THE 4TH NYUAD TRANSPORTATION SYMPOSIUM

November 18-19, 2018

Convened by

Samer Madanat, Dean of Engineering, NYUAD
Ali Diabat, Professor of Civil and Urban Engineering, NYUAD
Monica Menendez, Associate Professor of Civil and Urban Engineering, NYUAD
Saif Jabari, Assistant Professor of Civil and Urban Engineering, NYUAD

Overview

Demographic forecasts indicate that the world population will reach nine billion by 2050, with 70 percent living in urban areas. One challenge resulting from such population growth is an increasing need for high quality mobility solutions. Another is related to the logistics and supply chain management. Fortunately, new advances in automation and emerging data collection technologies are reshaping transportation and logistics operations. However, they offer both opportunities and challenges that did not exist five years ago. The fourth NYUAD Transportation Symposium provided a forum for learning about recent developments in smart cities, traffic modeling, control, and logistics and supply chain management to address some of those challenges.

The symposium was convened by Professor Samer Madanat, Dean of Engineering, and Professors Monica Menendez, Ali Diabat and Saif Jabari of Civil and Urban Engineering. It was held at New York University Abu Dhabi from November 18 to 19, 2018 and hosted 16 speakers, including 14 academics, an industry research leader, and a representative from the local government.

Symposium Objectives

The Fourth NYUAD Transportation Symposium built on the momentum created by the first three symposia. The themes of the fourth symposium were chosen based on local (UAE) transport needs that can be addressed by research. The primary goal of the NYUAD Transportation Symposia is to establish NYUAD as a transportation research hub in the MENA region.

The specific objectives of the fourth symposium were:

- to present critical issues in traffic operations, and the role that smart cities and data analytics solutions can play to address urban mobility challenges.
- to discuss existing and future needs in logistics and supply chain management both locally and globally, along with state-of-the-art approaches to meeting these challenges; and
- to identify current research trends and open questions in transportation systems, traffic modeling, and control.

Symposium Highlights

The event featured two and a half days of technical and social programs, all hosted at NYUAD. This year, the symposium focused on three thematic areas: (i) logistics and supply chain management, (ii) smart cities and data analytics, and (iii)the traffic modeling and control. Each topic had its own keynote presentation followed by 4-5 presentations. All speakers are well known international researchers and leaders in their individual areas. Below is a list of speakers (listed in alphabetical order) and their affiliations

- Noura Al Dhaheri, CEO, Maqta Gateway at Abu Dhabi Ports, UAE.
- Alexandre Bayen, Liao-Cho Innovation Endowed Chair Professor and Director of the Institute of Transportation Studies, University of California Berkeley, USA.
- Michel Bierlaire, Professor and Head of Transportation and Mobility Laboratory, EPFL, Switzerland.
- Jeffey Bohn, Director of the Swiss Re Institute, Swiss Re, Switzerland.
- Michael Cassidy, Chancellor's Professor and Robert Horonjeff Professor, University of California Berkeley, USA.
- Ali Diabat, Professor of Civil and Urban Engineering, NYUAD, UAE.
- Marta Gonzalez, Associate Professor of City & Regional Planning, University of California Berkeley, USA.
- Ludovic Leclercq, Professor and Research Director at IFSTTAR, University of Lyon and IFSTTAR (French Institute of Science and Technology for Transport, Spatial Planning, Development and Networks), France.
- Hani Mahmassani, Professor and William A. Patterson Distinguished Chair in Transportation, Northwestern University, USA.
- Monica Menendez, Associate Professor of Civil and Urban Engineering, NYUAD, UAE.
- Stefan Minner, Professor and Chair of Logistics and Supply Chain Management, Technical University of Munich, Germany.
- Chung Piaw Teo, Provost Chair and Professor, National University of Singapore, Singapore.
- Jean-Philippe Richard, Professor, University of Minnesota Twin Cities.
- Karen Smilowitz, Charles Deering McCormick Professor and Co-Director of Center for Engineering and Health, Northwestern University, USA.
- Amanda Stathopoulos, William Patterson Junior Assistant Professor, Northwestern University, USA.
- Pravin Varaiya, Professor Emeritus and Nortel Networks Distinguished Professor, University of California Berkeley, USA.

At the end of the second day a public lecture was hosted as a closing presentation. The presentation was delivered by one of the most prominent academic figures in the areas of traffic control, management, and vehicle technologies.

Additionally, on the day of arrival as well as on the two days of the symposium, social events were organized to bring researchers together and allow for the exchange of ideas in informal settings.

Please find the speakers' bios and abstracts together with the symposium highlights in the pages that follow.

SPEAKERS' ABSTRACTS AND BIOS

Chung Piaw Teo
National University of Singapore

TEO is currently a Provost Chair Professor in the Department of Analytics and Operations in NUS Business School and Director of the Institute of Operations Research and Analytics in NUS. He has taught in NUS and Sungkyunkwan University (Korea) and has held various administrative posts in NUS, as Deputy Dean, Vice-Dean (Research), and Head of Department in the Business School. He was also a fellow with the Singapore-MIT Alliance Program, an Eschbach Scholar with Northwestern University (US), and a Distinguished Visiting Professor in YuanZe University (Taiwan).

