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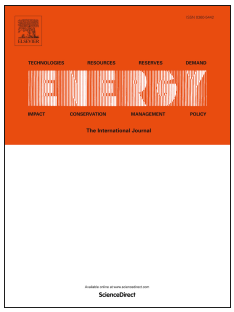

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Wenjie Li, Lixing Yang, Li Wang, Xuesong Zhou, Ronghui Liu, Ziyou Gao

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Eco-reliable Path Finding in Time-variant and Stochastic Networks

Wenjie Li[a], Lixing Yang[a]*, Li Wang[a], Xuesong Zhou[b], Ronghui Liu[c], Ziyou Gao[a]

[a] *State Key Laboratory of Rail Traffic Control and Safety, Beijing Jiaotong University, Beijing, 100044, China*

[b] *School of Sustainable Engineering and the Built Environment, Arizona State University, Tempe, AZ 85287, USA*

[c] *Institute for Transport Studies, University of Leeds, Leeds, LS2 9JT, United Kingdom*

Abstract

This paper addresses a route guidance problem for finding the most eco-reliable path in time-variant and stochastic networks such that travelers can arrive at the destination with the maximum on-time probability while meeting vehicle emission standards imposed by government regulators. To characterize the dynamics and randomness of transportation networks, the link travel times and emissions are assumed to be time-variant random variables correlated over the entire network. A 0-1 integer mathematical programming model is formulated to minimize the probability of late arrival by simultaneously considering the least expected emission constraint. Using the Lagrangian relaxation approach, the primal model is relaxed into a dualized model which is further decomposed into two simple sub-problems. A sub-gradient method is developed to reduce gaps between upper and lower bounds. Three sets of numerical experiments are tested to demonstrate the efficiency and performance of our proposed model and algorithm.

Keywords: Eco-reliable Path Finding; Vehicle Emission; Time-variant and Stochastic Network; Lagrangian Relaxation Approach

1 Introduction

1.1 Motivation

Nowadays, the negative impact of automobiles on energy consumption, land use, noise and greenhouse gas (GHG) emissions, is still a significant topic in the transportation fields (see Knörr [18]). Among various pollutant emissions, GHG emissions and carbon dioxide (CO_2) are of particular concerns to the environment and the people's health. The international council on clean transportation pointed out that the transport sector is responsible for about one-quarter of energy-related GHG emissions worldwide, among which passenger vehicles account for nearly half of this total emissions, and are predicated to remain the predominant source of these emissions for the foreseeable future. According to technical summary in climate change 2014 (Edenhofer et al. [7]), the global transport sector accounts for 27% of total energy consumption and 6.7 $GtCO_2$ direct emissions in 2010. The baseline CO_2 emissions in transport sector is projected to increase to 9.3-12 $GtCO_2$/year in 2050. Due to the large size of global vehicle fleet and its high rate of growth, CO_2 emissions produced by passenger vehicles will remain one of the greatest challenges for the governments.

* *E-mail address:* lxyang@bjtu.edu.cn (L. Yang)