Research School for Transport, Infrastructure and Logistics

TRAIL seminar

Applications of Data and Network Science in Transportation

27 February 2020

10.00 h – 12.05 h

TU Delft, Aula – Mekelweg 5

Commissiekamer 3

On 27 February 2020, at 15:00, TRAIL PhD researcher Panchamy Krishnan Krishnakumari will defend her PhD thesis *"Multiscale Pattern Recognition of Transport Network Dynamics and its Applications — a birds eye view on traffic"* at Delft University of Technology. The defence is public, and you are invited to join.

Moreover, on the occasion of this public defence, TRAIL and TU Delft have set up a seminar on *applications of data and network science in transportation*. In line with the broad scope of Panchamies work—from data science and machine learning, to computer science and network science and all this in the context of transportation networks—we have invited a promotion committee whose expertise spans the same breadth. Three of them agreed to share some of their latest research and insights in this morning seminar.

Prof Mike Bell will discuss an innovative method which applies network science to better understand and design the connectivity of the global container shipment network. Prof Francesco Viti will discuss transport at the scale of metropolitan networks and particularly how we can estimate and predict demand patterns using a combination of data and models. Prof Francisco Pereira will discuss an application of data science at the other end of the spectrum of scales within transportation: the individual decision maker. He will show how machine learning approaches can be used as viable alternatives to classic discrete choice models from behavioural economics.

Programme seminar – *more detailed information on the reverse side*

Chairman: Hans van Lint

10:00 - 10:05 Introduction

10:05 - 10:45 **Mike Bell** (University of Sydney)

10:45 - 11:25 **Francesco Viti** (University of Luxemburg)

11:25 - 12:05 **Francisco Pereira** (Denmark Technical University)

12.05 - 12.50 Lunch

Registration
Participation is free, registration is required: *click here*.

Public defence Panchamy Krishnakumari
At 15:00 h the public defence starts in the Senaatszaal of the Aula.
At 14:30 h Panchamy will give a brief presentation about her research in the same room.

Speakers and talks

Mike Bell is the Professor of Ports and Maritime Logistics in the Institute of Transport and Logistics, at the University of Sydney Business School. Prior to this, he was for 10 years the Professor of Transport Operations at Imperial College London and for the final 5 years at Imperial the Founding Director of the Port Operations Research and Technology Centre (PORTeC). He graduated from Cambridge University with a BA in Economics and obtained an MSc in Transportation and a PhD on Freight Distribution from Leeds University. His research and teaching interests span ports and maritime logistics, transport network modelling, traffic engineering, and intelligent transport systems. He is the author of many papers, a number of books (including Transportation Network Analysis, published in 1997), was for 17 years an Associate Editor and is now an Editorial Board Editor of Transportation Research B, the leading transport theory journal, was an Associate Editor of Maritime Policy & Management and is currently an Associate Editor of Transportmetrica A.

Understanding world container shipping network connectivity

Container shipping accounts for most of the world merchandise trade. Better maritime connectivity leads to lower freight rates and greater economic growth. This presentation presents a novel max-min integer optimization model to facilitate better shipping network connectivity by analysing the largest eigenvalue and its corresponding eigenvector of the (asymmetric) frequency weighted adjacency matrix. An algorithm is presented that can quickly identify which link not currently in the network would best improve its connectivity. Verification of the algorithm is achieved by applying it first to a 6-node example network and then to the world container shipping network. It is believed that this study is the first to use the largest eigenvalue approach to improve world shipping network connectivity. A demand matrix is not required by this method of analysis and network symmetry is not assumed.

Francesco Viti is associate professor and head of the MobiLab Transport Research Group, member of the Computational Engineering Institute within the Department of Engineering, affiliated member of the MIT Center for Logistics (LCL) and of the Interdisciplinary Centre for Security, Reliability and Trust (SnT). His research activities range from mobility and travel behavior analysis, development of decision support systems for travellers and for transport operators, Intelligent Transport Systems and network modelling and control. Having a strong interdisciplinary vision, combining engineering, computer science and social sciences, Prof. Viti has well-established collaborations with different groups within the University of Luxembourg, as well as with international academic and industrial partners. He is author of over 100 publications indexed by Scopus, and more than 250 conference papers. He is reviewer of top journals in the transportation domain, and is associate editor of Journal of ITS, Transportation Research Part C, and the Journal of Advanced Transportation. Since 2008 he acts as External Expert for the European Commission and since 2019 he is advisor for the European Investment Bank and for the Luxembourgish Ministries of Transport and of Economy.

Estimating and predicting daily mobility patterns: Where do we need data and where do we need models?

In the era of connected and driverless vehicles, operational decisions will be highly automatised, and (to a large extent) predictable. However, human behaviour will still dominate tactical decisions such as which mode of transport to use, at what time to start an activity requiring a trip, and which route to take. Estimating and predicting the demand in complex multimodal transportation networks will remain a challenge keeping researchers busy with new models and estimators, and seeking to extract relevant information out of (big) mobility data. This presentation will give an overview of the recent developments in dynamic demand estimation starting from a list of ingredients necessary for reliable estimation and prediction of daily demand flows. In particular, these ingredients call for a wise combination of models and data, which both are deemed necessary to clearly capture the spatiotemporal relations emerging from individuals activity-travel behaviour.

Francisco Camara Pereira is a Professor in the Technical University of Denmark (DTU), where he leads the Machine Learning for Smart Mobility group (MLSM). His research is about the methodological combination of Machine Learning and Transport Research, and some applications include demand modeling, traffic prediction, data collection, or anomaly detection. He is Marie Curie fellow, and has published over 50 articles in both Machine Learning and Transport Research fields. Before joining DTU, he was Senior Research Scientist with SMART/MIT (2011-2015) and assistant professor in university of Coimbra (2005-2015).

Representing behavior models with machine learning methods: opportunities and ideas

Modeling and predicting human behavior has been a lively research topic for decades. There is an entire established area, generally called behavior econometrics, that dedicates particularly to how people make choices, and how to use such knowledge to guide and inform interventional changes (e.g. policy making, infrastructure investments, marketing). Both from a research and practice stand-point, knowledge and data representation have followed the same principles for decades, essentially based on statistics and econometrics. However, such representations are arguably not ideal in many current challenges (e.g. social influence in behavior, hierarchical decision making, spatial and temporal causality). In this presentation, I will show some recent work that tries to address some of these newly recognized challenges, using Machine Learning research, such as generative modeling and neural network embeddings.