CP works in the interface of operations, analytics, and optimization. In operations, he is looking at issues of supply chain and process flexibility, and resource allocation in an online environment. In analytics and optimization, he is looking at choice inferences and predictive analytics using machine learning and distributionally robust models.

He is currently Editor of the Optimization Department in Management Science and was an Area Editor of Operations and Supply Chains Department in Operations Research. He is serving on the Advisory Board of the Engineering System and Design pillar in Singapore University of Technology and Design, and also in the Faculty Advisory Committee of the Faculty of Business in Hong Kong Polytechnic University.

Title: Flexible Resource Allocation: Theory and Applications

Abstract

Increased computing power and the explosion of data have created opportunities for the OM profession to analyze data to identify new models and approaches to drive decisions and actions. In this talk, we develop a real-time resource deployment approach to match supply/capacity with demands, incorporating multiple and possibly conflicting objectives in the system. In this way, we relate the service performance of the supply chain with the resources/capacities needed at each stage, based on the optimal allocation policy deployed. We show that a data-driven approach can be used to guide the system to allocate resources so that the performance attained has the smallest deviation away from a utopia point for the system. We evaluate the performance of this approach using synthetic data, and also data from a ride-sharing company.

Karen Smilowitz
Northwestern University

Dr. Karen Smilowitz is the James N. and Margie M. Krebs Professor in Industrial Engineering and Management Science at Northwestern University. Dr. Smilowitz is an expert in modeling and solution approaches for logistics and transportation systems in both commercial and non-profit applications, working with transportation providers, logistics specialists and a range of non-profit organizations.

Dr. Smilowitz received a CAREER award from the National Science Foundation and a Sloan Industry Studies Fellowship. Dr. Smilowitz is the founder of the Northwestern Initiative on Humanitarian and Non-Profit Logistics. She has been instrumental in promoting the use of operations research within the humanitarian and non-profit sectors through the Woodrow Wilson International Center for Scholars, the American Association for the Advancement of Science, and the National Academy of Engineering, as well as various media outlets.

Dr. Smilowitz recently served as President of the Transportation Science and Logistics Society within INFORMS. Dr. Smilowitz is an Associate Editor for Transportation Science and Operations Research. In 2016, Dr. Smilowitz received the Award for the Advancement of Women in OR/MS from the Women in OR/MS Forum of INFORMS.

Title: Operations Research in Humanitarian and Non-Profit Settings

Abstract

This talk will discuss opportunities and challenges related to the development and application of operations research techniques to transportation and logistics problems in humanitarian and non-profit settings. Much research has been conducted on transportation and logistics problems in commercial settings where the goal is either to maximize profit or to minimize cost. Significantly less work has been conducted for non-profit applications. In such settings, the objectives are often more difficult to quantify since issues such as equity and sustainability must be considered, yet efficient operations are still crucial. This talk will present several research projects that introduce new approaches tailored to the objectives and constraints unique to non-profit agencies, which are often concerned with obtaining equitable solutions given limited, and often uncertain, budgets, rather than with maximizing profits.

Stefan Minner
Technical University of Munich

Stefan Minner is a Full Professor for Logistics and Supply Chain Management at the School of Management, Technische Universität München. Before, he held positions at the Universities of Paderborn, Mannheim, and Vienna.

He serves on several editorial boards of logistics and operations research journals. Currently, Stefan is the Editor-in-Chief of the International Journal of Production Economics. His research interests are in global supply chain design, transportation optimization and inventory management and his work is published in many peer reviewed journals, including Management Science, Manufacturing & Service Operations Management, Operations Research, Production and Operations Management, Transportation Research Part B, European Journal of Operational Research and OR Spectrum.

In 2014, he was listed among the top 25 most productive researchers in Business Administration in Germany by the business newspaper Handelsblatt.

He is a fellow of the International Society for Inventory Research (ISIR) and is currently vice-chairman of the scientific advisory board of the scientific advisory board of the German Logistics Association (BVL), a member of the Research Committee of the European Logistics Association (ELA), and the speaker of the research training group Advanced Optimization in a Networked Economy (AdONE) at TUM.

Title: Crowd Logistics for Last-Mile Urban Delivery

Abstract

Further increasing urbanization and changing customer expectations in e-commerce and last-mile delivery pose disruptive challenges to the design and operation of logistics systems for metropolitan areas, in parts reversing what was believed to be optimal designs for urban logistics for a long time. To address these challenges, various technological and organizational solutions are currently developed and implemented. The success and diffusion of solutions will heavily depend on the availability, analysis and use of smart data to make the best matches between supply and demand in a dynamically changing environment of logistics 4.0.

The presentation highlighted ongoing research on data-driven logistic analytics for the design and operation of urban logistics from the perspective of different stakeholders. New organizational concepts like crowd-logistics and platform solutions as well as multi-tier city logistic concepts were discussed and the potential of artificial intelligence and machine learning investigated.

Jean-Philippe Richard
University of Minnesota

Jean-Philippe Richard is a professor of Industrial and Systems Engineering (ISyE) at the University of Minnesota. He received his undergraduate degree in applied mathematics engineering from Université Catholique de Louvain, in Louvain-La-Neuve, Belgium.

He holds a PhD in Algorithms, Combinatorics and Optimization from the School of Industrial and Systems Engineering (ISyE) at the Georgia Institute of Technology. His research interests are on theoretical and computational aspects of mixed integer linear and nonlinear programming. He is particularly interested in convexification techniques and polyhedral approaches for these problems.

