International Co-operation on Theories and
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Applying Traffic Conflicts - The Danger of Shortcuts

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The emergence of connected and automated vehicles (CAVs) and proliferation of roadside instrumentation are expected to continue at a growing rate. The expected outcome of this trend is twofold: (1) considerable changes in road safety, and (2) improvement of safety estimation. Instrumented CAVs and instrumented roads collect disaggregated motion data that should help document collisions and near-collisions across road networks. If properly used, such data would improve both understanding of the crash causality and application of effective countermeasures. These envisioned benefits are conditioned on a valid method of estimating safety and identifying its factors from observed trajectories and from other collected data. It comes as no surprise that a growing number of published research consider alternative ways of studying safety and its factors.

This presentation focuses on traffic conflicts analysis as the most promising among available alternatives. The presentation recalls the traffic conflict concept proposed in the eighties. It includes a driver's error that triggers the imminence of crash eventually avoided with an effective evasion. The causality link between conflict and potential crash is introduced with the required presence of error. Under the current lack of internal information, an external observer must confirm the presence of such an error based on observed uncharacteristically strong evasive behavior. Then, counterfactual analysis must be applied to check the inevitability of collision under the absence of evasion. According to recent research, this potential collision must be sufficiently harmful to make the potential event safety-relevant. Otherwise, the claimed error is concluded as non-consequential and the observed interaction should not be considered a traffic conflict.

Application of the above concept of traffic conflicts is quite demanding and may be discouraging. It may prompt researchers to look for shortcuts and simplifications. Tempting shortcuts, some of them already found in published work, include relaxing the thresholds or not applying some of the behavioral criteria. These shortcuts simplify field observations and increase the number of events claimed as conflicts. In some cases, the requirement of an evasive action is ignored, and the temporal proximity of collision is replaced with the spatial proximity of vehicles. These shortcuts and omissions are computationally attractive and the counterfactual (what-if) analysis needed to estimate the time to collision is eliminated.

This presentation discusses an example safety estimation with traffic conflicts properly defined via a rigorous process of setting the thresholds. Then, the presented case is used to demonstrate the consequences of traffic conflict definitions with relaxed or removed definition thresholds such as maximum time-to-collision, minimum jerk threshold, and minimum speed difference. The effect of applying incomplete or relaxed definitions to traffic conflicts on the results is evaluated.

Regression analysis is applied to obtain predictions within the observed range, while extreme value analysis extrapolates the observed values outside of the observed range. Thus, any inaccuracies in the data and any conceptual weaknesses of the studied mechanism are preserved or even emphasized in the obtained extrapolated values. Unfortunately, an extreme value

analysis is attractive and used by researchers when the studied events are not observed frequently. This shortage of observable target values makes validation of the obtained results difficult. The validity of the results must rely on the accuracy of the data and the soundness of the methodology.

Hopefully, the current necessity of claiming failure based on external observations will be relaxed in the future when CAVs internal reports are available to safety analysts. Counterfactual consideration of uncorrected failures will still be required to separate non-consequential errors from consequential ones. This could possibly be done by running advanced and operationally faithful microsimulation. Until then, the research practice of external observers should follow the recommended quality standards to avoid losing confidence in traffic conflicts. Such a situation happened over forty years ago when traffic conflicts were proposed for the first time while the available observation techniques did not have the needed sophistication of today.