Alexis Quesada-Arencibia
José Carlos Rodríguez
Roberto Moreno-Díaz
Gabriele Salvatore de Blasio
Carmelo Rubén García (Eds.)

EUROCAST 2022

Computer Aided Systems Theory

EXTENDED ABSTRACTS

18th International Conference on Computer Aided Systems Theory
Las Palmas de Gran Canaria, Spain, February 2022

Eighteenth International Conference on
COMPUTER AIDED SYSTEMS THEORY

EUROCAST 2022

Edited by

Alexis Quesada-Arencibia
José Carlos Rodríguez-Rodríguez
Roberto Moreno-Díaz
Gabriele Salvatore de Blasio
Carmelo Rubén García

ISBN: 978-84-09-38381-8
REGISTRO: 2022011735

eurocast 2022

Eighteenth International Conference on Computer Aided Systems Theory

February 20-25, 2022

Museo Elder de la Ciencia y la Tecnología, Las Palmas de Gran Canaria
Canary Islands, Spain

Supporter Institutions:

Instituto Universitario de Ciencias y Tecnologías Cibernéticas
Universidad de Las Palmas de Gran Canaria, Spain

Johannes Kepler Universität Linz
Linz, Austria

University of Applied Sciences
Upper Austria

Museo Elder de la Ciencia y la Tecnología
Las Palmas de Gran Canaria, Spain

Fundación Universitaria de Las Palmas
Las Palmas de Gran Canaria, Spain

With the collaboration of

City Council of Gáldar
Convention Bureau

To the Memory of Werner de Pauli Schimanovich

Conference Chairs

General: Roberto Moreno-Díaz (Las Palmas)

Program: Franz Pichler (Linz)

Logistics: Alexis Quesada-Arencibia (Las Palmas)

Technical Secretariat

Instituto Universitario de Ciencias y Tecnologías Cibernéticas
Universidad de Las Palmas de Gran Canaria
Campus de Tafira
35017 Las Palmas de Gran Canaria, Spain

Phone: +34-928-457108
Fax: +34-928-457099
E-mail: euroccast@iuctc.ulpgc.es

A Methodology to Consider Explicitly Emissions in Dynamic User Equilibrium Assignment

Mehmet Ali Silgu[1,3(✉)], Ismet Goksad Erdagi[1,4], Sercan Akti[1], Selin Hulagu[1,2], Hazal Akova[1], Gokhan Goksu[1] and Hilmi Berk Celikoglu[1,2]

[1]Technical University of Istanbul (ITU), ITU ITS Research Lab, Istanbul 34469, Turkey
msilgu@itu.edu.tr;masilgu@bartin.edu.tr
[2]Technical University of Istanbul, Department of Civil Engineering, Istanbul 34469, Turkey
[3]Bartın University, Department of Civil Engineering, Bartın, 74100, Turkey
[4] University of Pittsburgh, Department of Civil and Environmental Engineering, Pittsburgh, PA, United States of America

Abstract. This work presents a methodology to obtain Dynamic User Equilibrium (DUE) over a road network considering the exhausted gas effect of motorized traffic. On purpose, three emission models are integrated in part to the traffic simulator AIMSUN and, an entire modeling structure is proposed. The proposed methodology is tested on both a hypothetical test network and a real-world network from Istanbul, Turkey. With the use of dynamic traffic assignment components of AIMSUN, emissions are incorporated to dynamic cost functions. Furthermore, link travel times are considered in the dynamic cost functions in conjunction with emissions. The DUE condition is converged according to dynamic cost functions. Results with the employment of different emission models on a real road network are visualized, compared, and discussed.

Keywords: Dynamic Traffic Assignment, Vehicular Emissions, Traffic Simulation, Optimization.