He also has interests in transportation and logistics applications, having carried cooperative research with Class I railroads. His research has been funded by NSF, Union Pacific, and CSX. He is an associate editor for JOGO, IISE Transactions, Optimization Letters, and IMAMAN. He is the recipient of a CAREER award and a best application paper award (IIE transactions).

Title: On Unsplittable Flow Structures Arising in the Rail Transportation of Coal

Abstract

We study network models where flows cannot be split or merged when passing through certain nodes, i.e., for such nodes, each incoming arc flow must be matched to an outgoing arc flow of identical value. This requirement, which we call no-split no-merge (NSNM), appears in railroad applications where train compositions can only be modified at yards where necessary equipment is available. We propose modeling approaches to represent the NSNM requirement. In particular, we give a linear formulation of the requirement on a single node that describes the convex hull in a lifted space. We present a cut-generating linear program to obtain valid inequalities in the original space of variables, and introduce a polynomial-time procedure to lift strong inequalities of lower-dimensional models into strong inequalities of the original model. In addition, we identify an exponential family of facet-defining inequalities that can be separated efficiently. To evaluate our results computationally, we study a stylized unit train problem. We compare a solution approach based on our results with one that relies on column generation. We then show that our results significantly reduce relaxation times and gaps when compared to leading commercial branch-and-cut software.

Ali Diabat
New York University Abu Dhabi

Dr. Ali Diabat received his MSc degree in Operations Research from North Carolina State University and his PhD in Industrial Engineering from Purdue University. He is currently a Global Network Professor of Civil and Urban Engineering at NYUAD. Dr. Diabat's research focuses on different applications of optimization and operations research, encompassing applications such as logistics and supply chain management, healthcare management, and production planning. He has published over 90 research journal papers and over 30 conference papers in leading journals and international conference proceedings.

He has received several funded grants in the amount of more than 3 million dollars from different industries. Dr. Diabat has received several 'excellence in teaching' awards, including an Outstanding Graduate Instructor Award and an Excellence in Teaching Award from Purdue University, in 2004 and 2006, respectively. He was the recipient of the 2012 Excellence in Teaching Award from Masdar Institute, an achievement of special significance as it was the first award of its kind offered at the Institute. In 2014, he also received the Best Faculty Research Award from the Department of Engineering Systems and Management at Masdar Institute.

Dr. Diabat currently serves as an Associate Editor of the SME Journal of Manufacturing Systems, as an Area Editor of the Journal of Computers and Industrial Engineering, and as an Engineering Editor of the Arabian Journal for Science and Engineering.

Title: Airline Operations Management: A Mathematical Programming Approach

Abstract

Flight scheduling, fleet assignment, and aircraft routing are the three most prominent decisions in airline planning as they contribute towards a majority of the costs and revenues of an airline company. These decisions have to be made 10-12 weeks prior to the flight date as mandated by labor unions in order to accommodate cabin crew scheduling requirements. In this study, we develop a two-stage stochastic programming model for the integrated flight scheduling, fleet assignment, and aircraft routing problem. We extend the model to include propagated delay, which is a serious matter to consider in airline planning because it results in huge costs and inefficient utilization of aircraft and crew. Additionally, codeshare agreements were considered to test the effect of expanding the airline's outreach network while retaining low costs. Sample average approximation (SAA) algorithm is used to tackle the uncertainty in the demand while column generation is used to solve the resulting highly complex problem. Computational experiments conducted on a real-life airline company's flight network show that modeling the stochastic problem with 100 scenarios is sufficient to capture the effect of demand and fare uncertainty and to provide a solution with an optimality gap less than 1% within a reasonable computational time. Furthermore, the results show that column generation can solve the model in a fraction of the time a commercial solver takes. A sensitivity analysis on different parameters of the model was carried out and points out the applicability of the proposed model and solution in practice.

Noura Al Dhaheri

Maqta Gateway at Abu Dhabi Ports

Dr. Noura Al Dhaheri is the CEO of Maqta Gateway. A subsidiary of Abu Dhabi Ports, Maqta Gateway, which provides digital services to facilitate trade, is the developer and operator of the first purpose-built and most innovative port community system in the UAE, and the single trade window for Abu Dhabi "Mamar". Designed in line with international standards, Mamar acts as a single window provider facilitating information flow between all port stakeholders and users.

Dr. Al Dhaheri assumed leadership of Maqta Gateway from its inception as a project in 2014, under the patronage of His Highness Sheikh Hazza Bin Zayed Al Nahyan, Vice Chairman of the Abu Dhabi Executive Council. Since then, she has activated the development of the single window system and is now spearheading its market expansion.

Dr. Al Dhaheri has helped usher in a seamless transition into a totally digitalised way of conducting trade through the supply chain, creating a bridge between data and the port's business operations, while aligning with the Abu Dhabi 2030 economic vision and optimising port processes. One of the services developed by Maqta Gateway, for ports anchoring and departure, was recognized with the 'Best Government Service Award' during the 5th edition of Abu Dhabi Government Excellence Award.

Her innovative vision, coupled with remarkable technical and managerial skills, have been instrumental to achieving successful implementation of the most advanced and high standard port community system. Maqta Gateway provides efficient and modern solutions across Abu Dhabi which supports a sustainable and growing trade business in the Emirate.

