

# NIKOLA MARKOVIĆ

## EMPLOYMENT

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JOB TITLE	<b>Assistant Professor</b>	Aug 2018 — Present
EMPLOYER	<b>University of Utah</b> <b>Civil and Environmental Engineering Department</b>	Salt Lake City, USA
JOB TITLE	<b>Faculty Assistant</b>	Sep 2015 — Aug 2018
EMPLOYER	<b>University of Maryland</b> <b>Center for Advanced Transportation Technology (CATT)</b>	College Park, USA
JOB TITLE	<b>Postdoctoral Research Associate</b>	Dec 2013 — Sep 2015
EMPLOYER	<b>University of Maryland</b> <b>Civil and Environmental Engineering Department</b>	College Park, USA

## EDUCATION

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DEGREE	<b>Ph.D. in Transportation Engineering</b>	Dec 2013
THESIS	<b>Evasive Flow Capture</b>	
FOCUS	<b>Facility location, stochastic optimization, logistics</b>	
ADVISOR	<b>Paul Schonfeld</b>	
UNIVERSITY	<b>University of Maryland</b>	College Park, USA
DEGREE	<b>M.S. in Transportation Engineering</b>	Dec 2010
THESIS	<b>Scheduling Under Uncertainty for a Single-Hub Intermodal Freight System</b>	
FOCUS	<b>Probabilistic analysis, metaheuristics, logistics</b>	
ADVISOR	<b>Paul Schonfeld</b>	
UNIVERSITY	<b>University of Maryland</b>	College Park, USA
DEGREE	<b>Dipl.-Ing. in Transportation Engineering</b>	Jun 2009
THESIS	<b>A Petri Net Simulation Model of the Batajnica Railway Station</b>	
FOCUS	<b>Simulation modeling, railway systems, regression analysis</b>	
UNIVERSITY	<b>University of Belgrade</b>	Belgrade, Serbia

## RESEARCH INTERESTS

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### Operations Research

I am interested in development and application of operations research models that help improve efficiency of transportation systems. In my dissertation I developed models for the optimal location of violator-intercepting facilities in large-scale transportation networks. This work won the Glover-Klingman prize for the best paper published in *Networks*. My ride-sharing algorithms are used by half a dozen companies transporting seniors and people with disabilities. Currently, my group is developing a software for routing snowplow trucks in Utah.

## Data Science

I am interested in applications of machine learning and data visualization techniques that either help inform decision-making or help automate relevant processes. I have worked extensively with millions of GPS trajectories and used them to estimate statewide traffic patterns and network performance. Currently, my group is developing a computer vision system to automatically collect aircraft operations data at Utah airports.

## Interface of Optimization and Data Science

Traditional optimization approaches do not account for the cost of acquiring input data. My current research is concerned with developing methods for optimizing the amounts of data acquired for calibrating network optimization models. Similarly, traditional statistical methods for experimental design do not account for resource constraints that arise in any field collection of information. As part of multiple collaborative efforts, my group is currently working on algorithms to embed resource constraints into optimal learning procedures.

## EXTERNAL GRANTS

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FOCUS	<b>Vehicle routing, software development</b>
TITLE	<b>Development of a snowplow routing software for Utah</b>
PERIOD	<b>2020 – 2021</b>
FUNDING	<b>Utah Department of Transportation</b>
PI	<b>Nikola Marković</b>
CO-PI	<b>Cathy Liu</b>
FUNDING	<b>\$90,000</b>

FOCUS	<b>Computer vision, deep learning, automation</b>
TITLE	<b>Automated detection of airplanes at Utah airports</b>
PERIOD	<b>2020 – 2021</b>
FUNDING	<b>Utah Department of Transportation</b>
PI	<b>Abbas Rashidi</b>
CO-PI	<b>Nikola Marković</b>
FUNDING	<b>\$50,000</b>

FOCUS	<b>Machine learning, data visualization, big data (12 GB)</b>
TITLE	<b>Visual Exploration of Utah Trajectory Data and their Applications in Transportation</b>
PERIOD	<b>2018 – 2019</b>
FUNDING	<b>National Institute for Transportation and Communities</b>
PI	<b>Nikola Marković</b>
FUNDING	<b>\$40,000</b>

## TEACHING

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GRADUATE COURSE	<b>Quantitative Methods in Transportation Operations</b>
FOCUS	<b>Operations Research, Machine Learning, Data Visualization</b>
SOFTWARE	<b>GAMS, Matlab, LaTeX</b>
CODE	<b>CVEEN 6530</b>
OFFERED	<b>Fall 2018, 2019</b>

I developed from scratch a graduate level course covering relevant techniques from operations research, machine learning, and data visualization. I cover 15+ distinct network models. All the network models are solved in GAMS for the Utah state highway network and resulting solutions are visualized in Matlab. After each class students are assigned homework that includes programming sets in Matlab and GAMS. In addition, I set up hybrid modules to cover applications of machine learning models to transportation data. Students take the Stanford's online Machine Learning course to cover theoretical foundations, while I use the class time to introduce applications of machine learning algorithms to transportation data. At the beginning of the semester, students are given 5 weeks to pass a course Introduction to Programming with Matlab that requires a 30 hr effort.

