Centrum voor Wiskunde en Informatica

Dynamic Routing Problems with Fruitful Regions: Models and Evolutionary Computation

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Objective

We study under which settings of constraints the usage of anticipatory routing can increase the effectiveness within the context of dynamic routing problems, where customers are clustered into fruitful regions. To this end, an evolutionary algorithms is developed that uses self adaptation to control the amount of anticipatory routing.

Dynamic Routing

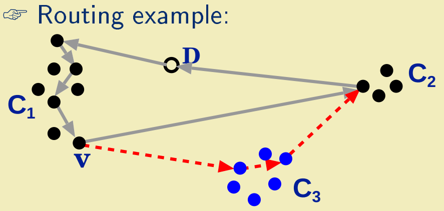
We study on-line routing, i.e., service requests arrive while solving the problem. A full mathematical model is in the paper, where we focus on the following constraints:

Capacity of each vehicle.

Delivery time allowed for a load to be transported to the depot.

Fruitful regions

☞ Routing example:



Fruitful region is a set of customers, geographically clustered that, together, have a high demand for service, e.g., C_3.

Anticipatory routing refers to relocating vehicles to customers that have not (yet) requested service, e.g., the dotted line.

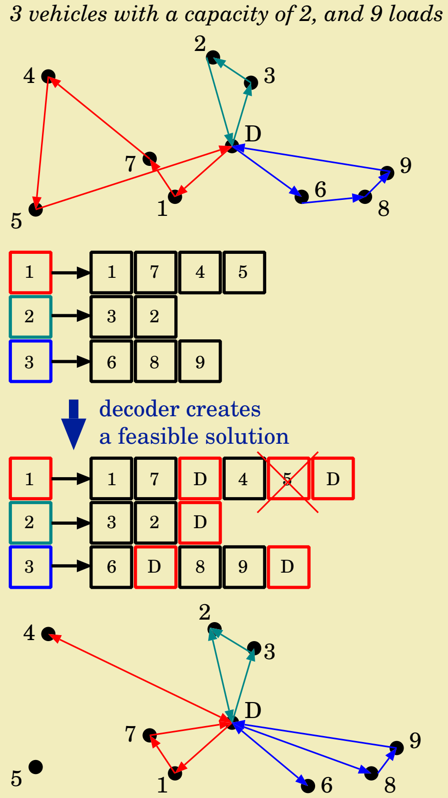
Evolutionary algorithm

☞ Knowledge about the demand of customers is incorporated into an evolutionary algorithm, which is used to perform anticipatory routing by means of a self-adaptive scheme.

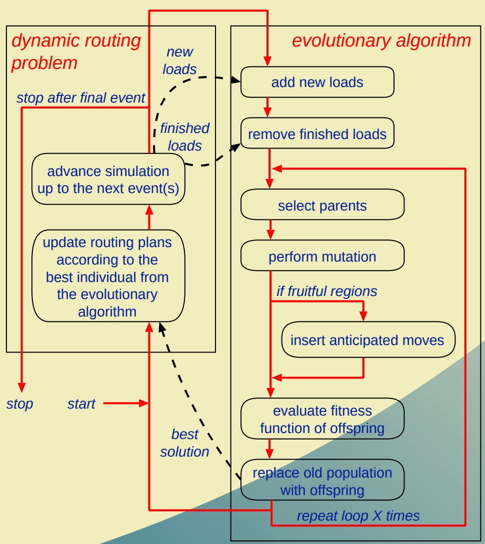
☞ Two variants are tested, one that uses anticipatory routing and one that does not.

☞ Decoder example:

3 vehicles with a capacity of 2, and 9 loads



Simulation flow

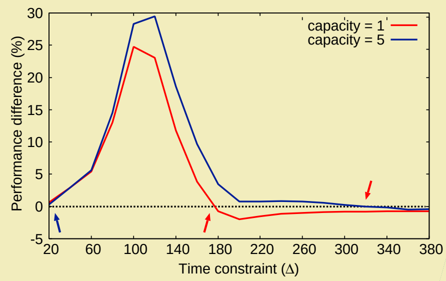


Experiments

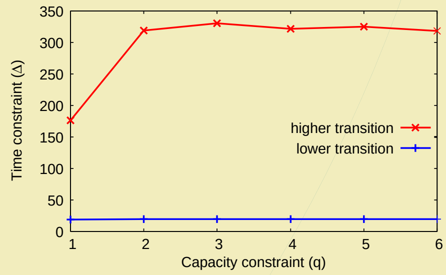
✔ We fix the capacity of the vehicles and vary the delivery time constraint.

✔ For each delivery time, 40 problems are generated and 30 independent runs are performed.

✔ We measure the fraction of loads that were successfully transported per run, averaged over 1200 runs.



✎ A phase transition occurs with a lower transition (blue arrow) and upper transition (red arrows).



✎ Open Source problem generator at `http://www.cwi.nl/~jvhemert`

Conclusions

✔ We have determined the conditions under which anticipatory routing will improve the efficiency with relation to capacity and delivery time constraints.

✔ The self-adaptive mechanism is shown to successfully control the amount of anticipatory routing and to apply it where beneficial.

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`http://www.almende.com/deal/`

www.cwi.nl