In addition to obtaining a BSc degree in Software Engineering and an MSc in Engineering Systems and Management with Honour, Dr. Noura Al Dhaheri completed her PhD at Masdar Institute and Massachusetts Institute of Technology. Her studies are part of the Interdisciplinary Doctoral Degree Program, focusing on formulating mathematical optimisation models with special applications to seaport operations, including developing a mathematical model to optimise efficiency, safety and sustainability at the container terminals at Khalifa Port by creating optimal schedules for the loading and unloading of containers using quay cranes, reducing the time spent at port by container vessels.

Dr. Noura was recognised with numerous prestigious awards for her outstanding contributions in the field of information technology, including the “Best Pipe Inspection Robot” Award which was presented to her by Schlumberger. She has also published in the international and highly respected Journal of Manufacturing Systems, Computers & Industrial Engineering, Simulation Modelling Practice and Theory and Annals of Operations Research.

Another accolade has been a letter of recognition from Bill Gates who praised her innovative approach in designing a mobile learning device for which she and her team won the first prize in a regional competition – Imagine Cup 2007. Dr. Noura was also recognized with the Excellence in Leadership Award during the MAFNOOD 2016 Awards, and Excellence in Best Technical Project. Her outstanding contribution to the Corporate Excellence Teams played an integral role in the awarding of Abu Dhabi Ports with several accolades from the Abu Dhabi Government Excellence Awards, including four categories, in addition to the Main Award for Outstanding Entity.

Dr Noura Al Dhaheri recently won both “The Technical Innovation Award” and “Integration of Women in the Maritime Sector Award” at The Seatrade Maritime Regional Awards for Middle East, Indian Subcontinent and Africa 2018.
Dr. Al Dhaheri is also committed to social, environmental, technological & educational programs. She is a founding member of the Emirates Digital Women Association and takes a leading role in supporting women in the digital and technical sectors, both at national and regional levels.

Alongside her unwavering support of academic institutions and scientific research, Dr. Al Dhaheri is the Chairperson of the Abu Dhabi Ports Research and Development Committee, Advisory Board Member of Khalifa University’s Industrial Engineering department. She has also greatly contributed to the use of scientific research to serve various sectors.

Title: From a Sparking Innovation to an Actual Transformation

Abstract

Established in 2016, Maqta Gateway, the wholly-owned subsidiary of Abu Dhabi Ports is the central pillar of the company’s strategy to provide advanced, smart and innovative solutions to trade, and port communities, paving the way for a new era of digital transformation in the maritime sector and the wider logistics supply chain.

Starting from Abu Dhabi’s Economic Plan 2030, promoting a knowledge-based economy that features smart solutions that facilitates trade, presentation sheds light in Abu Dhabi Ports journey “From a Sparking Innovation to an Actual Transformation” that contributed to more than $36 million direct cost saving in a single year and how Abu Dhabi Ports converted the supply chain challenges to opportunities to advance the wider trade community. We illustrate actual operational results and discuss future prospects.

Alexandre Bayen

UC Berkeley

Alexandre Bayen is the Liao-Cho Professor of Engineering at UC Berkeley. He is a Professor of Electrical Engineering and Computer Science, and Civil and Environmental Engineering. He is currently the Director of the Institute of Transportation Studies (ITS). He is also a Faculty Scientist in Mechanical Engineering, at the Lawrence Berkeley National Laboratory (LBNL). He received the Engineering Degree in applied mathematics from the Ecole Polytechnique, France, in 1998, the MS and PhD in aeronautics from Stanford University in 1998 and 1999 respectively. He was a Visiting Researcher at NASA Ames Research Center from 2000 to 2003.

Between January 2004 and December 2004, he worked as the Research Director of the Autonomous Navigation Laboratory at the Laboratoire de Recherches Balistiques et Aerodynamiques, (Ministere de la Defense, Vernon, France), where he holds the rank of Major. He has been on the faculty at UC Berkeley since 2005. Bayen has authored two books and over 200 articles in peer reviewed journals and conferences. Recipient of the Ballhaus Award from Stanford University, 2004, of the CAREER award from the National Science Foundation, 2009, also he won a NASA Top 10 Innovators on Water Sustainability, 2010.

His projects Mobile Century and Mobile Millennium received the Best of ITS Award for 'Best Innovative Practice', at the ITS World Congress and a TRANNY Award from the California Transportation Foundation, 2009. Mobile Millennium has been featured more than 200 times in the media, TV channels and radio stations (CBS, NBC, ABC, CNET, NPR, KGO, the BBC), and in press (The Wall Street Journal, The Washington Post, LA Times). Bayen is the recipient of the Presidential Early Career Award for Scientists and Engineers (PECASE) award from the White House, 2010. He is also the recipient of the Okawa Research Grant Award, the Ruberti Prize from the IEEE, and the Huber Prize from the ASCE.

