Parallel large neighborhood search

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This talk presents a simple, parallel and portable C++ software framework for the metaheuristic named *large neighborhood search* (LNS). The aim is to provide a framework where the user with a small amount of programming can implement a metaheuristic where parallelization "comes for free". The parallel framework is intended for multi-core processors that have become main-stream in the recent years.

LNS was proposed by Shaw [1998] and has been gaining popularity in the recent years. The two basic operations in a LNS heuristic are the *destroy* and *repair* methods. For the CVRP a destroy method could remove a number of customers from the solution (e.g. 20%) and the repair method would reinsert those customers, for example using a greedy heuristic. The LNS heuristic maintains a current solution and applies the destroy and repair method to that. The resulting solution is compared to the current solution and if it can be accepted it is promoted to the new current solution. This goes on for a number of iteration after which the heuristic terminates, returning the best solution observed during the search. The framework implements an adaptive mechanism proposed by Ropke and Pisinger [2006] that lets the user define several destroy and repair methods that the framework chooses from, based on their performance during the search.

The parallel framework takes advantage of the fact that the most time consuming parts of a LNS algorithm typically are the destroy and repair methods and therefore performs several of these operations concurrently. Computational tests show that the heuristic scales well in terms of computing time reduction when the number of computing units increases.

We test the parallel LNS heuristic on five well-known optimization problems: the *traveling salesman problem with pickup and delivery* (Ruland and Rodin [1997]), the *capacitated vehicle routing problem* (Toth and Vigo [2002]), the *capacitated minimum spanning tree* (Ahuja et al. [2001]) as well as *multi-depot/site-dependent vehicle routing problem with time windows and route duration constraints* (Cordeau et al. [2004]). We conclude by providing thoughts on future work.

References

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