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ILS-PR: An efficient heuristic for the Capacitated Centered Clustering Problem

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1 Introduction

The Capacitated Centered Clustering Problem (CCCP) consists of locating p facilities in a Euclidean space which satisfy n demand points in such a way that the total sum of distances between each point and its nearest facility is minimized. In this problem each facility has a limited service capacity and its location is given from the geometric center of the cluster.

This problem is known to be an NP-hard problem and has recently been tackled by approaches based on metaheuristics. For such problems, there is no known deterministic method able to find the optimal solution with a polynomial time complexity, regardless of the scale of the problem. Therefore, heuristic methods are often used in order to find efficient solutions to this problem.

Within the heuristics used to resolve the CCCP, those that stand out make use of the metaheuristics Clustering Search [5], Tabu Search [3], VNS [4] and GRASP [1]. Currently, the method proposed in [3] is considered state of the art.

In this work, an ILS (Iterated Local Search) [2] based heuristic method is proposed together with the Path Relinking (PR) technique. To evaluate the performance of the heuristic proposal, 25 instances commonly found in literature were used, ranging from 100 to 13221 points. Moreover, 25 instances created in this work were used ranging from 100 to 10000 points. Preliminary results show that the proposed method is highly competitive, there is not significant statistical difference when is compared with the considered method like state of the art.

2 ILS-PR

The heuristic proposal consists of a construction method based on the proposed in [1], four different neighborhood structures for the Local Search, which we call "Reallocation",

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"Swap", "Wave" and "Center Exchange". Furthermore, a perturbation mechanism that changes the allocation of points, and the Path-Relinking technique are used. Figure 1 shows the general structure of the implemented method, where ξ is the list of solutions used in PR, s^* the best solution found, and λ the degree of perturbation.

```
ILS-PR(λ)
1Begin
2       s ← Initial solution
3       s ← Local Search(s)
4   do
5       Update ξ and s*
6       s' ← Perturbation(s*,λ)
7       s  ← Local Search(s')
8       Radomly select s'' from ξ
9       s ← PR(s", s)
10  while Not stopping criterion
11  Return s*;
12End
```

Figure 1: Algorithm ILS with Path Relink

3 Conclusion

We have presented an efficient ILS with Path-Relink for the CCCP. Furthermore, this work contributed the proposal of new instances that have different characteristics in comparison to those commonly used in literature. Thus, it was possible to verify the performance of the algorithms in different situations than those currently found in literature.

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