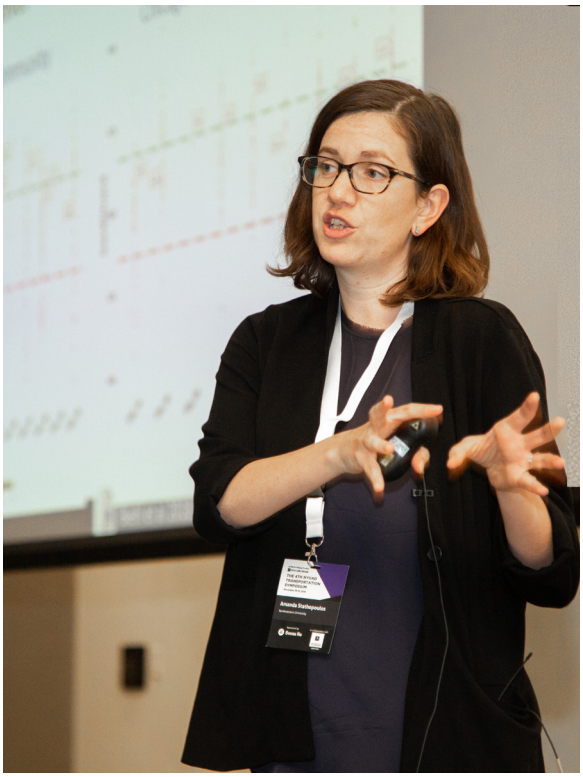
Title: Microsim + deep-RL + cloud: Disrupting the Future of Mixed Autonomy

Abstract

This talk investigates Lagrangian (mobile) control of traffic flow at large scale (city-wide, with fluid flow models) and local scale (vehicular level). For large scale inference and control, fluid flow models over networks are considered. Algorithms relying on convex optimization are presented for fusion of static and mobile (Lagrangian) traffic information data. Repeated game theory is used to characterize the stability such flows under selfish information patterns (each flow attempting to optimize their latency). Convergence to Nash equilibria of the solutions is presented, leading to control strategies to optimize the network efficiency.

At local scale, the question of how will self-driving vehicles change traffic flow patterns is investigated. We describe approaches based on deep reinforcement learning presented in the context of enabling mixed-autonomy mobility. The talk explores the gradual and complex integration of automated vehicles into the existing traffic system. We present the potential impact of a small fraction of automated vehicles on low-level traffic flow dynamics, using novel techniques in model-free deep reinforcement learning, in which the automated vehicles act as mobile (Lagrangian) controllers to traffic flow.

Amanda Stathopoulos
Northwestern University



I am the William Patterson Junior Professor chair at Northwestern's Department of Civil and Environmental Engineering since 2014 and a faculty affiliate of the Transportation Center and Spatial Intelligence and Learning Center. Before this, I was a research fellow at EPFL and I received my PhD in Transport Economics from the University of Trieste in 2012.

My lab studies 'human' aspects of sustainable mobility systems with a focus on transformative sharing and on-demand systems.

We develop data-collection tools and develop innovative models to understand the lifestyles, values, and attitudes of citizens and communities that participate in these new techno-social systems. My research typically combines methods including discrete choice and other behavioral modeling, statistical analysis, factor analysis, and other unsupervised learning methodologies, qualitative data collection such as focus groups, as well as large-scale surveys and network data.

The lab is engaged both in developing methods to collect data and in specifying mathematical models of behavior that can account for factors that are not dealt with in economic choice models (such as social determinants, environmental concern, user experiences/engagement, simplified decision rules).

Title: Modeling Innovative Mobility Services: Future of Passenger and Freight Movement

Abstract

The continuous transformation of innovative mobility services prompts the research community to revisit existing travel demand model formulations. The evolving mobility landscape includes bike-sharing (including dock-less), car and scooter-sharing and short-term rental, ride-sourcing with sharing options and e-hailing, and crowd-shipping, with automation on the horizon. These emerging mobility solutions are likely to, over time, alter vehicle ownership, urban travel dynamics, and patterns of land use, generate new markets and economic opportunities and affect mobility externalities. This talk explores user-motivations and functioning of innovative mobility services drawing on micro to large-scale data.

This research will enable smarter designs of emerging systems to maximize acceptance and trigger their positive potential linked to decreasing emissions, promoting multi-modality and transforming urban systems.

THE 4TH NYUAD TRANSPORTATION SYMPOSIUM PARTICIPANTS

Michel Bierlaire

Ecole Polytechnique Fédérale de Lausanne

Belgian, born in 1967, Michel Bierlaire holds a PhD in Mathematical Sciences from the Facultés Universitaires Notre-Dame de la Paix, Namur, Belgium (University of Namur). Between 1995 and 1998, he was research associate and project manager at the Intelligent Transportation Systems Program of the Massachusetts Institute of Technology (Cambridge, MA USA). Between 1998 and 2006, he was a junior faculty in the Operations Research group ROSO within the Institute of Mathematics at EPFL. In 2006, he was appointed associate professor in the School of Architecture, Civil and Environmental Engineering at EPFL, where he became the director of the Transport and Mobility laboratory.

Since 2009, he is the director of TraCE, the Transportation Center. From 2009 to 2017, he was the director of Doctoral Program in Civil and Environmental Engineering at EPFL. In 2012, he was appointed full professor at EPFL. Since September 2017, he is the head of the Civil Engineering Institute at EPFL.

Michel's main expertise is in the design, development, and applications of models and algorithms for the design, analysis, and management of transportation systems. Also active in demand modeling (discrete choice models, estimation of origin-destination matrices), operations research and Dynamic Traffic Management Systems.

