A

Asian Institute of Technology
ELECTRONIC DOCUMENTATION FORM

This form will include the following details:

1. Report Title and Type *(Thesis/Research Study/Special Study/etc)*

A TWO-STAGE GENETIC ALGORITHM FOR MULTI-OBJECTIVE JOB SHOP SCHEDULING PROBLEMS (THESIS)

2. Name of the Author

SIRIWAN SITHITHAM

3. Name(s) of Advisor and Committee Members

Dr. Voratas Kachitvichyanukul (Chairperson)
Dr. Huynh Trung Luong
Dr. Poompat Saengudomlert

4. Field of Study

INDUSTRIAL ENGINEERING AND MANAGEMENT

5. Address (School)

SCHOOL OF ENGINEERING AND TECHNOLOGY

6. External Examiner *(for Dissertations only)*

7. Expert Comments on the Work and Facility for the Feedback from the Users

8. Abstract of the Work

This study presents the a Two-stage GA (2ST-GA) for Multi-criteria Job Shop scheduling problem. 2ST-GA is proposed under three criteria: Minimize makespan, Minimize total weighted earliness, and Minimize total weighted tardiness. The objective is to find optimal or near optimal solution with these objectives, however the algorithm developed can also be implemented with one or two objectives without modification. The proposed algorithm is composed of two Phases: Phase I applies parallel GA with migration to find the best solution of each objective. The solutions are combined in Phase II using the compromise objective function with Steady-State GA.

The genetic algorithm is designed and implemented using the object library from the GALib. The random keys representation is applied to the problem. The schedules are constructed using a permutation with m-repetitions of job numbers. Performance of the proposed algorithm is tested on benchmark instances and compared with other approaches. The experimental results show that 2ST-GA is effective and efficient to solve in most cases of JSP in term of solution quality.

9. Keywords *(minimum 5; maximum 10)*

Multi-criteria; Genetic algorithm; Multistage; 2ST-GA; Job shop scheduling problem; Makespan; Earliness: Tardiness

10. Bibliographic data

Adams, J., Balas, E., and Zawack, D. (1988) The shifting bottleneck procedure for job shop scheduling. Management Science, 34, 391-401.

Baker. K. R. (1974) Introduction to Sequencing and Scheduling. John Wiley, New York.

Bean, J. C. (1994) Genetic algorithms and random keys for sequencing and optimization. ORSA Journal on Computing, 6(2): 154-160, 1994.

Bierwirth, C. (1995). In E. Pesch, & S. Vo (Eds.), A generalized permutation approach to job shop scheduling with genetic algorithms, OR-Spektrum (pp. 87–92). Special issue: Applied Local Search, 17(213).

Blackstone, J. H., Phillips, D. T., and Hogg, G. L. (1982) A state of the art survey of dispatching rules for manufacturing job shop operations. International Journal of Production Research, 20 (1), 27-45

Brucker, P., Jurisch, B., and Sievers, B. (1994) A branch and bound algorithm for the job-shop scheduling problem. Discrete Applied Mathematics, 49 (1-3), 107-127

Chang, P., Hsieh, J., and Lin, S. The development of gradual-priority weighting approach for the multi-objective flow shop scheduling problem, Int. J. Prod. Economics 79 (3) (2002) 171–183.

Cheng, R., Gen, M., and Tsujimura, Y. (1996) A tutorial survey of job-shop scheduling problems using genetic algorithms – I. representation. Computers & Industrial Engineering, 30, 983-997.

Cheng, R., Gen, M., and Tsujimura, Y. (1999) A tutorial survey of job-shop scheduling problems using genetic algorithms – II. Hybrid Genetic Search Strategies. Computers & Industrial Engineering, 37, 51-55.

Deb, K, Single and Multi-Objective Optimization Using Evolutionary Computation, KanGAL Report Number, 2004.
(http://www.iitk.ac.in/kangal/deb.htm.)

French, S. (1982) Sequencing and scheduling: An introduction to the mathematics of the job-shop, Wiley, New York.

Gary, M.R., Johnson, D. S. and Sethi, R. R. (1976) The complexity of flow-shop and job shop scheduling. Math. Ops. Res., 1, 117-129.

Gen, M., & Cheng, R. (1997). Genetic algorithms and engineering design. New York: Wiley.

Gen, M. & Cheng, R. (2000), Genetic Algorithms and Engineering Optimization, New York: Wiley-Interscience.

Giffler, B., and Thompson, G. L. (1960) Algorithms for solving production scheduling problems. Operations Research, 8 (4), 487-503.
Goncalves, G., Hsu, T., Dupas, R., and Jolly, D., (2002). Evalution of mutation heuristics for the solving of multiobjective flexible job shop by an evolutionary algorithm. IEEE international conference on systems, man and cybernetics, 6–9.

Gonçalves, J. F., José,. J., and Resende, M. G.C. (2005) A hybrid genetic algorithm for the job shop scheduling problem. European Journal of Operation Research, 167, 77-95.

