Real-World Applications.
Optimising the throughput of a manufacturing production line using a genetic algorithm

R. Dupas
LABOGP*- University of Artois
Rue de l'université BP 819 62408 Béthune
dupas@iut-gtr.univ-artois.fr
Phone: (33) 3.21.02.87.61

G. Cavory
LABOGP

G. Goncalves
LABOGP

1 INTRODUCTION

This study concerns a flowshop manufacturing production line represented in figure 1.

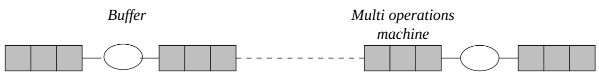

Figure 1: Manufacturing Line

2 THE SCHEDULING PROBLEM

Figure 2 shows the parameters of the maintenance jobs related to a machine.

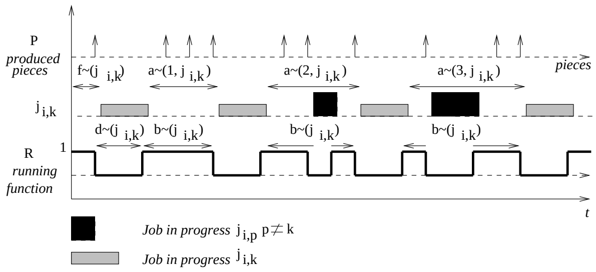

Figure 2: $(\tilde{b},\tilde{d},\tilde{f})$ Parameters of a Job $j_{i,k}$

Let $J_L$be the set of jobs :

$$J_L = \{j_{i,k} | i \in [1,w], k \in [1,n_i]\}$$

with $j_{i,k}$: k job on the i machine of the line.
Let $\tilde{S}$ be the scheduling function:

$$\begin{array}{lccl} \tilde{S}: & J & \to & \mathbb{N} \\ & j_{i,k} & \mapsto & \tilde{S}(j_{i,k}) = \tilde{f}(j_{i,k}) \end{array}$$

and $\overrightarrow{V_S}$ the vector associated with the function $\tilde{S}$.
Given:

- τ the line throughput
- g the function that gives τ in relation with $\overrightarrow{V_S}$

Find the scheduling vector $\overrightarrow{V_S}$ that gives the best throughput:

τ = g ($\overrightarrow{V_S}$)
Objective: Max (g)

3 VALIDATION

At first the use of GA was justified by comparison with two naive optimisation methods. The throughput gain obtained with the basic GA (noted GA1) is 2.1 percent better than the gain brought by a Random Search. This gain is 1.8 percent better than the gain brought by the Random Restart Hill-climbing. The global gain brought by the GA approach is 6.5 percent compared with no optimisation.

Then, three GA trials were compared (Figure 3):

- GA1: basic parameters
- GA2: tournament selection method
- GA3: specific selection and croosover operators integrating knowledge of the line

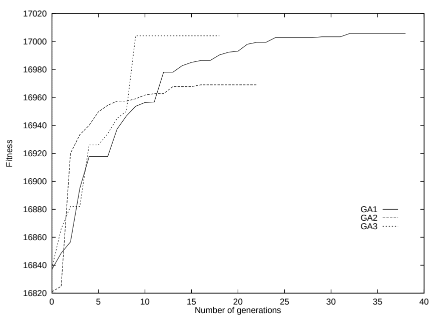

Figure 3: Comparison of three GA Trials

*LABoratoire en Organisation et Gestion de la Production