In 2017, he published 113 papers in international journals (including Transportation Research Part B, the transportation journal with the highest impact factor), 4 books, 170 articles in conference proceedings, 160 technical reports, and has given 187 scientific seminars. His ISI H-index is 25. His Google Scholar h-index is 51. He is the founder, organizer and lecturer of the EPFL Advanced Continuing Education Course "Discrete Choice Analysis: Predicting Demand and Market Shares". He is the founder and the chairman of hEART: the European Association for Research in Transportation. Also, Editor-in-Chief of the EURO Journal on Transportation and Logistics. He is an Associate Editor of Operations Research and of the Journal of Choice Modelling. He is the editor of two special issues for the journal Transportation Research Part C. He has been member of the Editorial Advisory Board (EAB) of Transportation Research Part B since 1995, of Transportation Research Part C since January 1, 2006, and of the journal European Transport since 2005.

Title: Smart Transfers Through Unravelling Urban Form and Travel Flow Dynamics

Abstract

The first part of the talk provided a general overview of the European Project TRANS-FORM "Smart transfers through unravelling urban form and travel flow dynamics". It is a cooperation between universities, industrial partners, public authorities, and private operators, that aims to develop, implement, and test a data driven decision making tool to support smart planning, and proactive and adaptive operations. The objective of the project is to better understand transferring dynamics in multi-modal public transport systems and develop insights, strategies, & methods to support decision makers in transforming public transport usage to a seamless travel experience by using smart data.

The second part of the talk will "zoom in" a specific aspect of the project: the management of pedestrian flows. Exploiting the full potential of pedestrian infrastructures in order to satisfy the demand induced by public transport modes is key to achieving good level-of-service for passengers during transfers. High temporal variability in demand can lead to high congestion and possibly dangerous situations while the infrastructure is underused moments after. In order to improve the level-of-service experienced by pedestrians, two management strategies will be investigated.

Marta Gonzalez

UC Berkeley

Marta C. Gonzalez is Associate Professor of City and Regional Planning at the University of California, Berkeley, and a Physics Research faculty in the Energy Technology Area (ETA) at the Lawrence Berkeley National Laboratory (Berkeley Lab). With the support of several companies, cities, and foundations, her research team develops computer models to analyze digital traces of information mediated by devices.

They process this information to manage the demand in urban infrastructures in relation to energy and mobility. Her recent research uses billions of mobile phone records to understand the appearance of traffic jams and the integration of electric vehicles into the grid, smart meter data records to compare the policy of solar energy adoption and card transactions to identify habits in spending behavior.

Prior to joining Berkeley, Marta worked as an Associate Professor of Civil and Environmental Engineering at MIT, a member of the Operations Research Center and the Center for Advanced Urbanism.

She is a member of the scientific council of technology companies such as Gran Data, PTV and the Pecan Street Project consortium.

Title: Data Science to study Macroscopic Dynamics in Urban Traffic Networks and Behavioral Patterns

Abstract

Marta presented a review on research related to the applications of big data and information technologies in urban systems. Data sources of interest include: Probe/GPS data, Credit Card Transactions, Traffic, and Mobile Phone Data. She also presented a multi-city study to unravel traffic under various conditions of demand and translate it to the travel time of the individual drivers. First, we start with the current conditions, showing that there is a characteristic time that takes to a representative group of commuters to arrive to their destinations once their maximum density has been reached. While this time differs from city to city, it can be explained by the ratio of the vehicle miles traveled to their available street capacity. We identify three states of urban traffic, separated by two distinctive transitions. In the second part, I present Computational Social Science methods that use credit card transactions to uncover different habits on social groups, based on their mobility, their communication and daily purchases. Finally, she suggested how to use these methods to enhance the behavioral changes and recommendations in Social Networks to improve Cities.

Jeffrey R. Bohn
Swiss Re Institute

Dr. Jeffrey Bohn is the Head of the Swiss Re Institute. Most recently, he served as Chief Science Officer and Head of GX Labs at State Street Global Exchange in San Francisco. Before moving back to California, he established the Portfolio Analytics and Valuation Department within State Street Global Markets Japan in Tokyo. (He is fluent in Japanese.) He previously ran the Risk and Regulatory Financial Services consulting practice at PWC Japan.

Past appointments for Dr. Bohn include Head, Portfolio Analytics and Economic Capital at Standard Chartered Bank in Singapore and General Manager, Financial Strategies group at Shinsei Bank in Tokyo where he supervised implementation of best-practice risk and capital analytics. Before moving to Asia, he led Moody's KMV's (MKMV's) Global Research group and MKMV's Credit Strategies group.

Dr. Bohn often conducts seminars on topics ranging from credit instrument valuation to portfolio management. He has published widely in the area of credit risk. He co-authored with Roger Stein Active Credit Portfolio Management in Practice (Wiley, 2009). His recent research focuses on factor modeling and large-scale risk simulations.

Dr. Bohn is an affiliated researcher at U.C. Berkeley's Center for Risk Management Research and serves as a board member for the Consortium for Data Analytics in Risk (CDAR) spanning U.C. Berkeley, Stanford and several industry partners. On occasion, he teaches financial engineering at U.C. Berkeley, National University of Singapore's Risk Management Institute and Tokyo University.

