

# Winter Road Maintenance in Czech Republic\*

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The winter road maintenance in a region of the Czech Republic is a case study of the undirected capacitated arc routing problem. Our task is to minimize the number of maintenance tours needed for the snow cleaning.

The Czech legislation and regulations give specific constraints to the problem. First, each road has the defined time interval 3, 6 or 12 hours in which a vehicle has to clean it. Second, most of the roads are maintained chemically while the roads in protected areas near to nature parks or water sources have to be maintained by gritting or by snowploughing. Third, the maximal length of each tour is constrained by the time schedule of work shifts and by average speeds and capacities of the vehicles. Fourth, each tour starts and ends in a base where also a storage of the corresponding strewing material is located. Fifth, each tour traverses all roads in both directions. Last, we are asked to create a fixed off-line plan for every vehicle where every road is maintained by one vehicle which will be used during the whole winter since the Czech law prohibits dynamic adaptations for changing weather conditions.

This case study optimises the winter road maintenance of Plzeň region. The area of the region is 7561 km<sup>2</sup> and the road network contains 1719 crossroads with 2280 road sections of the total length of 4860 km. The current plan has been gradually created by the expertise and the experience of the responsible local authority. However, the current plan has extensive dead mileage and many roads of a lower importance are currently maintained in only one direction. Furthermore, decreasing number of drivers causes necessity to reduce the number of tours.

Using methods from the graph theory and the combinatorial optimisation we created a plan which not only meets all requirements but also saves 20 per cent of tours and reduces dead mileage under 5 per cent. The main difficulty of further decrease of dead miles is caused by the fact that some roads are maintained chemically and others by gritting but every vehicle can carry only one type of strewing material. More details about possible improvements and used algorithms will be discussed in our talk and presented in the full paper.

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\*Supported by the Czech Science Foundation under grant 17-10090Y.