考量整備及拆卸時間之開放型工廠排程問題啟發式求解模式建構

林明賢、駱景堯 ; 蕭育如

E-mail: 9221561@mail.dyu.edu.tw

摘 要

以往有關開放型工廠排程之研究，大多是探討最小化總時程(Makespan)排程問題。對於延遲時間最小化方面的研究較少人研究，大多以閒置時間最小化為績效衡量指標。以顧客觀點而言，大多期望所有工作皆能於到期日前完成，而延遲時間是最能反應到期日的影響。 本研究針對開放型工廠排程之總延遲時間最小化為評估準則，以禁忌搜尋法求取最佳解或近似最佳解，同時也考量工件對於不同機器的整備時間及拆卸時間對於排程的影響性，以期縮短製程時間，使工作盡量如期完成，進而滿足顧客的需求。 為驗證本研究所建構演算法之正確性與優越性，本研究亦將所建構演算法之執行結果分別與數學規劃模式及數種啟發式演算法進行比較，分析之結果顯示：本研究所建構之演算法具有較佳之求解品質與效率。

關鍵詞 : 生產排程 ; 開放型工廠 ; 總延遲時間 ; 獨立整備時間 ; 相依整備時間 ; 禁忌搜尋法

目錄

封面內頁 簽名頁 授權書 iii 中文摘要 iv 英文摘要 v 誌 謝 v 目 錄 vii 圖目錄 x 表目錄 xi 第一章 緒論 1 1.1 研究動機 1 1.2 研究目的 2 1.3 研究範圍與假設 2 1.4 研究架構 3 第二章 文獻探討 6 2.1 排程問題之概述 6 2.2 開放型工廠排程之相關文獻 9 2.3 整備時間與拆卸時間之相關文獻 11 第三章 禁忌搜尋法 15 3.1 禁忌搜尋法之原理 15 3.2 禁忌搜尋法之組成架構 16 3.3 禁忌搜尋法之演算步驟 17 3.4 禁忌搜尋法之特性 19 第四章 啟發式演算法之構建 21 4.1 建構起始解 21 4.2 移步法則 36 4.2.1 閒置時間最大之作業優先移步法則 37 4.2.2 閒置時間最大之機器上任選一工件移步法則 39 4.2.3 總閒置時間最大之機器上任選一工件移步法則 41 4.2.4 延遲時間最大工件且總閒置時間最大機器之作業移步法則 42 4.2.5 延遲時間最大工件中處理時間最大的機器之作業移步法則 44 4.2.6 延遲時間最大工件中任選一機器之作業移步法則 46 4.2.7 隨機選取一作業移步法則 48 4.2.8 總結七種移步法則 49 4.3 改善免禁法則 50 第五章 結果分析 52 5.1 測試例題參數設定 52 5.2 最佳化問題求解 53 5.3 迭代次數對於禁忌搜尋法之影響 54 5.4 起始解對於禁忌搜尋法之影響 55 5.5 與其他演算法求解之比較 57 第六章 結論與建議 61 6.1 結論 61 6.2 建議 62 參考文獻 63 附錄一 七種移步之比較 70 附錄二 數學模式求解結果 71 附錄三 迭代次數之水準比較 73

參考文獻

[1] 莊舜智，民國87年，“ 多目標決策之應用－整備時間考量下之零工式排程問題探討 ”，大葉大學碩士學位論文。

[2] 施大維，民國89年，“ 開放工廠加權完工時間最小化問題之研究 ”，朝陽大學碩士學位論文。

[3] 林安祥，民國89年，“ 開放工廠加權延遲最小化排程問題之研究 ”，朝陽大學碩士學位論文。

[4] 柯惠雯，民國90年，“ 結合模擬退火法與禁忌搜尋法在流程式生產排程之應用 ”，大葉大學碩士學位論文。

[5] 吳佳璋，民國87年，“ 禁忌搜尋法在彈性製造系統排程問題之應用 ”，大葉大學碩士學位論文。

[6] 駱芳梧，民國91年，“ 考量整備及拆卸時間之開放型工廠排程問題研究 ”，大葉大學碩士學位論文。

[7] Glover, F.,“ Tabu Search-Part Ⅰ ”, ORSA Journal on Computing, Vol.1, 190-206,1989.

[8] Glover, F.,“ Tabu Search-Part Ⅱ ”, ORSA Journal on Computing, Vol.2, 4-32,1990.