UNDERGRAD COURSE	<b>Probability and Statistics</b>
SOFTWARE	<b>R</b>
CODE	<b>CVEEN 2310</b>
OFFERED	<b>Spring 2019, 2020, 2021</b>
NOTE	<b>Fully Online and Fully Automated</b>

I teach a sophomore Probability in Statistics course. The first 9 weeks are allocated to Probability Theory for which I leverage the online MIT course, Introduction to Probability, and the corresponding textbook. In this module, students are asked to: (a) watch an MIT video lecture covering theory, (b) take a quiz, (c) watch my video lecture where I summarize the main concepts and solve numerous numerical examples, and (d) solve homework problems that are automatically graded in Canvas. The remaining 6 weeks of the course are spent on statistics and computer labs. In this module, students take two online courses: R Programming A-Z: R For Data Science With Real Exercises! and Duke's Statistics with R Specialization to master relevant concepts.

UNDERGRAD COURSE	<b>Civil Engineering Materials</b>
SOFTWARE	<b>R</b>
CODE	<b>CVEEN 3510</b>
OFFERED	<b>Spring 2021</b>
NOTE	<b>Fully Online and Fully Automated</b>

I teach a junior level class in Civil Engineering Materials, which covers fundamental behavior and properties of various civil engineering materials. Topics include introduction to mechanical behavior of materials, characteristics of metals, characteristics of wood, evaluation of aggregates, design of Portland cement concrete and asphalt concrete, and introduction to materials testing. I have prepared from scratch all the video lectures and have automated the homework grading in Canvas. The goal is to eventually turn this course into a MOOC and offer it through a platform like Coursera.

#### JOURNAL ARTICLES UNDER REVIEW

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1. Wang, Y., **Marković, N.**, Ryzhov, I.O. & Schonfeld, P. (2021). Matrix Completion for Improved Cost Estimation in Vehicle Routing. *Annals of Operations Research*. Submitted.
2. Sheibani, R., Wang, Y., Ou, G. & **Marković, N.** (2021). Efficient structural reconnaissance surveying for regional post-seismic damage inference with optimal inspection scheduling. *Journal of Engineering Mechanics*. Submitted.

3. Chen, Y., **Marković, N.**, Ryzhov, I.O., & Schonfeld, P. (2021) Data-driven robust resource allocation with monotonic cost functions. *Operations Research*. Pending approval from the Editor-in-Chief.
4. Vander Laan, Z., Franz, M., & **Marković, N.** (2021) Scalable Framework for Enhancing Raw GPS Trajectory Data: Application to Trip Analytics for Transportation Planning. *Journal of Big Data Analytics in Transportation*. Forthcoming.
5. Mashhadi, A. H., Farhadmanesh, M., Rashidi, A., & **Marković, N.** (2021). State-of-the-Art Methods in Estimating Freeway Work zones Capacity: A Literature Review. *Transportation Research Record*. Forthcoming.
6. Yi, Z., Liu, X. C., **Marković, N.**, & Phillips, J. (2021) Inferencing hourly traffic volume using data-driven machine learning and graph theory. *Computers, Environment and Urban Systems*, 85, 101548.
7. Miller, S., Vander Laan, Z., & **Marković, N.** (2020). Scaling GPS trajectories to match point traffic counts: A convex programming approach and Utah case study. *Transportation Research Part E: Logistics and Transportation Review*, 143, 102105.
8. Dabiri, S., **Marković, N.**, Heaslip, K., & Reddy, C. K. (2020). A deep convolutional neural network based approach for vehicle classification using large-scale GPS trajectory data. *Transportation Research Part C: Emerging Technologies*, 116, 102644.
9. Kim, M., **Marković, N.**, & Kim, E. (2019). A vertical railroad alignment design with construction and operating costs. *Journal of Transportation Engineering, Part A: Systems*, 145(10), 04019043.
10. **Marković, N.**, Kim, M. E., Kim, E., & Milinković, S. (2019). A Threshold Policy for Dispatching Vehicles in Demand-responsive Transit Systems. *Promet-Traffic&Transportation*, 31(4), 387-395.
11. Sekuła, P., **Marković, N.**, Vander Laan, Z., & Sadabadi, K. F. (2018). Estimating historical hourly traffic volumes via machine learning and vehicle probe data: A Maryland case study. *Transportation Research Part C: Emerging Technologies*. Vol. 97, 147-158
12. **Marković, N.**, Sekuła, P., Vander Laan, Z., Andrienko, G., & Andrienko, N. (2018). Applications of Trajectory Data from the Perspective of a Road Transportation Agency: Literature Review and Maryland Case Study. *IEEE Transactions on Intelligent Transportation Systems*, Vol. 99, 1-12.
13. **Marković, N.**, Ryzhov, I.O. & Schonfeld, P. (2017). Evasive flow capture: A multi-period stochastic facility location problem with independent demand. *European Journal of Operational Research*, Vol. 257 (2), 687-703.
14. **Marković, N.**, Kim, E.K. & Schonfeld, P. (2016). Statistical and machine learning approach for planning dial-a-ride systems. *Transportation Research Part A: Policy and Practice*, Vol. 89, 41-55.

