Real-World Shop Floor Scheduling by Ant Colony Optimization

Andre Vogel[*]
Dept. of Economics
Technical University
D-09107 Chemnitz
Germany

Marco Fischer[‡]
Dept. of Economics
Technical University
D-09107 Chemnitz
Germany

Tobias Teich[¶]
Dept. of Economics[‖]
Technical University
D-09107 Chemnitz
Germany

Summary

Manufacturing Control Problems are still often solved by manual scheduling, that means only by out of the experience of the workers. Modern algorithms, such as Ant Colony Optimization, have proved their capacity to solve this kind of problems in theory.

The objective of this work was to compare the developed Ant Algorithm to the results achieved by a Genetic Algorithm tested on the same real-world data.

The algorithm was coupled to the ERP-System (Daamgard Axapta was used) in the way, displayed in figure 1.

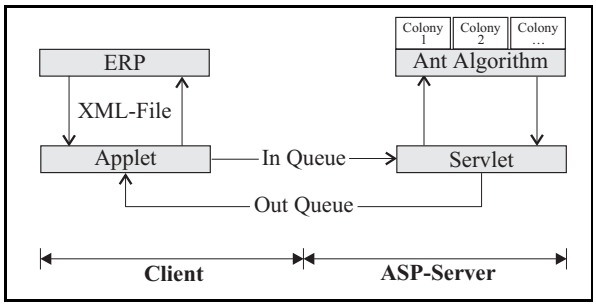

Figure 1: Communication structure

The shop floor scheduling problem was tested on real world data provided by a German engineering company. In order to be able to dispose of real world problem sizes and data, a set of numbers was recorded within a period of two months (e.g. release date, the finishing date and the due date of each job, ...).

The used algorithm based on an already applied one [1], which was successfully tested on the widely known Job Shop Scheduling.

[*]Email: andre.vogel@wirtschaft.tu-chemnitz.de
[‡]Email: marco.fischer@wirtschaft.tu-chemnitz.de
[¶]Email: t.teich@wirtschaft.tu-chemnitz.de
[‖]phone: ++49-371-531 42 52

In order to compare the reached solution quality, we used the mean flow time and the mean lateness of jobs. For the comparison of the results achieved by the means of the Ant Algorithm and other methods we used a priority rule scheduler (PRIORULE) and GACOPA [2]. The priority rule scheduler was allowed to calculate a number of single, standard priority rules (e.g.: shortest processing time, earliest due dates etc.) and combinations of these rules. The best out of the achieved results was used. Manual scheduling achieved a mean lateness of 2.4 days and a mean flow time of 13.2 days.

Table 1: Relative results (manual scheduling = 100%)

scheduler	*mean lateness*	*mean flowtime*
MANUAL	100.0 %	100.0 %
PRIORULE	95.3 %	97.9 %
GACOPA	55.3 %	85.0 %
ANTS	61.8 %	87.7 %

The following parameter settings were used: $\alpha = 1$; $\beta = 1$; $\rho = 0,01$; $c = 0,8$; $\gamma = 0,8$; $q = 2$. The results presented in table 1 show that ants perform very well, but not as good as the GACOPA the results are compared with.

This work has been supported by the Collaborative Research Center 457 and the CBS GmbH.

References

[1] Fischer, M., Vogel, A., Teich, T., Fischer, J.: A new Ant Colony Algorithm for the Job Shop Scheduling Problem. in: Proceedings of the Genetic and Evolutionary Computation Conference, San Francisco, 2001.

[2] Kaeschel, J., Meier, B., Fischer, M., Teich, T.: Real-World Applications: Evolutionary Real World Shop Floor Scheduling using Parallelization and Parameter Coevolution, in: Proceedings of the Genetic and Evolutionary Computation Conference, Las Vegas, 2000.