TransitData 2020
Sixth International Symposium on the
Use of Public Transit Automated Data for Planning and Operations

Hosted by the Transit Analytics Lab (TAL)
at the University of Toronto Transportation Research Institute (UTTRI)

Final Program

Note: All times in Eastern Daylight Time.

Tuesday 11 August, 2020

09:00 **Plenary 1: Introduction to Symposium and to Transit Analytics Lab**
Words of Welcome and Introduction to UTTRI's Transit Analytics Lab (TAL).
- Amer Shalaby, Professor and TAL Director, Department of Civil and Mineral Engineering, University of Toronto
- Eric Miller, Professor and Director- University of Toronto Transportation Research Institute (UTTRI), Department of Civil and Mineral Engineering, University of Toronto
- Christopher Yip, Dean, Faculty of Applied Science & Engineering, University of Toronto, Toronto, Canada
- Amer Shalaby and Brendon Hemily, TransitData 2020 Co-Chairs

09:45 **Plenary 2: A Conversation with Professor Nigel Wilson: The Long Road to Data-Powered Transit**
Moderator: Brendon Hemily, Hemily and Associates
Emeritus Professor Nigel Wilson of MIT is the eminence grise on research related to the use of automated transit date for planning and operations. We will engage him in conversation to discuss his perspectives on the use of transit data, and where we are today.

10:30 Break

10:50 **Parallel Sessions of Lightning Presentations - Part 1**
Our Call for Submissions resulted in over 80 accepted submissions from academics and practitioners alike. These studies will be presented in an innovative format of 6-minute lightning presentations, a sort of *tapas tasting buffet,* offering a broad menu on data-driven tools for planning and operations, methodology enhancements, and perspectives on related policy and organizational issues. Note that presenters are **bolded**.

Session 1-A: Planning Analyses
Moderator, Judy Farvolden, University of Toronto Transportation Research Institute
- Harnessing Smart-Card Data to Understand Our Clients Better: a Customer Segmentation Study at Société de transport de Laval, **Anna Dushina** and Gregory Wielinski, Société de transport de Laval
- Public Transit Accessibility Changes Over Time and Space: Measuring the Effects of Network Modifications and Bus Speed Variation from Years of Continuous GPS and GTFS Data, **Renato O. Arbex**, SPTrans, Sao Paulo, Brazil
- Analysing the Impacts of Long-Term Service Disruptions on Passenger Travel Behaviour: a Smart Card Analysis from the Greater Copenhagen area, **Nils Breyer**, Morten Eltved, Jesper Bláfoss Ingvardson and Otto Anker Nielsen, Linkoping University, Technical University Denmark
- Driving GO Bus into the Future: Strategic Planning & Performance Measurement using Big Data from PrestoBI & APC During COVID-19, **Anthony Smith**, Metrolinx and Eddy Ionescu, University of Waterloo
- Bussleneck - Visualization Tool to Analyze Data-Driven Bus Lane Allocation Guidelines, **Shaked Ofek-Kaufman**, Eran Ben-Elia, Noam Tractinsky and Peter Bak, Ben-Gurion University of the Negev, IBM

Session 1-B: Origin-Destination Enhancements and Analyses
Moderator: Juan Carlos Muñoz, Pontificia Universidad Católica de Chile
- Estimating Transit Route OD Flow Matrices from APC Data Using the IPF Method when Passengers Travel Through Terminals: Methodology and Evaluation, Aijing Chen, **Rabi G. Mishalani** and Mark R. McCord, The Ohio State University
- Completing an Origin-Destination Matrix by incorporating not recorded stages of trips using only passive data of Transmilenio BRT in Bogota, Colombia, **Carolina Palma**, Camilo Leng and José Imbarack, Chile CityPlanning
- Estimating Route-Level Passenger Demand Profile from Bus AVL Data, **Wenzhe Sun**, Jan Dirk Schmoecker, Koji Fukuda and Toshiyuki Nakamura, Kyoto University
- Long-Term Ridership Forecast Using Heuristic, SARIMA and Random Forest Methods, **Zhanhong Cheng**, Hamzeh Alizadeh, Mohsen Nazem, Martin Trépanier and Lijun Sun, McGill University, Exo, Polytechnique Montréal
- Transition: A New Platform for Transit Network Design and Optimization, **Pierre-Léo Bourbonnais**, Catherine Morency and Martin Trépanier, Polytechnique Montréal
- MTL Trajet 2018 Data Analyzing Results, **Ali Yazdizadeh**, Hamzeh Alizadeh, Mohsen Nazem, Zachary Patterson and Martin Trépanier, Exo, Concordia University, Polytechnique Montréal