15. **Marković, N.**, Ryzhov, I.O. & Schonfeld, P. (2015). Evasive flow capture: Optimal location of weigh-in-motion systems, tollbooths, and safety checkpoints. *Networks*, Vol. 65, 22-42. Glover-Klingman Prize for the best paper published in Networks in 2015.
16. **Marković, N.**, Nair, R., Schonfeld, P., Miller-Hooks, E., & Mohebbi, M. (2015). Optimizing dial-a-ride services in Maryland: Benefits of computerized routing and scheduling. *Transportation Research Part C: Emerging Technologies*, Vol. 55, 156-165.
17. **Marković, N.**, Milinković, S., Tikhonov, K.S., & Schonfeld, P. (2015). Analyzing passenger train arrival delays with support vector regression. *Transportation Research Part C: Emerging Technologies*, Vol. 56, 251-262.
18. **Marković, N.**, Drobnjak, Ž., & Schonfeld, P. (2014). Dispatching trucks for drayage operations. *Transportation Research Part E: Logistics and Transportation Review*, Vol. 70, 99-111.
19. **Marković, N.**, Milinković, S., Schonfeld, P., & Drobnjak, Ž. (2013). Planning dial-a-ride services: Statistical and metamodeling approach. *Transportation Research Record: Journal of the Transportation Research Board*, Vol. 2352, Num. 1, 120-127.
20. **Marković, N.** & Schonfeld, P. (2011). Scheduling under uncertainty for a single-hub intermodal freight system. *Transportation Research Record: Journal of the Transportation Research Board*, Vol. 2238, Num. 1, 24-31.
21. **Marković, N.**, Kim, M., & Kim, E. (2019). A simple threshold policy for dispatching vehicles in demand-responsive transit systems. *Promet – Traffic & Transportation*.
22. **Marković, N.** & Schonfeld, P. (2013). Scheduling for a single-terminal intermodal system recovery with Poisson arrivals. *Strojniški Vestnik – Journal of Mechanical Engineering*, Vol. 59, Num. 9, 564-572.

#### REFEREED CONFERENCE PROCEEDINGS

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1. Mashhadi, A. H., Farhadmanesh, M., Rashidi, A., & **Marković, N.** (2021). State-of-the-Art Methods in Estimating Freeway Work zones Capacity: A Literature Review. Transportation Research Board 100th Annual Meeting.
2. Yi, Z., Liu, X. C., **Marković, N.**, & Phillips, J. (2020) Statewide Hourly Traffic Volume Estimation via XGBoost – A Scalable Tree Boosting System. Transportation Research Board 99<sup>th</sup> Annual Meeting.
3. Sekula, P., **Marković, N.**, Vander Laan, Z., & Sadabadi, K. F. (2018). Application of vehicle probe data in estimating traffic volumes: A Maryland case study. Transportation Research Board 97<sup>th</sup> Annual Meeting.
4. **Marković, N.**, Nair, R., Schonfeld, P., Miller-Hooks, E., & Mohebbi, M. (2014). Optimizing dial-a-ride services in Maryland. Transportation Research Board 93<sup>rd</sup> Annual Meeting.

5. **Marković, N.**, Milinković, S., Schonfeld, P., & Drobnjak, Ž. (2013). Planning dial-a-ride services: statistical and metamodeling approach. Transportation Research Board 92<sup>nd</sup> Annual Meeting.
6. Bešinović, N., **Marković, N.**, & Schonfeld, P. (2013). Optimal allocation of truck inspection stations based on  $k$ -shortest paths. Transportation Research Board 92<sup>nd</sup> Annual Meeting.
7. Perovanović, J., Jaiswal, J., **Marković, N.**, & Hoffman, E. (2013). Nuclear envelope laminopathies: evidence for developmentally inappropriate chromatin-nuclear envelope interactions. *Epigenetics & Chromatin*, 6(Suppl 1), P65.
8. **Marković, N.**, Drobnjak, Ž., & Schonfeld, P. (2012). Nonstationary Markov chain framework for optimizing dedicated check-In. Transportation Research Board 91<sup>st</sup> Annual Meeting.
9. **Marković, N.**, Bešinović, N., & Schonfeld, P. (2012). Simulation-based optimization of recovery for multi-terminal freight transportation system. Transportation Research Board 91<sup>st</sup> Annual Meeting.
10. Bešinović, N., **Marković, N.**, & Schonfeld, P. (2012). Location of truck inspection stations based on stochastic flows. Transportation Research Board 91<sup>st</sup> Annual Meeting.
11. **Marković, N.** & Schonfeld, P. (2011). Scheduling under uncertainty for a single-hub intermodal freight system. Transportation Research Board 90<sup>th</sup> Annual Meeting.

#### PROFESSIONAL ACTIVITIES

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Institute for Operations Research and the Management Sciences (INFORMS)  
Transportation Research Board (TRB)