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A multi-objective evolutionary algorithm based on decomposition and constraint programming for the multi-objective team orienteering problem with time windows

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1 A multi-objective evolutionary algorithm based on decomposition
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3 orienteering problem with time windows

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8 **Abstract**

9 The team orienteering problem with time windows (TOPTW) is a well-known variant of
10 the orienteering problem (OP) originated from the sports game of orienteering. Since the
11 TOPTW has many applications in the real world such as disaster relief routing and home
12 fuel delivery, it has been studied extensively. In the classical TOPTW, only one profit is
13 associated with each checkpoint while in many practical applications each checkpoint can
14 be evaluated from different aspects, which results in multiple profits. In this study, the
15 multi-objective team orienteering problem with time windows (MOTOPTW), where check-
16 points with multiple profits are considered, is introduced to find the set of Pareto optimal
17 solutions to support decision making. Moreover, a multi-objective evolutionary algorithm
18 based on decomposition and constraint programming (CPMOEA/D) is developed to solve
19 the MOTOPTW. The advantages of decomposition approaches to handle multi-objective
20 optimization problems and those of the constraint programming to deal with combinatorial
21 optimization problems have been integrated in CPMOEA/D. Finally, the proposed algo-
22 rithm is applied to solve public benchmark instances. The results are compared with the
23 best-known solutions from the literature and show more improvement.

24 *Keywords:* multi-objective combinatorial optimization, team orienteering problem,
25 multi-objective evolutionary algorithm, decomposition approach, constraint programming

26 **1. Introduction**

27 The orienteering problem (OP) is an NP-hard combinatorial optimization problem in-
28 troduced by Tsiligirides [1]. The OP can be defined as follows. Given one specified control
29 point and a set of checkpoints, the travel times between any two points are known and each

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