



**HAL**  
open science

# Multi-attribute, Multi-class, Trip-Based, Multi-modal Traffic Network Equilibrium Model

Mostafa Ameli, Jean-Patrick Lebacque, Ludovic Leclercq

► **To cite this version:**

Mostafa Ameli, Jean-Patrick Lebacque, Ludovic Leclercq. Multi-attribute, Multi-class, Trip-Based, Multi-modal Traffic Network Equilibrium Model. Conference on Traffic & Granular Flow, Jul 2017, WASHINGTON DC, United States. 1p. hal-01825870

**HAL Id: hal-01825870**

**<https://hal.science/hal-01825870v1>**

Submitted on 28 Jun 2018

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Multi-attribute, Multi-class, Trip-Based, Multi-modal Traffic Network Equilibrium Model

Ameli M.<sup>1,2,\*</sup>, Lebacque J. P.<sup>1</sup>, and Leclercq L.<sup>2</sup>

<sup>1</sup>Universite Paris-Est, IFSTTAR, GRETIA

<sup>2</sup>Universit de Lyon, IFSTTAR, ENTPE, LICIT

\*mostafa.ameli@ifsttar.fr

In this work we consider a trip-based multi-modal approach to network equilibrium. We assume that mode and path choice are carried out at the same level, therefore travel time ( $TT$ ) depends on travel path and the mode(s) attributes of travelers. This study develops a multi-class model with several parameters per class. Most multi-class flow models, classify travelers by identifying traveler attributes. In the literature, this classification process identifies seven categories of information about travelers: 1- risk taking attitude, 2- economic attributes, 3- general cost function, 4- choice function, 5- knowledge level of network, 6- cost function and 7- social class. Some research uses hybrid classification [1]. In order to describe the traveler behavior, a general cost function that taking into account four of these information (2, 3, 6 and 7), is used. Typically the general cost function ( $GC$ ) will integrate  $TT$  and travel cost ( $TC$ ), and will take into account the class-dependent Value of time (VOT) [4] denoted  $\alpha_i$  for class  $i$ , and a vector  $\beta_i$  of economic and social class parameters. Hence the general cost of path  $p$  is

$$GC_p(\alpha_i, \beta_i) = TC_p(\beta_i) + \alpha_i \cdot TT_p \quad (1)$$

The vector of parameters  $\beta_i$  includes the mode(s) and social attributes of a traveler.

This study presents a formulation of conditions for user equilibrium based on finite-dimensional variational inequality (in the static case) with qualitative analysis of existence (which is usually straightforward) and unicity (which is usually not satisfied in the multi-modal case). Further we present a formulation for dynamic traffic assignment (DTA) and analyze the equilibrium in test cases by a simulation based approach with the gap function-based method [2]. The unicity in the static case is analyzed analytically [3]. We examine by simulation the formation of the equilibrium when the structure of the demand is given and the level of demand increases. The equilibrium changes qualitatively when the demand is increasing, which results in break points for the demand level at which the equilibrium solution changes significantly.

[This work has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program (grant agreement No 646592 – MAGnUM project)]

## References

- [1] Y. Jiang, W. Szeto, J. Long, and K. Han. Multi-class dynamic traffic assignment with physical queues: intersection-movement-based formulation and paradox. *Transportmetrica A: Transport Science*, 12(10):878–908, 2016.
- [2] C.-C. Lu, H. S. Mahmassani, and X. Zhou. Equivalent gap function-based reformulation and solution algorithm for the dynamic user equilibrium problem. *Transportation Research Part B: Methodological*, 43(3):345–364, 2009.
- [3] A. Nagurney and J. Dong. A multiclass, multicriteria traffic network equilibrium model with elastic demand. *Transportation Research Part B: Methodological*, 36(5):445–469, 2002.
- [4] K. Zhang, H. S. Mahmassani, and C. C. Lu. Dynamic pricing, heterogeneous users and perception error: Probit-based bi-criterion dynamic stochastic user equilibrium assignment. *Transportation Research Part C: Emerging Technologies*, 27:189–204, 2013.