Title: Mobility in a Sustainable Digital Society: Humans and Machines Living Together

Abstract

New general purpose technologies developed in the categories of machine intelligence, distributed ledgers, and the internet of things (IoT) have launched our global society onto a digital path. These technologies are still new and inchoate. Even so, individuals, companies, and governments are rapidly thrust into circumstances requiring decisions that will influence how a digital society develops without a complete understanding of how the interaction of these technologies will develop. Mobility, or how individuals have moved around, is one of the first areas to be materially changed by these new technologies. In this presentation, I will discuss the mobility-related issues policy-makers, executives, and researchers should be addressing to ensure we end up in a sustainable version of possible digital societies in which all of us want to live.

Hani S. Mahmassani

Northwestern University Transportation Center

Dr. Hani S. Mahmassani holds the William A. Patterson Distinguished Chair in Transportation at Northwestern University, where he is Director of the Northwestern University Transportation Center, and Professor in Civil and Environmental Engineering, with joint appointments in Industrial Engineering and Management Sciences, and Managerial Economics and Decision Sciences in the Kellogg School of Management. Prior to Northwestern, he served on the faculties of the University of Maryland and the University of Texas at Austin. He has over 35 years of professional, academic and research experience in the areas of intelligent transportation systems, freight and logistics systems, multimodal systems modeling and optimization, pedestrian and crowd dynamics and management, traffic science, demand forecasting and travel behavior, and real-time operation of transportation and distribution systems. He has served as principal investigator on over 150 funded research projects sponsored by international, national, state, and metropolitan agencies and private industry.

He is past editor-in-chief and current associate editor of Transportation Science, senior editor of IEEE Transactions on Intelligent Transportation Systems, and founding associate editor of Transportation Research C: Emerging Technologies.

He is a past president of the Transportation Science Section of the Institute for Operations Research and the Management Sciences, and International Association for Travel Behavior Research. Serves on the Board of Advisors to the Panama Canal Authority, and the Prince of Monaco's Smart Cities Advisory Council. Received Distinguished Alumnus Award of the Faculty of Engineering and Architecture of the American University of Beirut in 2006, the Intelligent Transportation Systems Outstanding Application Award of the Institute of Electrical and Electronics Engineers in 2010, and the Transportation Research Board's Thomas Deen Distinguished Lectureship in 2016. Elected Emeritus member of the Transportation Research Board on Telecommunications and Travel Behavior, Transportation Network Modeling Committee, and Traveler Behavior and Values. Mahmassani received his PhD from the Massachusetts Institute of Technology in transportation systems and MS in transportation engineering from Purdue University.

Title: Scenario Assessment for Autonomous, Connected, Electric, Sustainable Mobility Futures: Integrating Shared Mobility Services in Dynamic Multimodal Network Models

Abstract

Transportation is undergoing deep and significant transformation, seeking to fulfill the promise of connected mobility for people and goods, while limiting its carbon footprint. Autonomous vehicles are potentially changing the economics ownership and use of private automobiles, likely accelerating trends towards greater use of app-based ride hailing and/or sharing by private TNCs (Transportation Network Companies). Several potential business models with varying degrees of ride sharing and public vs. private involvement in the delivery of mobility as a service are presented. These are integrated in an intermodal dynamic network modeling framework, which incorporates an agent-based microsimulation of a transit urban network system with shared-ride autonomous vehicles (SAV) as first-mile feeders. The integrated mode choice and dynamic traveler assignment-simulation modeling framework is applied to the Chicago region to evaluate the mobility impact of new services. Implications for the evolving role of public transit in the future urban mobility landscape are discussed.

Michael Cassidy
University of California, Berkeley

Michael Cassidy is the Robert Horonjeff Professor in the Department of Civil and Environmental Engineering at the University of California, Berkeley.

He currently serves as an associate editor for the journal Transportation Research Part B; he is a member of the International Advisory Committee for the International Symposium on Transportation and Traffic Theory; is the Director of a University Transportation Center for federal region 9; and is a member of TRB's Committee on Managed Lanes.

His research interests focus primarily on transport planning and operations, particularly in the areas of highway traffic, public mass transit and systems that jointly serve multiple travel modes.

Title: Combatting Neighborhood Traffic Congestion via Analytical and Data-Driven Means

Abstract

Discussion focuses on ways of metering vehicle inflows to cordoned neighborhoods, to reduce vehicle hours traveled (VHT). Means entail the re-timing of ordinary traffic signals that reside along the peripheries of those neighborhoods. Metering rates for those peripheral signals are optimized with the aid of neighborhood-wide traffic models, as is now popular in the literature. The first part of the presentation described how the neighborhood models can be adapted in a simple way that adds physical realism. Computer simulations show that the adapted models produce time-varying cordon-metering rates that are more effective in reducing neighborhood VHT. The second part of the presentation explores how the cordon-metering plans can be further improved with machine-learning techniques. Reinforcement Learning is used to redistribute spatially-uniform rates generated by an adapted neighborhood traffic model, such that metering rates optimally varying along the length of a cordon line.

Ludovic Leclercq
IFSTTAR and Universite de Lyon

Ludovic Leclercq is a Professor at IFSTTAR (The French Institute of Science and Technology devoted to Transport, Planning and Networks) and is affiliated to the University of Lyon. He received his engineering and master degrees in Civil Engineering in 1998, his PhD in 2002 and his habilitation thesis (HDR) in 2009. He is currently deputy director of the LICIT laboratory and head of a research group about traffic modeling and analysis. His research interests correspond to multiscale and multimodal dynamic traffic modeling and the related environmental externalities.

