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SHORT COMMUNICATION

The VeRoLog solver challenge 2016–2017

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Abstract The VeRoLog Solver Challenge 2016–2017 is the third solver challenge facilitated by VeRoLog, the EURO Working Group on Vehicle Routing and Logistics Optimization, and is organized in cooperation with ORTEC B.V. The authors constitute the organizing committee of this challenge, and with this paper they report on the problem and organization of this challenge.

Keywords Vehicle routing · Solver challenge · Scheduling · Optimization · Transport

1 Introduction

In the past years, solver challenges in scheduling and routing attracted the attention of many researchers, not only during the challenges, but also after their end. The main reasons for this attention are a clear description of the problem at hand, the availability of challenging datasets, and the possibilities to compare different solution methods.

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2 Problem description

The problem of the VeRoLog Solver Challenge 2016–2017 is based on a routing challenge faced by a large cattle improvement company. The task at hand is to regularly measure the quality of milk samples at a number of farm locations, the customers. For this, special measuring tools are needed, and those have to be delivered to the customers at their request. After the measurement, the tools have to be picked up again. The scheduling of these deliveries to days and the routing for the planned deliveries and pickups are the issues to address in this challenge.

In more details, the planning horizon consists of a period of days and there is one depot. There are different tool kinds, initially at the depot, each having its own size, and for each tool kind a fixed number of tools are available.

There are tool requests from customers that have to be satisfied. A *request* asks for a number of tools of one kind, that need to be present at the customer for a given number of consecutive days. A request must be handled in one delivery, i.e., the tools of a request must be delivered together. The delivery of the tools has to fall within a certain time window, i.e., each request has a first and a last possible day of delivery. The tools of the request have to be picked up by one vehicle the day after the request is completed. The time windows of the deliveries are such that at all pickups will fall in the planning horizon. A customer may need more

than one tool kind: these needs will be defined by separate requests.

To carry out the deliveries and pickups, vehicles can be hired in any required amount. These vehicles all have the same capacity (with regard to the tool sizes). During any part of a route, the total size of the tools on board of a vehicle may not exceed the vehicle's capacity. As a result, when doing a pickup, a vehicle must have enough capacity left to load the tools. When doing a delivery task, a vehicle must have the tools of the requested kind on board.

The daily route of a vehicle *must* begin and end at a depot, even if there are no tools to be loaded or unloaded. A vehicle can load a tool at the depot and unload it at a customer. However, after the first day, a vehicle can also pickup the tools of a request at one customer and deliver (some of) them to another customer without visiting the depot in-between. At the end of a day, all tools on board of a vehicle are unloaded at the depot, and are, thus, available for the next day.

The distance a vehicle can travel in one day is limited to a given maximum travel distance. A vehicle is allowed to return to the depot several times during a day, to unload tools and/or load (extra) tools as long as the maximum travel distance is not exceeded. It is not allowed to exchange tools between vehicles during a day: the tools unloaded at the depot are not available for other vehicles on this day. However, a vehicle could collect two tools from a customer, and drop one at the depot to pick it up later on the day.

To determine the traveled distances, we provide coordinates for each customer location as well as the depot. The distance between the coordinates (x_1, y_1) and (x_2, y_2) is defined to be the floor of the Euclidean distance, i.e., $\lfloor\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}\rfloor$.

The main objective is to serve all requests at a minimum cost: there are costs for the traveled distance, costs for each route (i.e., using a vehicle for a day), and costs for using a vehicle at all. Additionally, there are costs associated with the tools in use. Each tool has a cost, depending on the kind of the tool. For each tool kind, we can calculate the minimum number of tools needed to execute the planning of the full horizon: for each day we can calculate the daily use, i.e., the number of tools of this kind that are at the customers. The minimum number needed is the maximum daily use.

To our knowledge, this extension of the vehicle routing problem has received little attention in the literature. Gromicho et al. [1] devised a heuristic solution approach for the original problem. However, they only considered a daily planning, whereas we now consider a longer horizon. The longer horizon adds an extra dimension to the problem, namely handling the time relation between deliveries and pickups: while we do know *what* pickups have to be done, we do not know *when* they have to be done in advance.

3 Challenge organization

The challenge was announced at the VeRoLog conference 2016 in Nantes (see https://verolog2016.sciencesconf.org/), that marked the kick-off of the challenge. Documents, tools, instances, and other support are provided through the challenge website at https://verolog.ortec.com.

The challenge will consist of two parts that run parallel in time:

1. *An all-time-best challenge*.
   The organizers will disclose 25 instances in October 2016, the "all-time-best instances". The participants are invited to submit a solution to an instance if it is better than the best solution submitted so far for this instance. Progress, i.e., the cost of the best solutions, will be shown on the website. The all-time-best challenge will run till June 1, 2017 and the participant who held the pole position for the longest period, as well the best submission will be rewarded. In this part you are allowed to use any means, resources and time, you want.
2. *A restricted resources challenge*.
   This is a challenge in the more "traditional" form: the resources are restricted, especially time. The time T (seconds) that your algorithm is allowed to run on the organizers' single core machine is limited by the formula $T = 10 + 2R$. Here R is the number of (delivery) requests in the instance. The organizers will provide a calibration tool, so that you can estimate the time that your algorithm can run on your local machine. In addition, it is not allowed to use any software that is not freely available for commercial use.
   To participate you have to run your algorithm on a set of about 20 instances, and send in the results and solver binaries on June 1, 2017. Based on these results and the validation thereof, around 5 finalists will be selected. The solvers of the finalists will then be applied to a set of hidden instances. For each instance, the participants will be ranked and the participant with the lowest mean rank will be the winner of the challenge.

4 Conclusion

We are convinced that this routing and scheduling problem poses interesting challenges. In particular, the need to monitor the inventory of tools and the routing of the unmatched pickups and deliveries makes it a nasty little puzzle which surely will intrigue and excite you. Please keep in mind that, albeit relatively unknown in the literature, this problem is a relevant practical problem.

We wish you good luck and we are confident that regardless of your final ranking, you will find it enjoyable to participate in the challenge. In addition, we hope to see you all at VeRoLog 2017 in Amsterdam, July 2017!

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Reference

1. Gromicho, J., Haneyah, S., Kok, L.: Solving a Real-Life VRP with Inter-Route and Intra-Route Challenges. Available at SSRN 2610549 (2015)