operational Research, 88, pp165-181 (1996) [26] Kirkpatrick, S., C. D. Gelatt. Tr., and M.P. Vecchi, “ Optimization by simulated annealing, ” Sci., 22, 671-680 (1983).
[27] Lai K. K. and J. W. M. Chan, “ Developing a simulated annealing algorithm for the cutting stock problem, ” Computers ind. Engng., 32, No.1, pp.115-127 (1997).
[28] Leung T.W. , C. H. Yung, and D. M. Troutt, “ Applications of genetic search and simulated annealing to the two-dimensional non-guillotine cutting stock problem, ” Computer and Industrial Engineering, 40, pp.201-214 (2001).
[29] Leung T.W. , C. K. Chan, and D. M. Troutt, “ Application of a mixed simulated annealing-genetic algorithm heuristic for the two-dimensional orthogonal packing problem, ” European Journal of Operational Research, 145, pp.530 – 542 (2003).
[30] Nader, N. and Z. Saeed, “ Adaptive temperature control for simulated annealing: a comparative study, ” Computers & Operations Research, 31, 2439-2451 (2004).
[31] Pacheco, P. S., “ Parallel Programming With MPI, ” University of San Franciso, (1995).
[32] Ram, D. J., T. H. Sreenivas. and K. G. Subramaniam, “ Parallel simulated annealing algorithm, ” Journal of Parallel and Distributed Computing , 37, pp.207-212 (1996).
[33] Wu, T. H., J. F. Chen, C. Y. Low, and P. T. Tang, “ Nesting of two-dimensional parts in multiple plates using hybrid algorithm, ” International Journal of the Production Research, 41, 3883-3900 (2003).
[34] Yu G. S. and V. N. Patsuk, “ A method of optimal lattice packing of congruent oriented polygons in the plane, ” European Journal of Operational Research, 124, 204-216 (2000).