Title: Surrogate Safety and Behavioural Analysis of Roundabout Merging Zones Using Computer Vision

Paul St-Aubin¹, Luis F. Miranda-Moreno², Nicolas Saunier¹

Authors: ¹Polytechnique Montreal, ²McGill University

Email: paul.st-aubin@polymtl.ca, luis.miranda-moreno@mcgill.ca, nicolas.saunier@polymtl.ca

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Surrogate safety is a growing area of research within the field of road safety. Surrogate safety methods promise proactive diagnosis of road safety issues and detailed analysis of motorist, pedestrian, and cyclist behaviour by observing and analyzing the spatial relationships between road users at the microscopic level over large datasets. Relying on the assumption of the existence of a safety continuum ranging from ordinary behaviour to conflicts to accidents, the aim of these methods is to measure safety from the observation and characterization of non-collision traffic interactions, for example through the number of severe interactions ("conflicts") or the distribution of safety indicators such as time to collision (TTC). These measures can then be used to identify contributing factors in road design leading to safer and smoother traffic flow. However, despite recent advances, research is still needed in some key areas, particularly in the continued development of a more robust theoretical framework and collision probability modelling.

This work outlines some of the latest methodological developments in 1) motion (and collision) prediction, from constant velocity projection to naturalistic motion patterns, 2) in resulting surrogate safety measures, such as time-to-collision and gap time, and 3) in the spatial and temporal aggregation of indicators for interpretation.

This work is presented in a case study of 40 merging zones located across 20 different roundabouts throughout the province of Québec, Canada. The data consists of over 120,000 vehicles tracked over 600 hours of video data using computer vision techniques built specifically for the purposes of detailed automated traffic and road safety analysis over large datasets. A cross-sectional analysis is conducted across these 40 merging zones to study the effects on time-to-collision and gap time of various potential contributing factors, such as number of lanes, lane arrangement, flow and flow ratio, approach speed limit, land use, roundabout diameter, merge zone length, etc. The study determines that some of the factors provide conclusive evidence of safety benefits based on our current understanding of surrogate safety methods.