ADVANCING ROAD SAFETY THROUGH TWINNING

PhD SEMINAR SESSIONS

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Application of video recordings in traffic studies

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21-02-2025

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Smart cities need Smart data for Smart analysis to take Smart actions

Accurate

Intelligent

Data-driven, people-centered solutions

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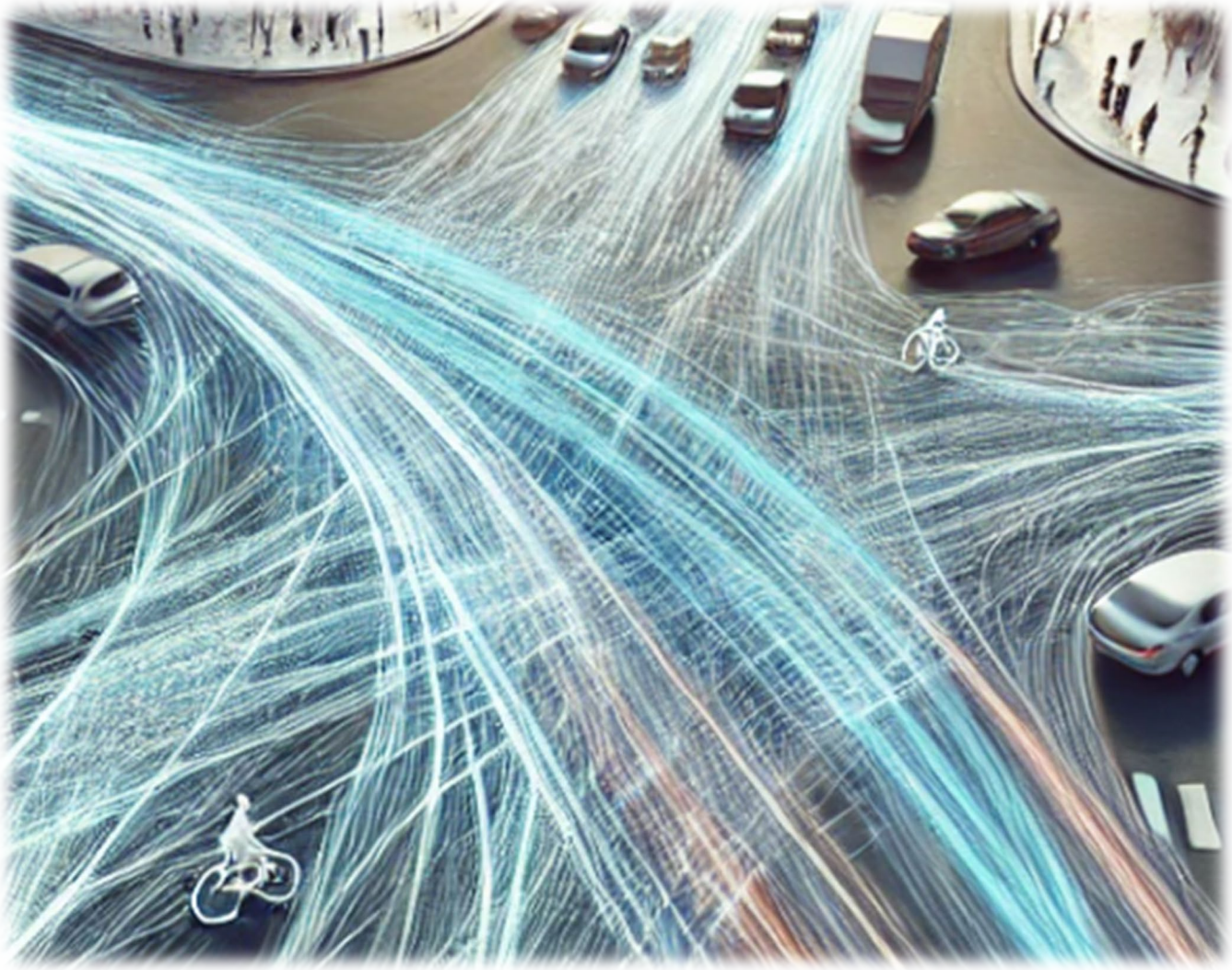
Smart data in traffic

Microscopic traffic behavioural data



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Behavioural observations in traffic

How to collect such data?

