16th INTERNATIONAL PROJECT MANAGEMENT CONFERENCE

شانزدهمین کنفرانس بین‌المللی مدیریت پـــروژه

Efficient metaheuristic algorithms to solve the resource-constrained project scheduling problem with different sizes

Fatemeh Sarvandi, Aliyeh Kazemi

Department of Industrial Management, Faculty of Management, University of Tehran, Tehran, Iran

۲۸و ۲۹ خرداد ماه ۱۴۰۱

تهران

Introduction

- A project is a set of activities that are aimed to achieve a particular goal or objective and must be carried out at certain times with predetermined costs and with a certain quality.

- One of the problems with rich theoretical fundamentals in the field of operational research and project management is the resource-constrained project scheduling problem (RCPSP).

Research questions

- How is the suitable structure of the mathematical model for the RCPSP?
- How the GA can be used for solving the RCPSP?
- How the DE algorithm can be used for solving the RCPSP?
- How the PSO algorithm can be used for solving the RCPSP?
- How is the performance of the abovementioned algorithms in small-scale, medium-scale, and large-scale projects?

The mathematical model for RCPSP

Variables

- X_{it} : If the activity **i** is done on day **t**, then it will take a value of 1, otherwise 0.

Parameters

- A_i : the set of prerequisites of activity i
- d_i : the duration of activity i
- r_{ik} : the required amount of resource k for activity i
- r_{tk} : the required amount of resource k on day t
- a_k : the available amount of resource k on each day
- EFT_n : the earliest finish time of the last activity
- LFT_n : the latest finish time of the last activity
- EST_i : the earliest start time of activity i
- LFT_i : the latest finish time of activity i
- EFT_i : the earliest finish time of activity i
- C_k : the cost of using each unit of resource of type k

The mathematical model for RCPSP

$$z_1 = Min \sum_{t=EFT_n}^{LFT_n} tx_{nt} \qquad z_2 = Min(Max(\sum_{t=1}^{T}(\sum_{k=1}^{K} C_k \times \sum_{i=1}^{N} r_{tk} \times X_{it}))$$

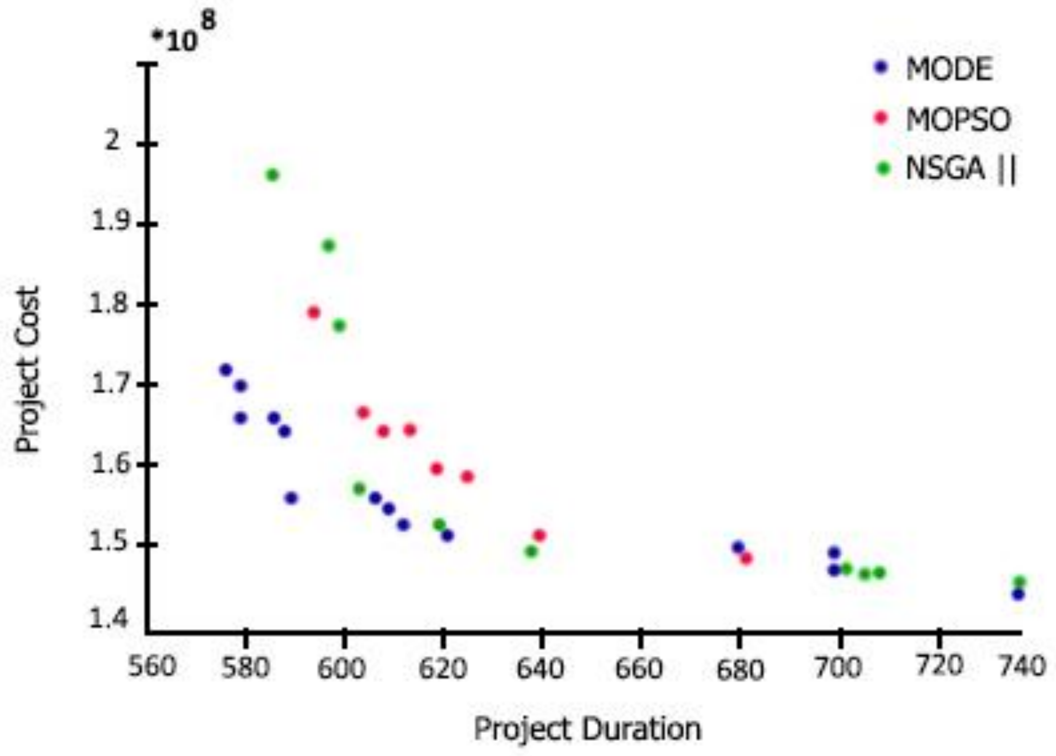
$$\sum_{t=EST_i}^{LFT_i} x_{it} = d_i \quad \forall_i$$