Smart cities, mobility as a service, sustainable and reliable transportation systems are some of the applications his researches are targeting. He is a member of the editorial board of Transportation Research part B, CACAIE, and the Journal of Intelligent and Connected Vehicles, the committee "Traffic Flow Theory and Characteristics" of the TRB, the international advisory committee of ISTTT and is associate editor of Transportmetrica B and the Journal of Advanced Transportation. He has co-authored 61 publications in top peer-reviewed journals, has supervised 10 PhD and is currently supervising 5 PhD students. In 2015, he was awarded the most prestigious research grant in Europe, i.e. an ERC consolidator grant in Social Science and Humanities.

Title: Modelling Traffic Dynamics at large Urban Scale: from Theory to Practice

Abstract

This talk focused on modelling traffic dynamics at large-scale city scale resorting to the concept of Network Macroscopic fundamental diagram (N-MFD). The first part is about the concept of N-MFD itself and the presentation of existing estimation methods using different data sources. The second part focuses on the mathematical formulation of existing MFD models for a single reservoir setting and proposes a review of the different model properties. A particular attention is paid to the newly proposed trip-based formulation where all vehicles in the system have the same mean speed (determined by the N-MFD) while having different trip lengths. Further discussions are proposed about the single reservoir case under fast-varying demand profile (classical a peak hour) to (i) explain the hysteresis phenomenon that can be observed, (ii) benchmark the different model formulations to identify their strengths and weaknesses and provide guidance about the calibration. The third part is dedicated to multi-reservoir setting, where the city is partitioned into multiple regions that exchange flows. First, the different extensions to the model (merge, diverge, entry flow functions) are discussed. Second, we present how the local network can be scaled up to define a regional path network that is consistent with the partitioning and the usual trip lengths. Third, a dynamic assignment framework dedicated to such a regional network is described. The global framework is illustrated by implementation and validation for Lyon Metropolis.

Monica Menendez
New York University Abu Dhabi

Monica Menendez is, since January 2018, an Associate Professor of Civil and Urban Engineering at New York University in Abu Dhabi; and a Global Network Associate Professor of Civil and Urban Engineering at the Tandon School of Engineering in New York University. Between 2010 and 2017, Monica was the Director of the research group Traffic Engineering at ETH Zurich. Prior to that, she was a Management Consultant at Bain & Company in the San Francisco office.

She joined Bain after receiving a PhD. and an MSc in Civil and Environmental Engineering from UC Berkeley in 2006. During her studies there she received, among other awards, an NSF Fellowship, and the Gordon F. Newell Award. In total, she is the recipient of more than 20 scholarships and awards from well-known and prestigious organizations, professional societies, and universities. Monica also holds a dual degree in Civil Engineering and Architectural Engineering from the University of Miami, from where she graduated Summa Cum Laude in 2002.

Her research interests include monitoring, modeling, and control of multimodal transportation systems, paying special attention to new technologies and data sources.

She is an active reviewer for over 20 journals and a member of multiple editorial boards for top journals in Transportation as well as the Advisory Committee for the International Symposium on Transportation and Traffic Theory (ISTTT). Monica is the author of over 50 ww-reviewed journal publications and over 150 conference proceedings and reports.

Title: Macroscopic Modeling of Multimodal Networks with Limited Information

Abstract

The Macroscopic Fundamental Diagram (MFD), and its multimodal extension, the 3D-MFD, have received significant attention over the last few years. However, our ability to predict either of them in the presence of limited information or complete absence of empirical data is still quite limited. In this presentation, we discussed multiple complementary techniques and research findings that can inform the shape of the 3D-MFD for different levels of information availability.

Pravin Varaiya
University of California, Berkeley

Pravin Varaiya is a Professor of the Graduate School in the Department of Electrical Engineering and Computer Sciences at the University of California, Berkeley.

He has been a Visiting Professor at the Institute for Advanced Study at the Hong Kong University of Science and Technology since 2010. He has co-authored four books and 350+ articles. His current research is devoted to transportation networks and electric energy systems.

Varaiya has held a Guggenheim Fellowship and a Miller Research Professorship. He has received three honorary doctorates, the Richard E. Bellman Control Heritage Award, the Field Medal and Bode Lecture Prize of the IEEE Control Systems Society, and the Outstanding Researcher Award from the IEEE Intelligent Transportation Systems Society.

He is a Fellow of IEEE, a Fellow of IFAC, a member of the National Academy of Engineering, and a Fellow of the American Academy of Arts and Sciences.

Title: Description, Prediction and Control of Traffic using High-Resolution Data

Abstract

A high-resolution (HR) data system for an intersection collects the location (lane), speed, and turn movement of every vehicle as it enters an intersection, together with the signal phase. Some systems also provide video monitoring; others measure pedestrian and bicycle movements; and some have vehicle to infrastructure (V2I) communication capability. The data are available in real time and archived. The data are processed to produce important performance metrics; compressed to provide a compact description of the trends in traffic; and to predict the traffic several hours into the future. Lastly, a suite of algorithms is described to generate good signal control schemes. Empirical results are presented to illustrate the use of HR data.

Symposium Highlights

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