Greenberg, H. H. (1968) A branch and bound solution to the general scheduling problem. Operation Research, 16, 353-361.

Holland, J. (1975) Adaption in Natural and Artificial Systems. The University of Michigan Press, Ann Arbor.

Ishibuchi, H. and Murata, H., Multi-objective genetic local search algorithm and its applications to flow shop scheduling, IEEE Trans. SMC 28 (3) (1998) 392–403.

Ishibuchi, H. and Murata, H., Local search procedures in a multi-objective genetic local search algorithm for scheduling problems, in: Proceedings of IEEE International Conference on SMC, 1999, pp. 119–124.

Kacem, I., Hammadi, S., and Borne, P., (2002). Pareto-optimality approach for flexible job shop scheduling problems: Hybridization of evolutionary algorithms and fuzzy logic. Mathematics and computers in simulation, 60: 245-276.

Koksalan, M., K., and Keha. A. B., (2003). Using genetic algorithms for single machine bi-criteria scheduling problems. European journal of operation research, 145: 543-556.

Lam, N. and Kachitvichyanukul, V. (2005). An enhanced genetic algorithm for multi-objective job shop scheduling.

Lageweg, B. J., Lenstra, J. K., and Rinnooy Kan, A. H. G. (1977) Job-shop scheduling by implicit enumeration. Management Science, 24, 441-450.

Lo, Z., and Bavarian, B., (1991). Scheduling with neural networks for flexible manufacturing system. Proceedings of the IEEE International Conference on Robotics and Automation, 818-823.

Loukil, T., Elaoud, S., and Teghem, J. (2005). The Pareto fitness genetic algorithm: Test function study. European Journal of Operational Research xxx.

Matsuo, H., Suh, C. J. and Sullivan, R. S. (1988) A Controlled Search Simulated Annealing Method for the General Job-Shop Scheduling Problem, Working Paper #03-04-88, Graduate School of Business, The University of Texas at Austin, Austin, Texas, USA.

Murata, T., Ishibuchi, H., and Tanaka, H., (1996). Multi-objective genetic algorithm and its applications to Flow shop scheduling. International journal of Computers and Industrial Engineering, 30 (4): 957-968.

Nowicki, E., and Smutnicki, C. (1996) A fast tabu search algorithm for the job shop problem. Management Science, 42 (6), 797-813.

Pongchairerks, P., and Kachitvichyanukul, V. (2006) Particle swarm optimization's algorithms for job shop scheduling problem. Journal of Applied Artificial Intelligence., xx,xx.

Ponnambalam, S., Aravindan, P., and Mogileeswar, G., A multiobjective algorithm for solving assembly line balancing problem, Int. J. Adv. Manuf. Technol. 16 (4) (2000) 341–352.

Saravana Sankar, S., Ponnanbalam, S., Rajendran, C., A multiobjective genetic algorithm for scheduling a flexible manufacturing system, Int. J. Adv. Manuf. Technol. 22 (2003) 229–236.

Singer, M., and Pinedo, M. (1998) A computational study of branch and bound techniques for minimizing the total weighted tardiness in job shops. IIE Transactions, 30 (2), 109-118.

Turkcan, A., and Akturk, M. S., (2003). A problem space genetic algorithm in multiobjective optimization. Journal of intelligent manufacturing, 14: 363-378.

Udomsakdigool, A., and Kachitvichyanukul, V. (2006) Two-way scheduling approach in ant algorithm for solving job shop problems. International Journal of Industrial Engineering and Management Systems, xx, xx.

Xia, W., and Wu, Z., (2005) An effective hybrid optimization approach for multi-objective flexible job-shop scheduling problems. Computers & Industrial Engineering ,48, 409-425.

Yamada, T., and Nakano, R. (1995) A genetic algorithm with multi-step crossover for job-shop scheduling problems. Proceedings of the IEE/IEEE International Conference on Genetic Algorithms in Engineering Systems: Innovations and Applications, 146-151.

David, G. (1989). "Genetic algorithms in search, optimization, and machine learning". New York: Wesley.

French, S. (1982). "Sequencing and scheduling: An introduction to Mathematics of the Job Shop". New York: Wesley.

Matthew, W. (1999). GALib: "A C++ library of genetic algorithm components". http://lancet.mit.edu/ga.

Mitsuo, G., and Runwei, C. (2000). "Genetic algorithms and engineering optimization". New York: John Wiley and Sons.

11. Type of Project *(Sponsored /Non-Sponsored)*, if applicable

NON-SPONSORED.

12. Details of the Sponsor/Donor, if applicable

13. Specific Agreement involved in the Sponsorship Agreement, if applicable

14. AIT Code Number

ST102902

Each thesis/dissertation should have an ISBN Code Number, which would be the responsibility of the AIT Library.

The requested details above have to be submitted in a single PDF file to the library.