$$\sum_{t=EFT_i}^{LFT_i} tx_{jt} \le \sum_{t=EFT_i}^{LFT_i} tx_{it} - d_i \qquad \forall_i, j \in A_i$$

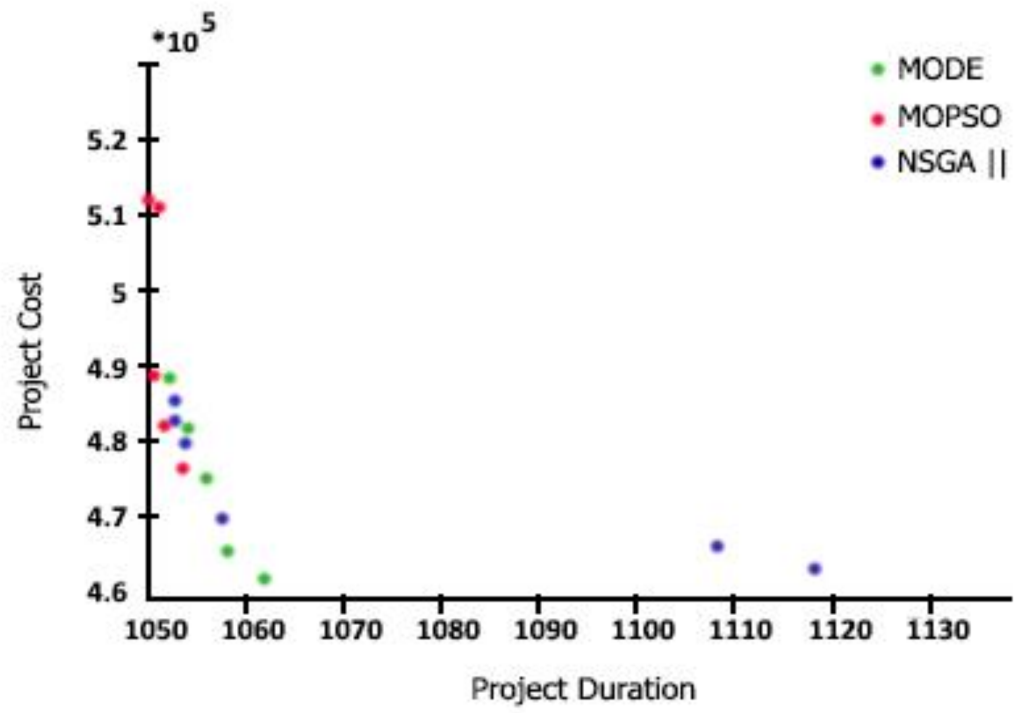
$$\sum_{t=1}^{T} \sum_{i=max\{t,EFT_i\}}^{min\{t+d-1,LFT_i\}} r_{ik} \times x_{it} \le a_k \quad \forall k$$

$$x_{it} \in \{0,1\} \quad \forall i,t$$

The Pareto graph obtained from different algorithms in the large-scale project.



The Pareto graph obtained from different algorithms in the medium-scale project.



Conclusion and suggestions

- In the small-scale projects, the application of metaheuristic algorithms is an inefficient and inappropriate approach.

- The superiority of the DE algorithm over the other two algorithms in large-scale projects and also the superiority of the PSO algorithm over the other two algorithms in medium-scale projects can be observed considering the four criteria, including the comparison of the number of Pareto solutions, quality, diversity, and distance from the ideal solution.

- It is suggested to investigate this problem considering multi-mode activities, and considering multiple projects at the same time.