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An iterated local search algorithm for the time-dependent vehicle routing problem with time windows.

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Summary: We generalize the standard vehicle routing problem with time windows by allowing both traveling times and traveling costs to be time-dependent functions. In our algorithm, we use a local search to determine routes of the vehicles. When we evaluate a neighborhood solution, we must compute an optimal time schedule for each route. We show that this subproblem can be efficiently solved by dynamic programming, which is incorporated in the local search algorithm. The neighborhood of our local search consists of slight modifications of the standard neighborhoods called 2- opt*, cross exchange and Or-opt. We propose an algorithm that evaluates solutions in these neighborhoods more efficiently than the ones computing the dynamic programming from scratch by utilizing the information from the past dynamic programming recursion used to evaluate the current solution. We further propose a filtering method that restricts the search space in the neighborhoods to avoid many solutions having no prospect of improvement. We then develop an iterated local search algorithm that incorporates all the above ingredients. Finally we report computational results of our iterated local search algorithm compared against existing methods, and confirm the effectiveness of the restriction of the neighborhoods and the benefits of the proposed generalization.

Keywords: vehicle routing problem; general time windows; time-dependent traveling time and cost; dynamic programming; local search; metaheuristics
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