[9] Johnson, S. M.,“ Optimal two- and three-stage production schedules with set-up times included ”, Naval Research Logistics Quarterly, Vol.1, 61-68, 1954.

[10] Kirkpatrick, S., C. D. Gelatt. Jr. and Vecchi, M. P.,“ Optimization by simulated annealing ”, Science, Vol.22, 671-680, 1983.

[11] Goldberg, D. E.,“ Genetic Algorithm in Search ”, Optimization and Machine Learning, Addison-Wesley, Reading, 1989.

[12] Adams, J., Balas, E., and Zawack, D., ”The Shifting Bottleneck Procedure for Job Shop Scheduling ”, Management Science, Vol.34 (3), 391-401, 1988.

[13] Gonzalez, T., Sahni, S.,“ Open shop Scheduling to minimize finish time ”, Journal of The Association For Computing Machinery, Vol. 23(4), 665-679, 1976.

[14] Achugbue, J. O., Chin F. Y.,“ Scheduling the open shop to minimize mean flow time ”, SIAMJ. COMPUT. , Vol.11, 709-720, 1982.

[15] Liawler, E. L., Lenstra, J. K., Rinnooy Kan, A. H. G. and Shmoys, D.B.,“ Sequencing and scheduling: Algorithms and complexity ”, Report BS-R8909, Centre for Mathematics and Computer Science, P.O. Box 4709,1009 AB Amsterdam, The Netherlands, 1989.

[16] Du, J. Z. and Leung Y-T,“ Minimizing Mean Flow Time in Two-machine Open Shops and Flow Shops ”, Journal of Algorithms, Vol.14,

24-44, 1993.
[17] Shaklevich, N. V. and Strusevich, V. A., " Two Machine Open Shop Scheduling Problem to Minimize an Arbitary Machine Usage Regular Penalty Function " , European Journal of Operational Research, Vol.70, 391-404, 1993.
[18] Pinedo, M., " Scheduling: Theory, Algorithms, and Systems " , Prentice Hall, Englewood Cliffs, NJ, 1995.
[19] Lin, H. F., " A Heuristic Solution To The Total Tardy Cost Of An M Machine Non-Preemptive Open Shop Scheduling " , Sun Yat Sen Management Review, Vol.3 (4), 122-143, 1995.
[20] Sule, D. R., Industrial Scheduling, PWS. Publishing Company, 187-218, 1996.
[21] Lin H. F., Liu, C. Y., Liu, P. Y., " A Heuristics Approach To The Total Tardiness In Nonpreemptive Open Shop Scheduling " , International Journal of Industrial Engineering, Vol.2 (1), 25-33, 1995.
[22] Lin, H. F., " A Heuristics Solution To The Total Tardiness And Earliness Penalties Of An M-Machine Nonpreemptive Scheduling " , Journal Of The Chinese Institute Of Industrial Engineers, Vol.15 (2), 159-167, 1998.
[23] Brucker Peter, Johann Hurink, Bernd Jurisch, Birgit Wostmann, " A Branch & Bound Algorithm For The Open Shop Problem " , Discrete Applied Mathematics, Vol.76, 43-59, 1997.
[24] Liaw C., " An Iterative Improvement Approach For The Nonpreemptive Open Shop Scheduling Problem " , European Journal of Operational Research, Vol.111 (3), 509-517, 1998.
[25] Liaw C., " A Tabu Search Algorithm For The Open Shop Scheduling Problem " , Computers & Operations Research, Vol.262 (2), 109-126, 1999.
[26] Liaw C., " A Hybrid Genetic Algorithm For The Open Shop Scheduling Problem " , European Journal of Operational Research, Vol.124 (1), 28-42, 2000.
[27] Liaw C., " A Hybrid Genetic Algorithm For The Open Shop Scheduling Problem " , European Journal of Operational Research, Vol.124 (1), 28-42, 2000.
[28] Kyparisis, G. J., Koulamas, C., " Open Shop Scheduling With Makespan And Total Completion Time Criteria " , Computers & Operations Research, Vol.27 (1), 15-27, 2000.
[29] Lawler, E. L., Lenstra, J.K. and Rinnooy Kan, A.H.G., " Minimizing Maximum Lateness In A Two-Machine Open Shop " , Mathematics of Operations Research, Vol.6 (1), 153-158, 1981.
[30] Strusevich V. A., " Two Machine Open Shop Scheduling Problem with Setup, Processing And Removal Times Separated " , Computational Operation Research, Vol.20, 597-611, 1993.
[31] Yoshida T., Hitomi K., " Optimal two-stage production scheduling with setup times separated " , AIIE Trans, Vol.11, 261-263, 1979.
[32] Sule D. R., " Sequencing n jobs on two machines with setup, processing and removal times separated " , Naval Research Logistics Quarterly, Vol.29, 517-519, 1982.
[33] Sule D. R., Huang K. Y., " Sequence On Two And Three machines With Setup, Processing And Removal Times Separated " , International Journal of Production Research, Vol.21, 721-732, 1983.
[34] Monma C. L., Potts C. N., " On The Complexity Of Scheduling With Batch Setups " , Operation Research, Vol.37, 798-804, 1989.
[35] Proust C., Gupta J. N. D., Deschamps V., " Flow Shop Scheduling With Set-Up, Processing And Removal Times Separated " , International Journal of Production Research, Vol.29, 479-493, 1991.
[36] Rajendran C., Ziegler H., " Heuristics For Scheduling In A Flow Shop With Setup, Processing And Removal Times Separated " , Production Of Planning Control, Vol.8, 568-576, 1997.
[37] Ovacik I. M., Uzsoy R., " Worst-Case Error Bounds For Parallel Machine Scheduling Problems With Bounded Sequence- Dependent Setup Times " , Operation Research Letters, Vol.14, 251-256, 1993.
[38] Gupta J. N.D., Darrow W.P., " Approximate Schedules For The Two-Machine Flowshop With Sequence Dependent Setup Times, " Indian Journal of Management Systems, Vol.1, 6-11, 1985.
[39] Corwin B. D., Esogbue A.O., " Two-Machine Flowshop Scheduling Problems With Sequence Dependent Setup Times: A Dynamic Programming Approach " , Naval Research Logistics Quarterly, Vol.21, 515-524, 1974.
[40] Mitsumori S., " Optimal production scheduling of multi-commodity in flow line " , IEEE Transactions Systems Management Cybernation, Vol.2, 486-493, 1972.
[41] Marsh J. D., Montgomery D.C., " Optimal Procedures For Scheduling Jobs With Sequence-Dependent Changeover Times On Parallel Processors " , AIIE Technical Papers, Vol.1, 279-286, 1973.
[42] Gilmore P. C., Gomory R.E., " Sequencing A One-State Variable Machine: A Solvable Case Of The Traveling Salesman Problem " , Operation Research, Vol.12, 655-679, 1964.
[43] Burstall R. M., " A Heuristic Method For A Job-Shop Scheduling Problem " , Operation Research, Vol.17, 291-304, 1966.
[44] Bruno J., Sethi R., " Tasks Sequencing In A Batch Environment With Setup Times " , Founding Of Control Engineering, Vol.3, 105-117, 1978.
[45] Dearing P. M., Henderson R.A., " Assigning Looms In A Textile Weaving Operation With Changeover Limitations " , Production Of

