



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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$$\text{Min } Z_1 \quad ()$$

$$\text{Min } Z_2 \quad ()$$

$$\text{Min } Z_3 \quad ()$$

s. t.

$$Z_1 \geq c(t, k) \quad \forall t, k \quad ()$$

$$t(i, k) \leq c(t, k) - t(i, k) + M(1 - a_{ik})c(t, l) \quad \forall ()$$

$$c(j, k) - t(j, k) + M(1 - x_{ijk}) \geq c(t, k) \quad \forall i, j, k \quad ()$$

$$a_{ilk} + a_{ikl} = 1 \quad \forall i, k, l \quad ()$$

$$x_{ijk} + x_{jik} = 1 \quad \forall i, j, k \quad ()$$

$$c(i, k) - t(i, k) \geq 0 \quad \forall i, k \quad () \quad i=\{1, \dots, n\} \quad j=i$$

$$mc(i) = \max\{c(t, k)\} \quad \forall i, k \quad () \quad m \quad j=\{1, \dots, m\} \quad k$$

$$Z_2 = \sum_{i=1}^n \max\{mc(i) - d(i)\} \quad ()$$

$$Z_3 = \sum_{k=1}^m \sum_{j=1}^m \sum_{i=1}^m s_i(j, k) x_{ijk} \quad ()$$

$$() \quad ()$$

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Max

Z_1 Z_1

Max

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1 کلاً روی ماشین k در صورتی که ماشین i باشد } a_{ik}
 0 در غیر این صورت

1 کار i روی ماشین k در صورتی که کار j قبل روی ماشین i باشد } x_{ijk}
 0 در غیر این صورت

k i $:T_{ik}$
 i $:d_i$
 k i $:O_{ik}$
 j k $:S_i(j, k)$
 i k
 k i $:C_{ik}$
 i $:mc_i$



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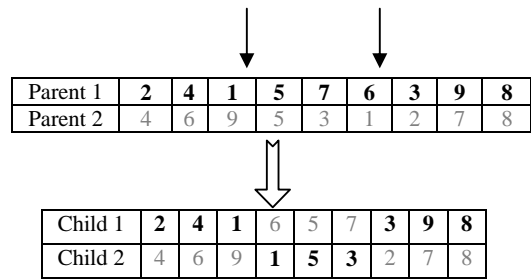
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2	5	3	6	4	1
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4	2	6	3	1	5
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$n \times m$

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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

(S₁,S₂,S₃)

Refset1 : S₁
 |b₁-1|
 Refset2 : S₂
 |b₂-1| N
 Refset1 : S₃ []
 Refset2
 Refset1
 Refset2
 b₁

OX []

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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

Refset1 = b <= b₁ + b₂ b₂ b₁
 Refset1
 b₁

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
b₁

b₂ Refset2

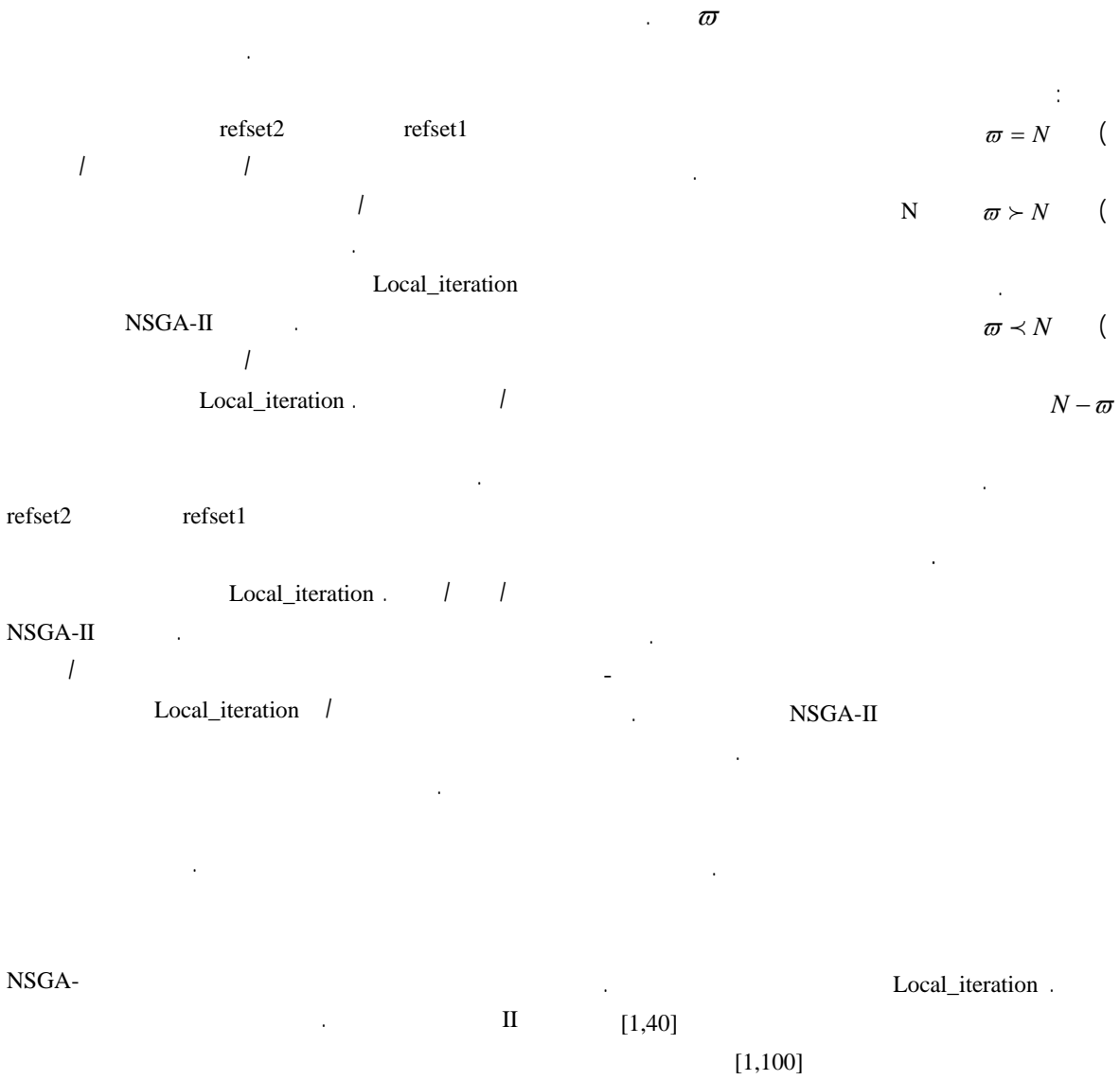
New trial solution 1 : 9 8 1 7 3 5
 New trial solution 2 : 1 7 8 9 4 6

Refset2

Refset1
Refset1

$[0.2p_{mean}, 0.3p_{mean}]$
 $[p(1-t-r/2), p(1+t+r/2)]$
 $p_{mean} \quad p=p_{mean}(n+m-1)$
 $t \quad r$
 $t=0.4 \quad r=\{0.2, 0.6\}$

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



() ()

NSGA-II

$t=0.4, r=0.2$

$t=0.4, r=0.6$

MOSS

NSGA-II

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$t=0.4, r=0.2$

$t=0.4, r=0.6$

MOSS

NSGA-II

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t=0.4 , r=0.2						t=0.4 , r=0.6					
MOSS	NSGA-II	MOSS	NSGA-II	MOSS	NSGA-II	MOSS	NSGA-II	MOSS	NSGA-II	MOSS	NSGA-II
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NP-hard

NSGA-II

NSGA-II
NSGA-II

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