www.elsevier.com/locate/caor

A heuristic algorithm for a single vehicle static bike sharing rebalancing problem

Fábio Cruz, Anand Subramanian, Bruno P. Bruck, Manuel Iori

PII: S0305-0548(16)30248-9
DOI: http://dx.doi.org/10.1016/j.cor.2016.09.025
Reference: CAOR4098

To appear in: *Computers and Operation Research*

Received date: 20 April 2016
Revised date: 13 September 2016
Accepted date: 30 September 2016

Cite this article as: Fábio Cruz, Anand Subramanian, Bruno P. Bruck and Manue Iori, A heuristic algorithm for a single vehicle static bike sharing rebalancing problem, *Computers and Operation Research* http://dx.doi.org/10.1016/j.cor.2016.09.025

A heuristic algorithm for a single vehicle static bike sharing rebalancing problem

Fábio Cruz[a,*], Anand Subramanian[a], Bruno P. Bruck[b], Manuel Iori[b]

[a] *Centro de Informática, Universidade Federal da Paraíba, CEP 58059-900, João Pessoa, Brazil.*
[b] *DISMI, University of Modena and Reggio Emilia, 42122 Reggio Emilia, Italy.*

Abstract

The static bike rebalancing problem (SBRP) concerns the task of repositioning bikes among stations in self-service bike-sharing systems. This problem can be seen as a variant of the one-commodity pickup and delivery vehicle routing problem, where multiple visits are allowed to be performed at each station, i.e., the demand of a station is allowed to be split. Moreover, a vehicle may temporarily drop its load at a station, leaving it in excess or, alternatively, collect more bikes from a station (even all of them), thus leaving it in default. Both cases require further visits in order to meet the actual demands of such station. This paper deals with a particular case of the SBRP, in which only a single vehicle is available and the objective is to find a least-cost route that meets the demand of all stations and does not violate the minimum (zero) and maximum (vehicle capacity) load limits along the tour. Therefore, the number of bikes to be collected or delivered at each station must be appropriately determined in order to respect such constraints. We propose an iterated local search (ILS) based heuristic to solve the problem. The ILS algorithm was tested on 980 benchmark instances from the literature and the results obtained are competitive when compared to other existing methods. Moreover, our heuristic was capable of finding most of the known optimal solutions and also of improving the results on a number of open instances.

Keywords: Bike-sharing, Vehicle Routing, Split pickup and delivery, Iterated local search.

1. Introduction

The task of repositioning a commodity from one location to another is a well-known problem arising in different contexts such as logistics, transportation, and various disciplines, notably industrial engineering and operations management. A practical application arises in

*Corresponding author
Email addresses: fabiocba@di.ufpb.br (Fábio Cruz), anand@ct.ufpb.br (Anand Subramanian), bruno.p.bruck@gmail.com (Bruno P. Bruck), manuel.iori@unimore.it (Manuel Iori)