Session 1-C: Policy Applications Using Automated Data
Moderator: Willem Klumpenhouwer, University of Toronto
- New Paradigm of Equity in Transportation Modelling, **Kiarash Ghasemlou** and Murat Ergün, Istanbul Technical University
- A Social Equity Lens on Bus Bridging and Ride Hailing Responses to Unplanned Subway Disruptions, **Rick Liu**, Matthew Palm, Amer Shalaby and Steven Farber, University of Toronto
- Data-Driven Analysis in Support of a Fare Reform, **Ka Kee Alfred Chu** and André Lomone, ARTM
- Spatial Analyzing of Cash to Smart Card Payment Ratio at the Bus Stop Level, **Yuval Hadas** and Genadi Birfir, Bar-Ilan University
- Data-Driven Advocacy: Encouraging and Supporting Open Data Analysis to Enhance Public Input in Transit Projects, **Willem Klumpenhouwer**, University of Toronto

11:50   Lunch Break

1:00   Lunch Activity **Recent Transit Projects in Canada – A Technical Tour**

1:30   Break

1:40   **Parallel Sessions – Part 2**

Session 2-A: System and Route Performance Monitoring Applications
Moderator: Willem Klumpenhouwer, University of Toronto
- Grand River Transit Application of Automated Data for Planning Decisions, Blair Allen, Lucas Braun and **Howard Chang**, Grand River Transit
- From Taps and Beam-Breaks to Service Design: Developing and Evaluating Service Design Scenarios Using AFC and APC, **Joey Reid**, Metro Transit-Minneapolis
- Corridor-Based Bus Performance Analysis, **Graeme Brown**, TransLink
- Open Source Tools for Visualizing Stop-Level Performance Measures: A Case Study in Calgary, **Saadiq Mohiuddin**, City of Calgary
- Smart Systems for Big Data: MTA's Route Grades & Performance Monitoring Program, Sandy Brennan, **Jeremy Strauss**, Foursquare Integrated Transportation Planning, Rockville, MD, U.S.A.
- Communicating Insights in a Compelling Way, Maureen McLeod, Michael Parravani and **Sam Behnood**, Metrolinx

Session 2-B: Operator Performance and Operations Applications
Moderator: Marcela Munizaga, Universidad de Chile
- Performance Chauffeur - A Standardized Metric on Drivers' Operational Performance Based on Peers' Performance: A Methodological Framework Developed at Société de Transport de Laval (STL), **Grzegorz Wielinski** and Vincent Dionne, Société de Transport de Laval
- Using Aggregate Operator Data to Improve Extraboard Planning, **Qing Yi Wang**, Haris N. Koutsopoulos and Nigel H.M. Wilson, Massachusetts Institute of Technology, Northeastern University
- Two-Way Adaptive Transit Signal Priority for High Frequency Bus Lines using Deep Reinforcement Learning, **Wen Xun Hu** and Amer Shalaby, University of Toronto
- Empirical Identification of Location-Specific Carbon Monoxide Patterns Using a Low-cost Sensor Mounted on a Transit Bus in Operational Service, **Mark R. McCord**, Rabi G. Mishalani, Andrew May and Yangyang Zou, The Ohio State University
- Developing a Smart System to Identify Bus Drivers Drowsiness Caused by Physical or Mental Fatigue, **Vahid Abolhasannejad** and Mohammad Abdoli-Eramaki, Ryerson University

2:40   Break

3:00   **Plenary 3: Data-Driven Analyses and Visualizations in Response to COVID 19**
The entire world is grappling with responding to the COVID-19 pandemic. Transit agencies have had to scramble to rethink their schedules, services and sometimes networks, and data has played a critical role in these analyses. This session will provide some perspectives on the use of data to assist planning and operations in response to the pandemic
Moderator: Eric Lind, Metro Transit (Minneapolis)

