

19th EURO Working Group on Transportation Meeting, EWGT2016, 5-7 September 2016,
Istanbul, Turkey

Cycle-tourist network design

Alessandro Giovannini ^a, Federico Malucelli ^b, Maddalena Nonato ^{c,*}

^a*Dipartimento di Matematica, Facoltà di Scienze e Tecnologie, Università degli Studi di Milano, Via Cesare Saldini 50, Milano 20133, Italy*

^b*DEIB, Dipartimento di Eletttronica, Informazione e Bioingegneria, Politecnico di Milano, P.zza Leonardo da Vinci 32, Milano 20133, Italy*

^c*EnDIF, Dipartimento di Ingegneria, Università di Ferrara, Via Giuseppe Saragat 1, Ferrara 44122, Italy*

Abstract

Among the most effective actions to promote functional cycling, i.e., cycling as a mean of transport, infrastructure design and planning are major topics. Much less attention has been dedicated to the design and deployment of bikeways devoted to recreational cycling, despite the role of cycle routes in promoting cycle tourism, and the effectiveness of cycle tourism in fostering sustainable and environmentally friendly economic growth, in addition to encouraging healthy life styles. In this paper we contribute to fill this gap: we propose a quantitative based methodology for designing a cycle-tourist network infrastructure intended to provide local administrators with a quantitative based decision support tool to optimally exploit the scarce public funding devoted to the project deployment. We consider as a case study the data of the Trebon region, in South Bohemia. Given the local points of attractions and a set of potential links which can be turned into cycle pathways against a little investment in addition to a set of links already fit for cyclists, a network of cycle routes that interconnects a set of pre selected gates must be designed, so that the total link refurbishment cost is budget compliant and the attractiveness of cycle itineraries from gate to gate supported by the infrastructure is maximized.

In previous studies we showed how to compute a resource-constrained optimal path from origin to destination, which maximizes a utility function related to the attractiveness of the arcs and nodes along the path. In a later work we generalized the problem to the case of multiple users with different utility functions that must share the same monetary budget. Building on these results, in this paper we propose a heuristic solution approach for the network design problem, where routes connecting several origin destination pairs have to be designed, yielding a connected infrastructure which allows for further itineraries. We exploit the ability of modern solvers to quickly find solutions to the single-pair single-user aforementioned case to generate a pool of promising paths from gate to gate, according to different preferences and constraints. In a second step, the network is built by solving a second combinatorial optimization problem which selects a path for each pair of gates from the pool, to yield a budget compliant connected infrastructure. Finally, a post optimization step deletes redundant links, if any.

The solution approach is validated by an experimental campaign performed on realistic data for the Trebon zone, in Southern Bohemia.

© 2017 The Authors. Published by Elsevier B.V.
Peer-review under responsibility of the Scientific Committee of EWGT2016.

Keywords: Bicycle network design; cycle tourism; routing with profit; orienteering problem; heuristic;

* Corresponding author. Tel.: +39-0532-974994 ; fax: +39-0532-974870.
E-mail address: maddalena.nonato@unife.it

1. Introduction

Environmental concerns over pollution and climate change, which have been dominating the public debate in the last few months after the United Nations convention in Paris, bring to the forefront the discussion on how to promote sustainable economic growth and encourage soft mobility at the same time. Fostering cycle tourism provides an answer to both concerns. First, cycle tourism may activate a positive synergy towards functional cycling, i.e., cycling as a mean of transport, even in those countries without a well-established cycling culture that have experienced the automotive domination for years. Since regular cyclists are more willing to commute by bike than others, promoting cycle tourism and enlarging the cyclist community indirectly fosters the use of bike as a mean of transport, as the case of the Great Western Greenway in Ireland, described in Deenihan et al. (2013), suggests: created to attract visitors and to cater to recreational cycling, it increased the percentage of sustainable travel patterns of residents, school commuting by bike in particular. It has also been observed that, once a cycling infrastructure has been deployed, even if it was originally designed for leisure it often gets used for functional journeys by experienced cyclists. At the same time, these cycling facilities provide an opportunity to practice for first time cyclists and for those starting to cycle again as well. These people find a friendly and protected environment where they can gain or regain confidence with this mean of transport while having fun in complete safety, and are more likely to become potential utility cyclists afterward. Second, cycle tourism is an expanding sector in several European countries and represents an opportunity for economic growth in a sustainable and environmental friendly manner. Being able to attract cycle-tourists expands the regional economy by boosting small businesses run by local communities aimed at providing a different range of services to the tourists, varying from small scale lodging facilities to technical support for bikers, including regional food productions and all those activities related to the exploitation of local culture and traditions, as discussed in the final report of the European Project Cycle Cities (2014).

Whether intended for leisure or mobility needs, the level of cycling depends on the quality of available infrastructure, whose design methodologies still pose several challenges to the scientific community. In fact, decision makers are eager for reliable quantitative tools to support them when designing from scratch or when expanding a cycling network. A flourishing literature aims at defining the ideal characteristics of bikeways to be built along existing roads, taking into account traffic data, the geometrical shape of the roads, and the features of bicycles as means of transport (speed and safety distances), generalizing to bicycles the methodologies applied to vehicles, as discussed in detail, for example, in the Local Transport Note 2 (2008) report issued by the U. K. Department of Transport. Fewer are the studies that analyze the impact of infrastructure improvements on cycling mobility, such as Hamilton and Wichman (2015), or how to anticipate expected benefits in terms of traffic reduction and modal shift, such as Wardman et al. (2007). Although functional cycling network design is undoubtedly at the top of the agenda of local governments and planners, to our knowledge there is no assessed methodology for it. At the same time, the scarce literature on the design of leisure devoted infrastructures for cyclists usually disregards the hints coming from functional cycling, and tends to privilege the analysis of economical and societal impacts of the existing systems and their interrelations with the transportation network (see for example Lumsdon (2000) where the tourist transport system is discussed). On the contrary, we believe that a few issues are common to both fields with slightly different interpretations, such as continuity, attractiveness, safety, and societal and economical impacts of a cycling infrastructure, beside evaluation of user needs, as discussed hereafter.

Certainly, the **continuity** of cycle pathways is an important feature in both cases. Its lack is often questioned by urban cyclist and it strongly affects the perceived suitability of cycling as a transport mode of choice. In a similar way, a cycle route devoted to cycle tourists is appealing to a large community only provided that it ensures a certain quality standard throughout its way, from origin to destination, and connects all the local attractions in a seamless manner. **Attractiveness** is another common issue. In case of recreational cycling, the leisure and attractiveness of cycle routes are obviously necessary requirements. The concept of attractiveness is related not only to the particular features of the pathway but it extends to the appeal of the points of interest reachable along the pathways and to the traversed landscape. In a more restricted interpretation, the positive impact of pathway attractiveness started to be recognized by academics and city planners also in case of cycleways intended to commuters within a urban environment, as reported in Lin and Liao (2014). Indeed, attractiveness turns out to be, beside safety and comfort, among the most influential factors that drive functional cyclist behavior, and it was selected as one of the attributes on which the quality index for functional cycling infrastructures proposed in Hulla and OHolleranb (2014) is based. Finally, promoting cycling as a

Download English Version:

<https://daneshyari.com/en/article/5125368>

Download Persian Version:

<https://daneshyari.com/article/5125368>

[Daneshyari.com](https://daneshyari.com)