1 Introduction

The environmental aspects of transportation problems have been gaining significant focus in recent years. According to the United States Environmental Protection Agency (USEPA) [1], road transportation has become the greatest source for carbon monoxide (CO), nitrogen dioxide (NO_x), and sulfur dioxide (SO_x) emissions. One of the ways of addressing such issues in transportation engineering requires the consideration of environmental perspectives for transportation network flow modeling. Integration of such environmental perspectives to modeling methodologies (i.e., Dynamic Traffic Assignment) is an active topic in the literature [2]. In the work summarized in this paper in part, a methodology is developed considering explicitly the dynamic variation of emissions throughout the modeling horizon. On purpose, the DTA module in AIMSUN [3] is used in the integrated model structure. Different emission models, i.e., Barth and Boriboonsomsin [5], MOVESTAR [6], and QUARTET [7], are integrated to AIMSUN as a part of dynamic cost functions. Using the DTA module of AIMSUN, Dynamic User Equilibrium (DUE) is aimed to be obtained considering emission effects of traffic. To observe the effects of emissions

on vehicle routing, two scenarios are created. In the first scenario, the dynamic cost functions are written considering only the link travel times. For the second scenario, emissions and travel times are considered together in the dynamic cost functions. Prior to case study modeling, the proposed methodology is tested on Nguyen-Dupuis test network with hypothetical traffic demand data. Following trials at the test network, the proposed modeling structure is used to simulate flows over a medium-large scale road network of the main campus of (ITU) using real-world measurements. Real-world measurements, i.e., observed speeds on links and turning ratios at intersections, have been used to calibrate the model and to obtain demand profiles for the morning and evening peak hours. The test network and ITU network, which is modeled in AIMSUN network editor, are given respectively in Fig.1a and Fig. 1b.

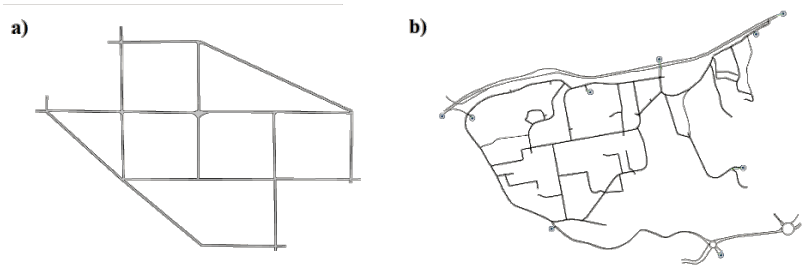

Fig. 1. a) Nguyen-Dupuis Test Network, b) Istanbul Technical University Campus

Acknowledgments

This work is supported by the Scientific and Technological Research Council of Turkey (TUBITAK) under Project 218M307.

References

1. United States Environmental Protection Agency. Sources of greenhouse gas emissions, Accessed: 2020-08-06. URL https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.
2. Wang, Y., Szeto, W. Y., Han, K. and Friesz, T. L.: Dynamic traffic assignment: A review of the methodological advances for environmentally sustainable road transportation applications. Transportation Research Part B, Vol. 111, pp. 370–394 (2018). doi: 10.1016/j.trb.2018.03.011.
3. Aimsun Next Version 20 User's Manual TSS—transport simulation systems, Barcelona, Spain, (2020) , www.aimsun.com
4. Istanbul Technical University, ITU Green Campus Project. URL https://impact.itu.edu.tr/itu-green-campus-project
5. Barth, M., & Boriboonsomsin, K.: Real-World Carbon Dioxide Impacts of Traffic Congestion. Transportation Research Record, 2058(1), 163–171 (2008). https://doi.org/10.3141/2058-20
6. Z. Wang, G. Wu, and G. Scora, "MOVESTAR: An Open-Source Vehicle Fuel and Emission Model based on USEPA MOVES", arXiv:2008.04986, 2020.
7. QuARTET (1992) Assessment of current tools for environment assessment in QUARTET, DRIVE II Project V2018: QUARTET, September 1992.

Instituto Universitario de Ciencias y Tecnologías Cibernéticas
Universidad de Las Palmas de Gran Canaria

Johannes Kepler University Linz

University of Applied Sciences Upper Austria

Museo Elder de la Ciencia y la Tecnología

Fundación Universitaria de Las Palmas