- Customer Load Dashboard for CTA Transit Riders During the COVID Pandemic, **Raymond Chan**, Business Intelligence Developer, Data Analytics, Chicago Transit Authority, Chicago, IL, U.S.A.
- Real-Time Local Bus Crowding Information for MBTA Riders, **Logan Nash** and Anna Gartsman, Massachusetts Bay Transportation Authority
- Using the APC Ridership Tool to Develop a Demand-Responsive Service Plan During the COVID-19 Pandemic in Toronto, Ontario, **Jasmine Eftekhari**, Conor Adami, Kevin Shen, Ian Huang, Graeme Parry, Toronto Transit Commission
- Leveraging Twitter Data to Support Transit Planning and Operations**, Omar Kabbani**, Tamer El-Diraby and Amer Shalaby, University of Toronto
- Critical MaaS: The Power of Journey-Planning Data During a Pandemic, **Jonathan Scheff** and David Block-Schachter, Transit App
- Analysis of Public Transportation Demand and Passenger Behavior during Covid-19 Pandemic: Case Study of Tehran, Nima Aminpour , Mohammad Amir Ahmadian , **Faraz Zargari**, and Amir Samimi (Department of Civil Engineering, Sharif University of Technology), Saeid Saidi (Department of Civil Engineering, University of Calgary)
- The Relationship Between Ridehailing and Public Transit in Chicago: An analytical approach and application to the COVID-19 Pandemic, **Patrick Meredith-Karam**, Hui Kong and Jinhua Zhao, Massachusetts Institute of Technology
- Virus Transmission Risk in Public Transportation Systems: A Microscopic Simulation-Based Analysis, **Jiali Zhou**, Haris N. Koutsopoulos, Northeastern University

Discussion

4:30   End of Day 1

Wednesday 12 August, 2020

08:30   Pre-show: **Tour of Toronto and University of Toronto**

09:00   **Plenary 4: Spotlight on Transit Data / Analytics Labs**
A small number of research labs from around the world have been on the forefront of conducting applied research related to transit data and analytics **in collaboration** with Public Transport authorities and operators. This session will provide a spotlight on some of their activities.
Moderator: Amer Shalaby, University of Toronto
- University of Queensland, Brisbane, Australia (**Mark Hickman**)
- Kyoto University (**Jan-Dirk Schmöcker**) and Nagoya University (**Toshiyuki Nakamura**), Kyoto / Nagoya, Japan
- TU Delft, Delft, Netherlands (**Oded Cats**)
- Pontificia Universidad Católica de Chile (**Juan Carlos Muñoz**) and Universidad de Chile (**Marcela Munizaga**), Santiago, Chile
- MIT (**Jinhua Zhao**) and Northeastern University (Haris Koutsopoulos), Cambridge / Boston, MA, U.S.A.
- CIRRELT, Quebec, Canada (**Martin Trépanier**)
- The Ohio State University, Columbus OH, U.S.A. (**Mark R. McCord** and Rabi G. Mishalani)

10:45   Break

11:00   **Parallel Sessions - Part 3**

Session 3-A: Matching Performance and Customer Experience, and Customer-Centric Analyses
Moderator: Steve Farber, University of Toronto
- TRANSIT-Performance: Using Open GTFS and GTFS-realtime Data to Measure Transit Agency Performance, **Farah Machlab** and Ritesh Warade, IBI
- Visualization Dashboard for Bus Performance Evaluation and Analysis, **Nicholas Caros**, Xiaotong Guo, Anson Stewart, John Attanucci and Jinhua Zhao, Massachusetts Institute of Technology
- Who Is Complaining the Most? Combining Bus Operational Data with Customer Complaints in Portland, OR, James DeWeese, Miles Crumley, TriMet, **Leila Hawa** and Ahmed El-Geneidy, McGill University, Ehab Diab, University of Saskatchewan
- Modelling the Effects of Objective System Performance on Customer Satisfaction Metrics, Mark Hickman, Tianwei Yin and Alexis de Germay de Cirfontaine, Queensland University
- Perception of Seat and Boarding Probability in Crowded Metro Systems, **Menno Yap** and Oded Cats, Delft University of Technology
- Improving Real-Time Elevator Status Information with User-Centered Design, **Simon Hochberg** and Dan Howard, San Francisco Municipal Transportation Agency

