A two-phase hybrid algorithm for the periodic rural postman problem with irregular services on mixed graphs

Demetrio Laganà

Department of Mechanical, Energy and Management Engineering, University of Calabria, Italy

Email: demetrio.lagana@unical.it

Enrique Benavent

Departament d'Estadística i Investigació Operativa (DEIO), Universitat de València, Spain

Ángel Corberán

Departament d'Estadística i Investigació Operativa (DEIO), Universitat de València, Spain

Francesca Vocaturo

Department of Economics, Statistics and Finance "Giovanni Anania", University of Calabria, Italy

We address the periodic rural postman problem with irregular services ($PRPP$–IS), where some arcs and/or edges of a mixed graph must be traversed (to be serviced) a certain number of times in some subsets of days of a given time horizon. The goal consists of designing a set of minimum cost tours, one for each period of the time horizon, satisfying the service requirements. Such a problem has been introduced by Benavent et al. [1] to model operational activities in road maintenance and road network surveillance, where these operations are carried out periodically and different roads may have different service requirements (number of visits/traversals/passages) according to their importance in the network (see Monroy et al. [2]) In this typology of activities, the number of visits also depends on the time. For instance, some roads may require more visits during the weekend because there is more traffic and less during the working week (and vice versa for other roads). In order to consider this feature, Benavent et al. [1] subdivide the time horizon in subsets of different size. The number of visits varies depending on these subsets. For the $PRPP$–IS, Benavent et al. [1] propose an integer linear program, some valid inequalities and a branch-and-cut algorithm. In this article we propose a two-phase algorithm that combines heuristics and mathematical programming. In the first phase, two different procedures are used to construct feasible solutions: a multi-start heuristic based on feasibility pump and a multi-start constructive heuristic. From these solutions, some fragments (parts of tours associated with the different days) are extracted. The second phase determines a solution for the $PRPP$–IS by combining the fragments by means of a mathematical model. We show the effectiveness of this solution approach through an extensive experimental phase on benchmark instances. The results provided by the two-phase algorithm are compared with the optimal values and the upper bounds obtained with the branch-and-cut algorithm designed by Benavent et al. [1]

References

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[2] I.M. Monroy, C.A. Amaya, and A. Langevin, "The periodic capacitated arc routing problem with irregular services", *Discrete Applied Mathematics*, 61(4-5), 691-701, 2013.