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Arrival time synchronization in vehicle routing

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Abstract:

In traditional vehicle routing applications customer sites must be visited by exactly one vehicle. Therefore, the set of customer sites is partitioned into clusters (tours). Sites in a cluster are ordered so that explicit time windows are respected. I investigate an extension of the well-studied vehicle routing problem with time windows in which customer sites require the visit of two or even more vehicles. Typical applications comprise the routing of technical service teams executing complex maintenance or repair works as well as home care scenarios in which nurses and doctors must meet at the patient's site. At these rendez-vous sites the arrival times of the two (or more) required vehicles must be coordinated in a way that all required vehicles arrive at the customer site within an implicit time windows, i.e. at the same time. Consequently, the scheduling within a cluster cannot be done independently from the scheduling in the other clusters but arrival times must be synchronized in a cross-route fashion. In such a situation, simple arrival time determining procedures (e.g. earliest arrival times) do not meet the synchronization requirements. After the introduction of the problem scenario, a suitable mathematical optimization model is presented and discussed. Small instances of the model are exactly solved by CPLEX but for solving larger instances a heuristic approach becomes necessary. In this context, I propose a matheuristic that combines a genetic algorithm with CPLEX. The heuristic genetic search proposes routes but CPLEX adjusts the arrival times of the deployed vehicles considering a maximal allowed arrival time difference at rendez-vous sites. Results from computational experiments are reported and analyzed.