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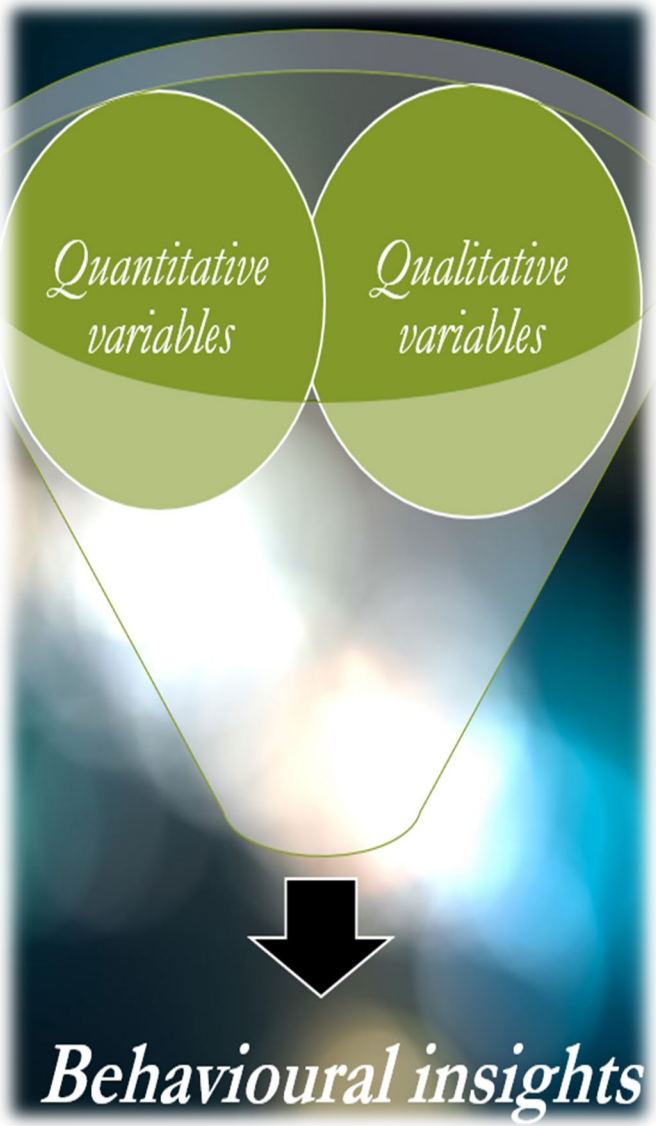
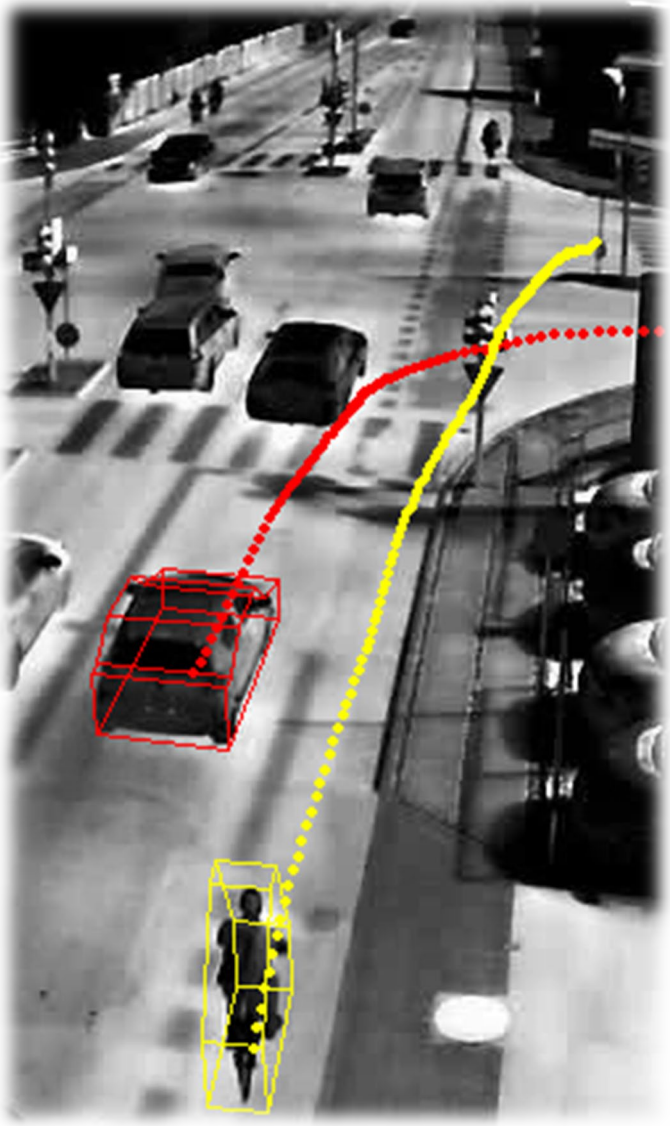
Turning traffic videos into actionable insights





