

Eulerian graphs have a closed walk traversing each edge exactly once. Finding such a walk is a basic arc routing problem based on a road network. Most of the problems with applications in operational research are NP-hard. We describe a formal model of a road network and vehicle routes and formulate several arc routing problems motivated by winter road maintenance in the Czech Republic.

The main part is focused on single vehicle routing problems on trees. We propose a new unfairness minimization problem for finding a vehicle route with properties that lead to a minimal number of resident complaints against unfair maintenance. Residents feel like they are skipped when the vehicle route has multiple trips and passes nearby without providing maintenance to their street. By reduction of the necklace splitting problem to the unfairness minimization problem we prove it is PPA-complete.

Further, we define a restricted arc routing problem on trees which formalize conditions given by Czech legislation. We proved the existence of a polynomial algorithm for deciding whether a single vehicle route exists when there is a single priority for roads. If multiple priorities are used, we express conditions and conjectures when the problem has polynomial complexity. Finally, a utilization of the model is illustrated by an application in winter road maintenance in the Plzeň region.