Invention Management, Vol.25, 23-31, 1984.
[46] Tan K. C., Narasimhan R., " Multi-Objective Sequencing With Sequence Dependent Setup Times " , International Journal Of Operation Quantitative Management, Vol.3, 69-84, 1997.
[47] Miyazaki S., Ohta H., " Backward Scheduling To Minimize The Actual Mean Flow Time With Dependent And Independent Setup Times " , Proc Ixth ICPR, 2680-2686, 1987.
[48] Schutten J. M. J., Leussink R. A. M., " Parallel Machine Scheduling With Release Dates, Due Dates And Family Setup Times " , International Journal Of Production Economics, Vol.46, 119-125, 1996.
[49] Lee Y. H., Bhaskaran K., Pinedo M., " A Heuristic To Minimize the Total Weighted Tardiness With Sequence Dependent Setups " , IIE Transactions, Vol.29, 45-52, 1997.
[50] Lee and Y. H., Pinedo M., " Scheduling Jobs On Parallel Machines With Sequence Dependent Setup Times " , European Journal of Operational Research, Vol.100, 464-474, 1997.
[51] Parthasarathy S., Rajendran C., " A Simulated Annealing Heuristic For Scheduling To Minimize Weighted Tardiness In A Flowshop With Sequence Dependent Setup Times Of Jobs-Case Study " , Production Of Planning Control, Vol.8, 475-483, 1997.
[52] Parthasarathy S., Rajendran C., " An Experimental Evaluation Of Heuristics For Scheduling In A Real-Life Flowshop With Sequence Dependent Setup Times Of Jobs " , International Journal Of Production Economics, Vol.49, 255-263, 1997.