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Examples of application of microscopic traffic data extracted from video recordings

Study 1. Understanding the subtle and dynamic behaviours of road users in daily traffic, with a focus on cyclists–method exploration

Study 2. Practical application of SMoS approach in order to find ‘better’ traffic event severity measure

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Examples of application of microscopic traffic data extracted from video recordings

Study 1. Understanding the subtle and dynamic behaviours of road users in daily traffic, with a focus on cyclists–method exploration

Lack of user-friendly, real-time feedback tools for transport specialists to assess infrastructure interventions, optimise systems, and improve efficiency while reducing costs and risks

Study 2. Practical application of SMoS approach in order to find ‘better’ traffic event severity measure

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Study 1:

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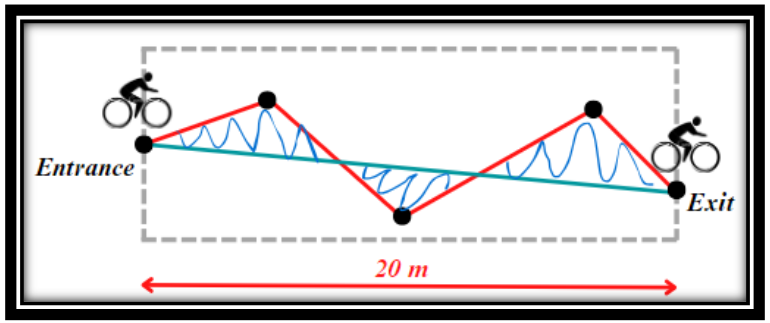
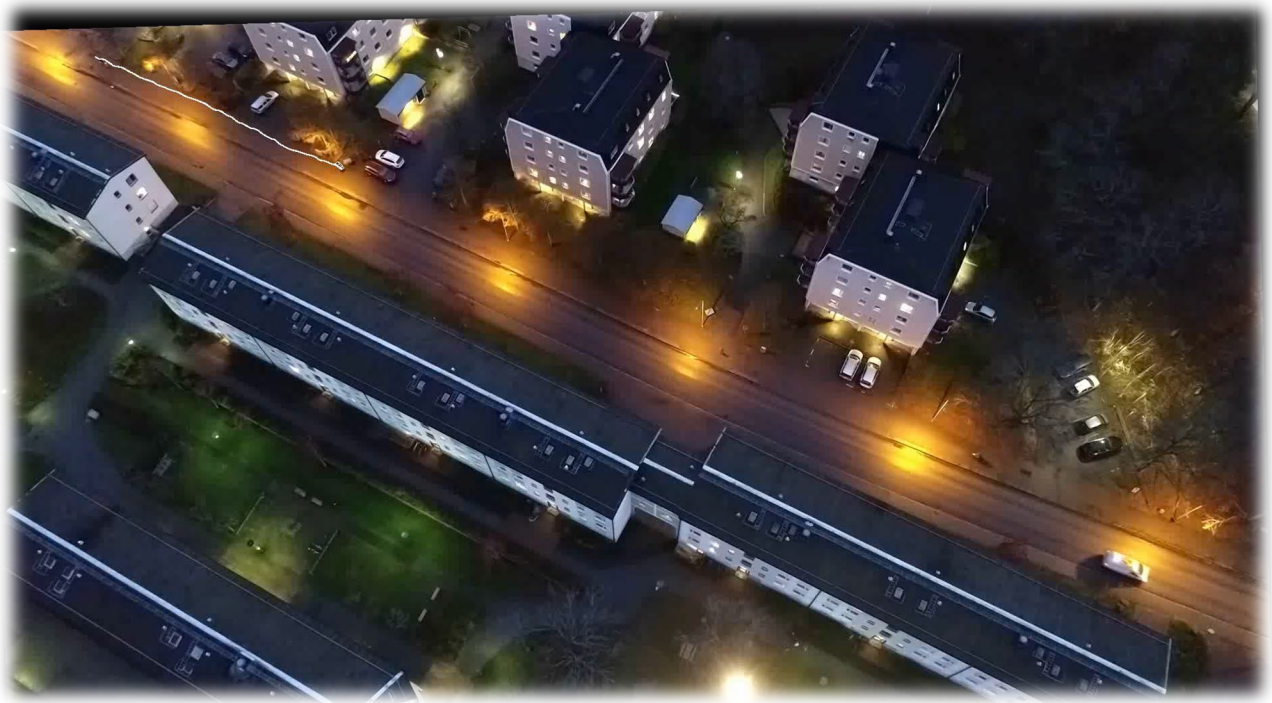
Investigation 1:

Impact of surfacing and lighting on individual cyclists behaviour

Speed (median)
Slalom measure





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Analysis:

Two-way ANOVA:

path surfacing/design

lighting conditions

$$DV \sim C(IV\_1) + C(IV\_2) + C(IV\_1):C(IV\_2)$$

behaviour variables

interaction

Tukey's honestly significant difference (HSD) test

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Two-way ANOVA

DV	IV	*p*
Speed	Physical changes	**< .01**
	Lighting conditions	**< .01**
	Interaction	**.01**
Slalom	Physical changes	**.04**
	Lighting conditions	**.04**
	Interaction	.06

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Tukey HSD test

Group1	Group2	Physical changes	DV	*p*	Change in %
Baseline (Daylight)	Baseline (EL)	Daylight to EL	Speed	.01	−9.03
			Slalom	.05	−18.77
Baseline (Daylight)	Intervention 1 (Daylight)	New surfacing, appearance of a separation line	Speed	.02	+13.57
			Slalom	.03	−24.38
Baseline (EL)	Intervention 1 (EL)	New surfacing, appearance of a separation line	Speed	.90	-
			Slalom	.76	-
Intervention 1 (Daylight)	Intervention 1 (EL)	Daylight to EL	Speed	< .01	−17.69
			Slalom	.74	-
Intervention 1 (Daylight)	Intervention 2 (Daylight)	No changes	Speed	.90	-
			Slalom	.90	-
Intervention 1 (EL)	Intervention 2 (EL)	EL application	Speed	.01	+16.40
			Slalom	.05	−25.06
Intervention 2 (Daylight)	Intervention 2 (EL)	Daylight to EL	Speed	.90	-
			Slalom	.05	−24.66
Baseline (Daylight)	Intervention 2 (Daylight)	New surfacing, appearance of a separation line	Speed	.05	+11.06
			Slalom	.03	−24.18
Baseline (EL)	Intervention 2 (EL)	New surfacing, separation, EL application	Speed	.01	+15.77
			Slalom	.01	−29.67

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Key findings and implications:

- Significant impact:

Physical alterations to path surfacing&design(segregation), and lighting conditions notably affect cyclist behavior

but more research is necessary to get insights about other features

(e.g. path width, technical aspects of lighting applications)