Session 3-B: Transfer Analyses
 Moderator: Rabi Mishalani, The Ohio State University
- A Combined Use of Sensor Count Data and Smart Card Data to Study the Flows of a Multimodal Transport Hub, **Paul De Nailly**, Latifa Oukhellou, Allou Same, Etienne Come, Laurent Gerardin, Nelly Darrort and Jacques Ferriere, Régie Autonome des Transports Parisiens, Université Gustave Eiffel
- Determining Transfer Times and Transfer Activities in Multimodal Public Transport Systems, Morten Eltved, **Niklas Christoffer Petersen** and Philip Lemaitre, Technical University of Denmark
- Public Transit Transfer Analysis from Smart Card Data, Benjamin Disson, **Martin Trépanier** and Catherine Morency, Polytechnique Montréal
- A Methodology for Identifying Inconsistencies Between Scheduled and Observed Travel and Transfer Times using Transit AVL Data: Framework and Case Study of Columbus, OH, Yuxuan Wang, **Andre Carrel** and Zhenhua Chen, The Ohio State University
- A Bus Location Estimation Algorithm by Integrating Smart Card and General Transit Feed Specification Static Data, **Li He** and Charles de la Chevrotière, Autorité régionale de transport métropolitain

Session 3-C: Data Quality and Governance
Moderator: Brendon Hemily, Hemily and Associates
- Six Flavors of AVL: How Differences Among AVL Data Systems Affect Bus Performance Evaluation, **Catherine Vanderwaart**, Washington Metropolitan Area Transit Authority
- Stop Making Sense: Internally Inconsistent CAD/AVL Data, **Joey Reid**, Metro Transit-Minneapolis
- CERT&Info Module, an Advanced Tool for the Assessment of Public Transport Service Performance: The Results of Two Case Studies in Tuscany Region, **Giorgio Ambrosino** and Claudio Disperati, MemEx
- GTFS Quality Control Through a Feed Comparison and Visualization App, **Wylie Timmerman**, Thomas Orgren and Sandy Brennan, Foursquare Integrated Transportation Planning, Rockville, MD, U.S.A.

- The City Data Model Collaboratory: Towards an ontology-based standard for transit data (and more), **Megan Katsumi**, Mark Fox, University of Toronto

12:00   Lunch Break

12:50   Lunch Keynote**: Dr. Kari E. Watkins**, Frederick Law Olmsted Associate Professor, Department of Civil and Environmental Engineering, Georgia Institute of Technology
Using Transit Data for Deep Dives into Understanding Transit Ridership Trends

1:30   Break

1:45   **Plenary 5: Data Management Challenges and Initiatives – Panel Discussion**
Moderator: Brendon Hemily, Hemily and Associates
A few transit agencies have moved beyond just ensuring quality assurance of their data to developing comprehensive data management programs and sophisticated analytic capabilities. This panel discussion will bring together some of the managers from these agencies to discuss the organizational challenges they have faced, and their different approaches to these challenges.
- **Raymond Chan**, Business Intelligence Developer, Chicago Transit Authority, Chicago, IL, U.S.A.
- **Pierre Lavigueur**, Senior Director of Innovation, Société de transport de Laval, Laval, Canada
- **John Levin**, Director of Strategic Initiatives, Metro Transit, Minneapolis, MN, U.S.A.
- **Teresa O'Reilly**, Analytics Manager, TransLink, Vancouver, Canada
- **Alla Reddy**, Deputy Chief, Data Research & Development, New York City Transit, New York, NY, U.S.A.

3:00   Break

3:20   **Parallel Sessions - Part 4**

Session 4-A: Passive Data Applications
Moderator: Haris Koutsopoulos, Northeastern University
- Can We Improve Public Transport Route Recommendation Using Passive Data? Felipe Vera and **Marcela Munizaga**, University of Chile
- Interactive Dashboard Tools for Transit Market Analysis Using Location-based Services Data: Experiences from Transit System Redesign Projects in Three Large US Cities, **Pragun Vinayak**, Jingjing Zang, Salah Uddin Momtaz, Amit Ranjan Mondal and Anurag Komanduri, Cambridge Systematics Inc
- Re-Inventing SORTA's Network through Innovative Data Analysis, Khaled Shammout, **Mark Samaan** and Waleed Ismael, SORTA-Cincinnati
- Redesigning Winnipeg: The Role of Automatic Passenger Counters, Location Based Devices, and WebGIS in the Development of the Winnipeg Transit Master Plan, **Aaron Baxter**, Stantec
- Estimation and Prediction of Queues at Bus Stops Using Wi-Fi Signal Data, **Hyungsub Jee**, Jan-Dirk Schmöcker and Toshiyuki Nakamura, Kyoto University
- Driverless Shuttle User's Perception and Experience: Global Assessment Using Twitter Data, **Mahmood Nesheli**, Jiaxing Li, Amer Shalaby and Tamer El-Diraby, University of Toronto

