COLLEGE OF ENGINEERING
*Civil and Environmental Engineering*

NEBRASKA TRANSPORTATION CENTER

# Transportation Engineering Seminar Series

# A Crash Severity Analysis at Highway-rail Grade Crossings: The Random Survival Forest Method

## Presentation Abstract

This paper proposes a machine learning approach, the random survival forest (RSF) for competing risks, to investigate highway-rail grade crossing (HRGC) crash severity during a 29-year analysis period. The benefits of the RSF approach are that it (1) is a special type of survival analysis able to accommodate the competing nature of multiple-event outcomes to the same event of interest (here the competing multiple events are crash severities), (2) is able to conduct an event-specific selection of risk factors, (3) has the capability to determine longterm cumulative effects of contributors with the cumulative incidence function (CIF), (4) provides high prediction performance, and (5) is effective in high-dimensional settings. The RSF approach is able to consider complexities in HRGC safety analysis, e.g., non-linear relationships between HRGCs crash severities and the contributing factors and heterogeneity in data. Variable importance (VIMP) technique is adopted in this research for selecting the most predictive contributors for each crash-severity level. Moreover, marginal effect analysis results real several HRGC countermeasures' effectiveness. Several insightful findings are discovered. For examples, adding stop signs to HRGCs that already have a combination of gate, standard flashing lights, and audible devices will reduce the likelihood of property damage only (PDO) crashes for up to seven years; but after the seventh year, the crossings are more likely to have PDO crashes. Adding audible devices to crossing with gates and standard flashing lights will reduce crash likelihood, PDO, injury, and fatal crashes by 49%, 52%, 46%, and 50%, respectively.

## About the Speakers

**Dr. Pan Lu** is an accomplished academic and researcher specializing in transportation. She began her career as a research analyst with the Upper Great Plains Transportation Institute/ North Dakota State University (UGPTI/NDSU) in 2010. She is currently an associate professor, an advanced research fellow with UGPTI/ NDSU, and an associate center director with the Tier one Center on Multi-Modal Mobility in Urban, Rural, and Tribal Areas (CMMM). Her research interests include Connected and Autonomous Trucking, Multimodal Transportation, Geospatial Modeling, Transportation Safety, Equitable Mobility, and Advanced Sensor Application in Transportation.

She has a well-established academic career with over 100 peer-reviewed journals, research reports and conference publications. She has successfully secured more than $16.5 million in research funding as Principal Investigator (PI) or Co-Principal Investigator (Co-PI) from various sources. She mentored two peer-researchers, four post-docs, along with over 40 graduate students. Among them, 11 received their Ph.D. degrees, and 16 received their M.S. degrees. In addition, she also mentored more than 80 middle school/high school students through her outreach mentoring activities. Her extensive research portfolio and substantial funding underscore her significant contribution to the field of transportation systems. In addition, she also actively contributes to the profession community by serving as TRB committee member and Research Coordinator (AR080 Highway/Rail Grade Crossings), NSF review panels, committee/conference session chairs, and editorial board members/reviewers.

**Dr. Amin Keramati** serves as an Assistant Professor of Supply Chain Management and Data Analytics at Widener University. Beyond his teaching duties, he holds the positions of SAP University Alliances Coordinator and GIS Administrator within the School of Business Administration. Dr. Keramati earned his PhD in Transportation and Logistics from North Dakota State University, with a focus on logistics and supply chain systems. His professional background includes work on significant federal projects addressing safety systems in transportation. Dr. Keramati's research is driven by a commitment to employing mathematical, statistical, and machine learning methodologies to unravel complex issues in transportation, supply chain, and logistics. He teaches in the areas of supply chain management, data analysis, and database systems.

## Join us via livestream:

**Friday, September 20, 2024**
**11:00 - 11:50 AM Central Time**
**Connect at: https://unl.zoom.us/j/98630335322**

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