A bacteria foraging algorithm for solving integrated multi-period cell formation and subcontracting production planning in a dynamic cellular manufacturing system

ABSTRACT

The bacteria foraging algorithm (BFA) is a new computation technique inspired by the social foraging behaviour of Escherichia coli (E. coli) bacteria. Since the introduction of the BFA by Kevin M. Passino, there have been many challenges in employing this algorithm to problems other than those for which the algorithm was proposed. This research aims to apply this emerging optimisation algorithm to develop a mixed-integer programming model for designing cellular manufacturing systems (CMSs), and production planning in dynamic environments. In dynamic environments, product mix and part demand vary under multi-period planning horizons. Thus the best-designed cells for one period may not be adequate for subsequent periods, requiring their reconstruction. The advantages of the proposed model are as follows: consideration of batch inter-cell and intra-cell material handling by assuming the sequence of operations, allowing for alternative process plans for part types, and consideration of machine copying, with an emphasis on the effect of trade-offs between production and outsourcing costs. The goal is to minimise the sum of the machines constant and variable costs, inter-cell and intra-cell material handling costs, reconstruction costs, partial subcontracting costs, and inventory carrying costs. In addition, a newly-developed BFA-based optimisation algorithm has been compared with the branch and bound algorithm. The results suggest that the proposed algorithm performs better than related works.

Keyword: Bacteria foraging algorithm (BFA); Social foraging behaviour of Escherichia coli (E. coli) bacteria; Kevin M. Passino; Cellular manufacturing systems