Session 4-B: Analytics for Improving Prediction Accuracy and Other Applications
Moderator: Martin Trépanier, CIRRELT
- A Customer-Focused Methodology for Measuring Prediction Accuracy Using Automatically Collected Data and Metrolinx Case Study, **Farah Machlab** and David Duong, IBI, USA

- An Open-Source Framework to Implement Kalman Filter Bus Arrival Predictions, Sean Òg Crudden and **Simon Berrebi**, Georgia Institute of Technology
- A Machine Learning Approach to Estimate Transit Travel Times Using Sparse GPS Data, Ramón Bahamonde, Hans Löbel and **Ricardo Giesen**, Pontifical Catholic University of Chile
- Real-Time Bus Travel Time Prediction within a Reliability Space Framework, **Ryan Williams**, Amer Shalaby and Siva Srikukenthiran, University of Toronto
- Studying "The Danger Zone of Express Services" with Simulation, Carlos Olivos, **Homero Larrain** and Juan Carlos Munoz, Pontifical Catholic University of Chile
- Dynamic Holding Control to Avoid Bus Bunching: A Multi-Agent Deep Reinforcement Learning Framework, Lijun Sun and **Jiawei Wang**, McGill University

4:20   Break

4:30   **Plenary 6: Pertinent Initiatives Related to Data Specifications and Management**
Moderator: Brendon Hemily, Hemily and Associates
This session will highlight some current studies or recent initiatives that support enhanced data management or encourage the use of data specifications. One such study is TCRP Project G-18 entitled *Improving Access and Management of Transit ITS Data.*
- TCRP Study G-18: Improving Access and Management of Transit ITS Data **Catherine Vanderwaart**, WMATA / **Cecilia Viggiano**, EBP
- GTFS-ride: A Unifying Standard for Fixed-Route Ridership Data, **J. David Porter**, Oregon State University
- The Mobility Data Initiative to Enhance and Extend the Use of GTFS, **Carl Fredlund**, MobilityData

5:30   End of Day 2

Thursday 13 August, 2020

08:30   Pre-show: **Tour of Canada from Coast to Coast to Coast**

09:00   **Parallel Sessions - Part 5**

Session 5-A: Service and Operations Planning Applications and Studies
Moderator, Judy Farvolden, University of Toronto Transportation Research Institute
- The Practicalities of using Open Data in Live Transit Control Systems, Matt McInnes and **Ryan Burt**, Lynxx
- Deep Troubles in a Bus Station: Let's Investigate It with Deep Learning! **Florian Cys** and Gregory Wielinski, Société de transport de Laval
- Improving Local Transit Connections at GO Rail Stations using GTFS and PRESTO Data, **Eddy Ionescu**, University of Waterloo
- Transit Service Visualization, **Alla Reddy** and Tuan Huynh, New York City Transit Authority
- From Pings to Planning: Developing, Analyzing, and Using ITS Data to Improve Transit Performance, **Eric Lind** and John Levin, Metro Transit-Minneapolis

Session 5-B: Network Analyses and Optimization
Moderator: Ricardo Giesen, Pontifical Catholic University of Chile

