



Modelling a Novel Multi-Objective Open-Shop Scheduling Problem and Solving by a Scatter Search Method

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Keywords

Open shop scheduling problems,
Tardiness and earliness time,
Makespan, Setup cost, NSGA-II,
Multi-objective scatter search

ABSTRACT

This paper proposes a novel, multi-objective integer programming model for an open-shop scheduling problem (OSSP). Three objectives are to minimize the makespan, total job tardiness and earliness, and total jobs setup cost. Due the complexity to solve such a hard problem, we develop a meta-heuristic algorithm based on multi-objective scatter search (MOSS), and a number of test problems are solved by this proposed algorithm. Finally, to prove its efficiency, the related results are compared with the results obtained by the well-known multi-objective evolutionary algorithm, called NSGA-II. The results confirm the efficiency and the effectiveness of our proposed MOSS to provide good solutions, especially for medium and large-sized problems.

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NP-hard

NSGA-II

NSGA-II

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NSGA-II

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NSGA-II

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NSGA-II

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Min Z_1	()	•
Min Z_2	()	
Min Z_3	()	•
s. t.		•
$Z_1 \geq c(i, k) \quad \forall i, k$	()	•
$t(i, k, l) \leq c(i, k) - t(i, k) + M(1 - a_{ilk})c(i, l) \quad \forall$	()	•
$c(j, k) - t(j, k) + M(1 - x_{ijk}) \geq c(i, k) \quad \forall i, j, k$	()	•
$a_{ilk} + a_{ikl} = 1 \quad \forall i, k, l$	()	
$x_{ijk} + x_{jik} = 1 \quad \forall i, j, k$	()	
$c(i, k) - t(i, k) \geq 0 \quad \forall i, k$	()	$i=\{1, \dots, n\} \quad j=i$
$mc(i) = \max\{c(i, k)\} \quad \forall i, k$	()	$m \quad j=\{1, \dots, m\} \quad :k$
$Z_2 = \sum_{i=1}^n \max\{mc(i) - d(i)\}$	()	
$Z_3 = \sum_{k=1}^m \sum_{j=1}^n \sum_{i=1}^n s_i(j, k)x_{ijk}$	()	
()	()	
()		
Max Z_1		$k \quad i \quad :T_{ik}$
Z_1	Z_1	$i \quad :d_i$
()	()	$k \quad i \quad :O_{ik}$
Max		$j \quad k \quad :S_i(j, k)$
()		$i \quad k$
()		
()		$k \quad i \quad :C_{ik}$
()		$i \quad :mc_i$
()		$\left. \begin{array}{l} 1 \text{ اگر } i \text{ روی ماشین } k \text{ در صورتی که ماشین قبل } i \text{ باشد} \\ 0 \text{ در غیر این صورت} \end{array} \right\} a_{ilk}$
()		$\left. \begin{array}{l} 1 \text{ اگر } j \text{ روی ماشین } k \text{ در صورتی که کار قبل روی ماشین } k \text{ باشد} \\ 0 \text{ در غیر این صورت} \end{array} \right\} x_{ijk}$
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n

m

$m \times n$

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k

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¹ O_{12}	² O_{24}		^{$n \times m$} O_{ik}
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$b_1)$

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b_2

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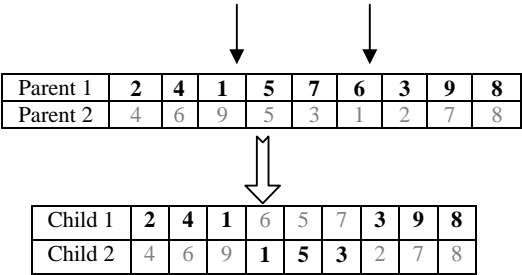
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2	5	3	6	4	1
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4	2	6	3	1	5
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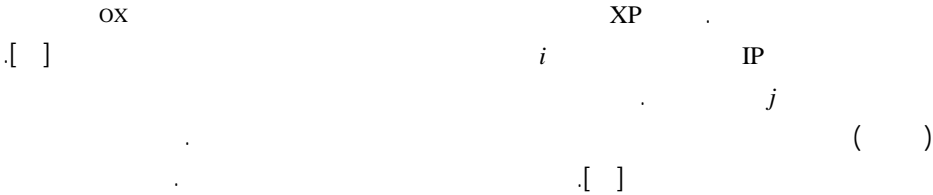
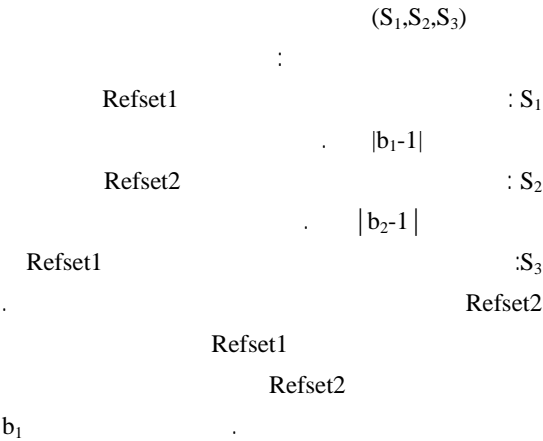
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$n \times m$

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4	2	6	3	1	5
1	2	6	3	4	5
5	2	6	3	4	1
2	5	6	3	4	1
2	5	3	6	4	1



Original trial solution 1 :	1	4	7	2	3	5	9	8	6
Original trial solution 2 :	3	9	5	2	4	6	1	7	8

() Refset2 () Refset1

$|Refset|=b \leq b_1+b_2$

Refset1

b_1

b_2 b_1

New trial solution 1 :	9	8	6	1	4	7	2	3	5
New trial solution 2 :	1	7	8	3	9	5	2	4	6

Refset1

b_1

b_2 Refset2

Refset1

Refset1

New trial solution 1 :	9	8	1	7	3	5
New trial solution 2 :	1	7	8	9	4	6

Refset2

Local_iteration .

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