Evolutionary Clustering Search for dynamic vehicle routing

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The objective of this work is to contribute with a solution method for a vehicle routing problem with time windows, considering a dynamic aspect of answering new demands after cargoes´ pick up/distribution are already started. These routing procedure problems are generally of difficult solution, but of relevant significance face to the economic aspect of Transportation Companies´ pick up/distribution and any other kind of transportation services.

This work utilizes the Genetic Algorithm (GA) proposed by [Ribeiro and Lorena, 2005] as a base to the Evolutionary Clustering Search (ECS) proposed by [Oliveira, 2004] thesis. The ECS attempts to locate promising search areas by framing them by clusters. It is particularly interesting to find out such areas as soon as possible to change the search strategy over them. The ECS will be applied to a Vehicle Routing Problem with Dynamic Time Window (VRPDTW) that considers some dynamic aspects.

The VRPDTW is a particular case of the Vehicle Routing Problem that has pick up/distribution routes with added penalties due to delays/anticipated arrivals of vehicles to the pick up/delivery destinies and/or adding pick up/delivery places for the routes already in course. Figure 1 shows two routes in the moment when a new request is made. The black circles refer to the real position of each vehicle in transit. In each case there is a set of existing routes where each vehicle starts in the current position and arrives to the final destiny.

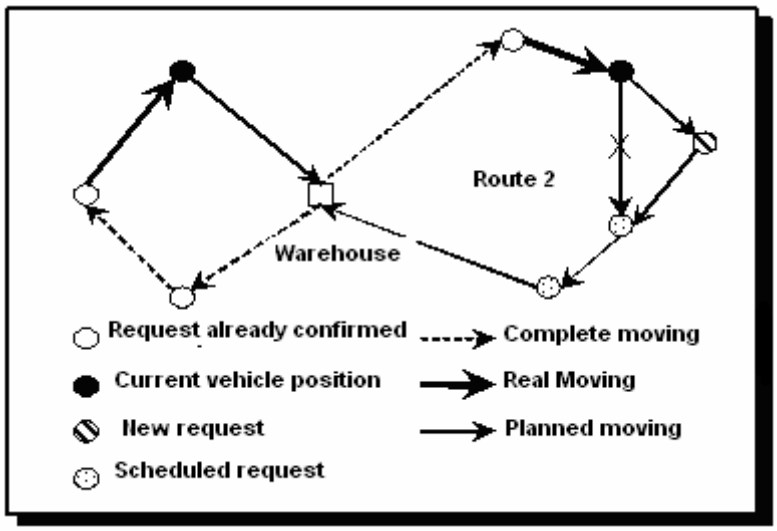

Figure 1 – Two "programmed" routes against a new request.
Source: Adapted from [Gendreau et al., 1999].

The Clustering Search

In a general view the Evolutionary Clustering Search (ECS) (Figure 2) is employs clustering for detecting promising areas of the search space. It is particularly interesting to find out such areas as soon as possible to change the search strategy over them. An area can be seen as an abstract search subspace defined by a neighborhood relationship in metaheuristic coding space.

The ECS can be splited off in four conceptually independent parts: (a) a search metaheuristic (SM) (the GA in this case); (b) an iterative clustering (IC) component; (c) an analyzer module (AM); and (d) a local searcher (LS). The GA works as a full-time solution generator. The IC aims to gather similar information about the problem at hand into groups, maintaining a representative solution associated to this information, named the cluster center. The AM provides an analysis of each cluster, in regular intervals of generations, indicating a probable promising cluster. At last, the LS is an internal searcher module that provides the exploitation of a supposed promising search area, framed by cluster.

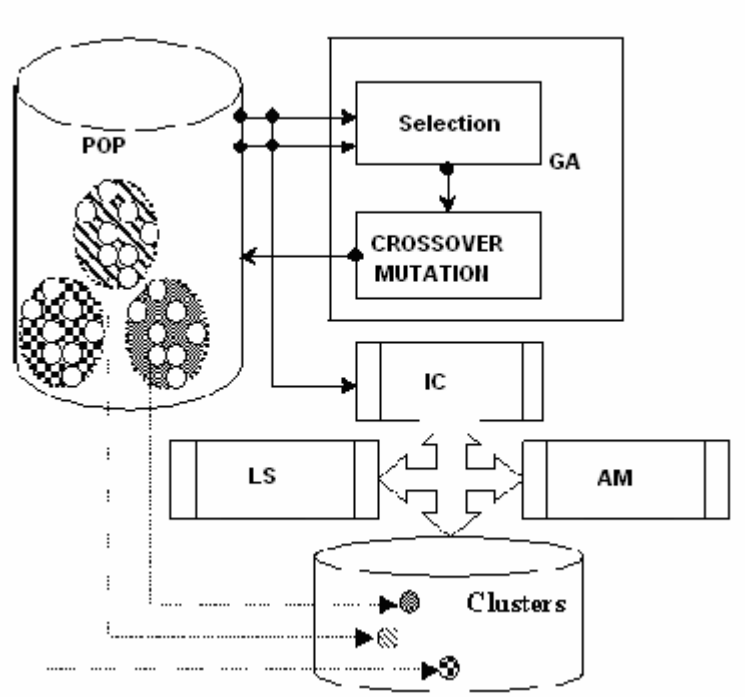

Figure 2 – Architecture of ECS.
[Oliveira, 2004]

Preliminary results

The AG of [Ribeiro and Lorena, 2005] was initially improved by the introduction of a local search mutation of 2-opt type. Others possible improvements are intended to be implemented before the application to some geo-referenced instances of São José dos Campos. The ECS will be applied to the improved AG to guide the search to promising regions.

References

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