- Considering the Problem of Common Bus Line for Public Transit Accessibility Evaluation to Enhance Network Analysis, **Rattanaporn Kaewkluengklom**, Fumitaka Kurauchi, Toshiyuki Nakamura and Takenori Iwamoto, Gifu University, Nagoya University, Shizuoka Railway Co
- Automated Modular Bus Systems: A Macroscopic Perspective, **Igor Dakic**, Kaidi Yang and Monica Menendez, ETH, Stanford University, New York University
- A Frequency-Based Transit Assignment Model That Considers Online Information, **Nurit Oliker**, Université de Montréal
- Public Transportation Reliability: Learning Long-Term Travel Time Density to Measure Reliability and Move Towards Reliable Schedules, **Léa Ricard**, Guy Desaulniers, Andrea Lodi and Louis-Martin Rousseau, Université de Montréal, Polytechnique Montréal
- Stochastic Transfer Synchronization in Transit Networks: Comparison of Alternative Formulations, **Zahra Ansarilari**, Merve Bodur and Amer Shalaby, University of Toronto
- Transit Origin-Destination Estimation for Special Events: A Compressed Sensing Approach, Pramesh Kumar and **Alireza Khani**, University of Minnesota, Twin Cities

Session 5-C: Rail Applications
Moderator: Menno Yap, TU Delft
- Link Customer Delays to Trouble Tickets through Development of Incident Time-Space Zones, **Michael Eichler**, Washington Metropolitan Area Transit Authority
- Integrating Travel Behavior Regularity into Passenger Flow Prediction, **Zhanhong Cheng**, Martin Trépanier and Lijun Sun, McGill University, Polytechnique Montréal
- Incorporating AVL and AFC data for Mesoscopic Modeling of Train Operations, **Saeid Saidi**, Nigel H. M. Wilson, Haris N. Koutsopoulos and Jinhua Zhao, University of Calgary, Massachusetts Institute of Technology, Northeastern University, Canada
- Investigating train dwell time using signal berth data, **Taku Fujiyama**, University College London
- Detecting Platform Overcrowding in the TTC Subway System**, Jeremy Foran**, Alexander Witte, BAI Communications

10:00   Break

10:20   **Plenary 7: New Data Sources: Perspectives and Challenges - Panel Discussion**
Automated transit data has primarily been derived to date from transit ITS or smart card technologies. But new potential sources of data, including Location-Based services, social media, etc. are being used in research and applications, opening new horizons on their use for transit planning and operations. This panel discussion will provide some perspective on these new sources of data, their potential use in transit, and some of the challenges they raise, including quality assurance, manipulation, protection of privacy, cybersecurity, etc.
Moderator: Amer Shalaby, University of Toronto
- **Jinhua Zhao**, Associate Professor and Director MIT Mobility Initiatives, Department of Urban Studies and Planning, MIT, Cambridge, MA, U.S.A.
- **Scott Hale**, Business Analyst, Calgary Transit, Calgary, Canada
- **Eric Mok**, Chief Enterprise Architect, Toronto Transit Commission, Toronto, Canada

11:50   Lunch Break

1:15   Lunch Activity **History of Public Transit in Toronto**

1:45   **Plenary 8: Academic/Industry Collaboration on Data Analytics and Applications – Panel Discussion**
Moderator: Brendon Hemily, Hemily and Associates
Academic researchers and transit agency staff often inhabit two separate worlds. However, in recent years the use of automated data to develop analytics applied to transit planning and operations has become an area of growing common interest, where collaboration is feasible and of mutual benefit. This panel includes experts who have worked to build such collaborations and will discuss both benefits and challenges in pursuing academic/industry collaboration to enhance transit effectiveness and efficiency through the application of data.

- **Miles Crumley**, Senior Operations Analyst, TriMet, Portland, Oregon, U.S.A.
- **Antonio Gschwender Krause**, Advisor, Planning and Infrastructure Management, Directorio de Transporte Público Metropolitano, Santiago, Chile
- **Catherine (Kate) Lawson**, Associate Professor, Geography and Planning, University at Albany, Albany NY, U.S.A.
- **Kim McDonough**, Corporate Advisor, Development of Planning Tools, Sociéte de transport de Montréal, Montreal, Canada

2:45   **Plenary 9: Looking to the Future**
The final session will provide some concluding remarks about the Symposium, and open up perspectives on the future with thoughts for participants to reflect on as they move forward.

- TransitData 2021 / CASPT, **Yuval Hadas**, Bar Ilan University, Tel Aviv, Israel
- **Nigel Wilson**, Professor Emeritus, Civil and Environmental Engineering, MIT, Cambridge, MA, U.S.A.
- **Brendon Hemily**, Principal, Hemily and Associates
- **Amer Shalaby**, Professor and TAL Director, Department of Civil and Mineral Engineering, University of Toronto

4:00   End of Symposium