

Enhancing Road Quality and Safety Intelligence with Onboard Vehicle Telematics: Hotspot Detection and Junction Scoring in the Netherlands

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Background and Motivation

Traditional road safety management is reactive: authorities rank danger hotspots by historical accident records, which may take years before it can be meaningfully assessed. This study adopts a proactive approach to road safety analysis using onboard vehicle telematics for accident risk mitigation. A vehicle's probe data—such as its harsh cornering and braking events, and other accelerometer data—can act as proxies to infer road quality and characteristics, as well as assess where accidents are more likely to happen.

Two difficulties follow. Ranking on raw harsh event counts will largely show locations with high-traffic and many harsh events; and a fixed-threshold detector is unable to tell whether a manoeuvre was avoidable: where a road entails a sharp turn, it will tend to fire on the road layout rather than a genuine hazard.

Data and Methods

Mobito's Dutch connected-vehicle feed for 9–15 February 2026: 215,536,825 probe observations and 3,667,229 driving events from a predominantly heavy commercial fleet. Both feeds were map-matched to the Dutch road network by nearest segment.

The safety score is harsh events per 1,000 vehicles entering a junction, with exposure as distinct vehicle-days unioned across both feeds and segments aggregated to their endpoint junctions, giving 419,309 scored junctions. A k-means clustering analysis ($k = 4$) used speed ratio, surface roughness and peak share to profile the roads into four interpretable clusters. National national accident records for 2025 and 2024 are used as validation for the ranking and tiering of the safety hotspots.

Key Findings

The score ranks ordinary junctions. Across non-roundabout junctions above the exposure floor, accident probability rises almost monotonically from lowest decile to highest in both years, indicating that the score ranks dangerous junctions well up to a certain point.

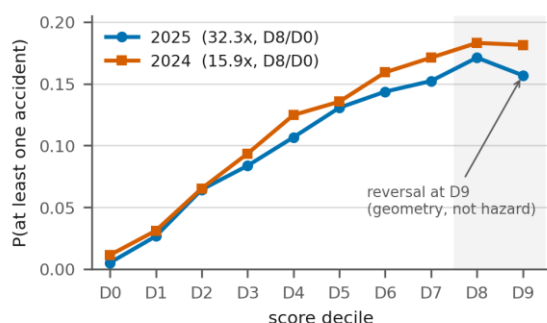


Figure 1: Accident probability by decile of the exposure-normalised score. 24,369 non-roundabout junctions above 600 vehicles per week, two independent validation years.

The clustering resolves into four interpretable road types.

Segment-level k-means ($k = 4$) separates short, slow, cornering-heavy roads — carrying 2.24× the roundabout enrichment of any other cluster — from open-road, peak-hour-congested, and poor-surface profiles, without ever using a road-type label as a feature.

	Cluster 0	Cluster 1	Cluster 2	Cluster 3
Profile	Short & slow	Open road, free flow	Peak-hour congestion	Poor surface
Segments	140,476	94,718	57,110	67,074
Speed ratio	0.40	0.80	0.59	0.63
Roughness	36.2	41.0	46.2	79.9
Peak share	0.20	0.19	1.00	0.00
Roundabout enrichment	2.24×	0.19×	0.38×	0.08×

Score signal certainty rises with traffic exposure. Correlation with accidents rises as the exposure floor increases. A threshold floor of 1,200 vehicles/week at a junction is where a positive relationship with accidents begins to be observed. 600 is set as the minimum floor threshold.

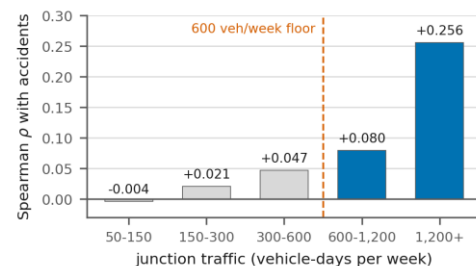


Figure 2: Spearman correlation between score and recorded accidents within bands of observed weekly traffic.

The score underperforms at roundabouts. But it can distinguish ordinary junctions well. Cornering comprises most events at roundabouts, hence the score becomes overranked relative to actual risk. Hence, roundabouts are excluded from safety scoring.

The riskiest junctions are concentrated at major cities, even after accounting for traffic. A total of 4,874 junctions with an Elevated score, carrying 1.84× the accident probability compared to 19,495 Standard junctions.

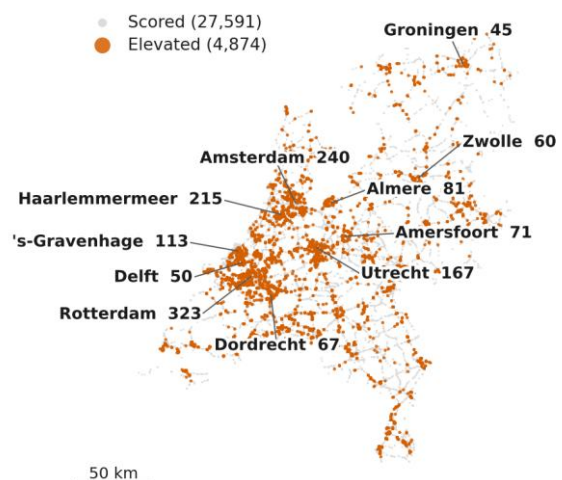


Figure 3: Map of municipalities with the most Elevated junctions

Value of the research

A telematics feed from a vehicle fleet is able to support road safety screening subject to some constraints. Three implications follow: 1) stratify by junction type before ranking; 2) cornering as a proxy is confounded by cornering heavy junctions by design; 3) and report braking and cornering separately.