- Effectiveness of chosen methodology:

Speed and slalom measures proved their effectiveness for capturing changes in cyclists' behavioural responses

but interpreting behavioural changes requires a sound theoretical basis

In overall:

Potentially the methodology can be used as a 'quick tool' for evaluating the effectiveness of interventions to cyclist's infrastructure

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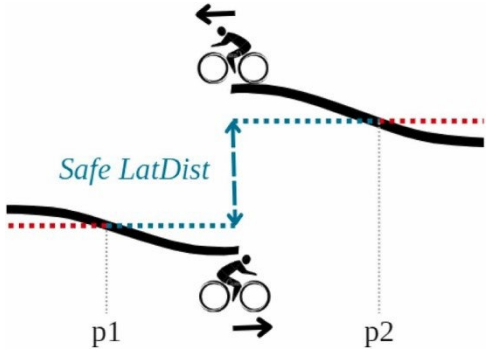
Investigation 2:

Impact of outdoor lighting conditions on cyclists' positioning during interactions with other cyclists (bi-directional interactions)

Lateral Passing Distance



- **longitudinal distance** between cyclists (p1–p2)
- **time**

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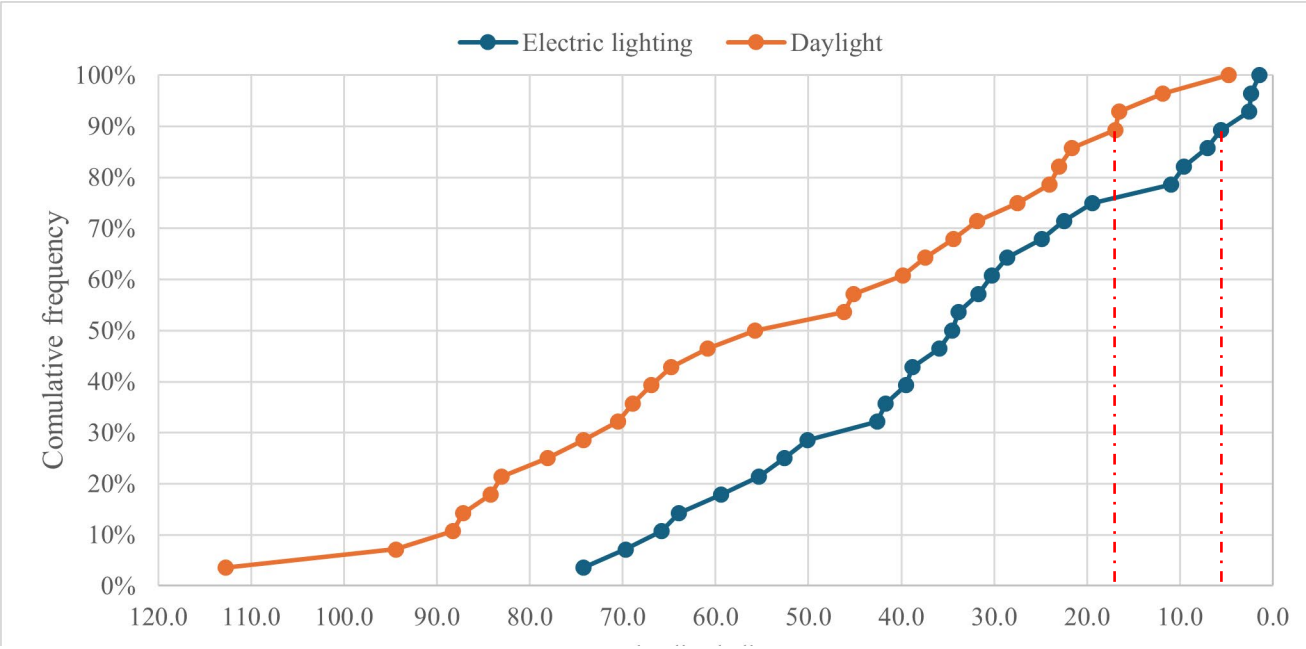
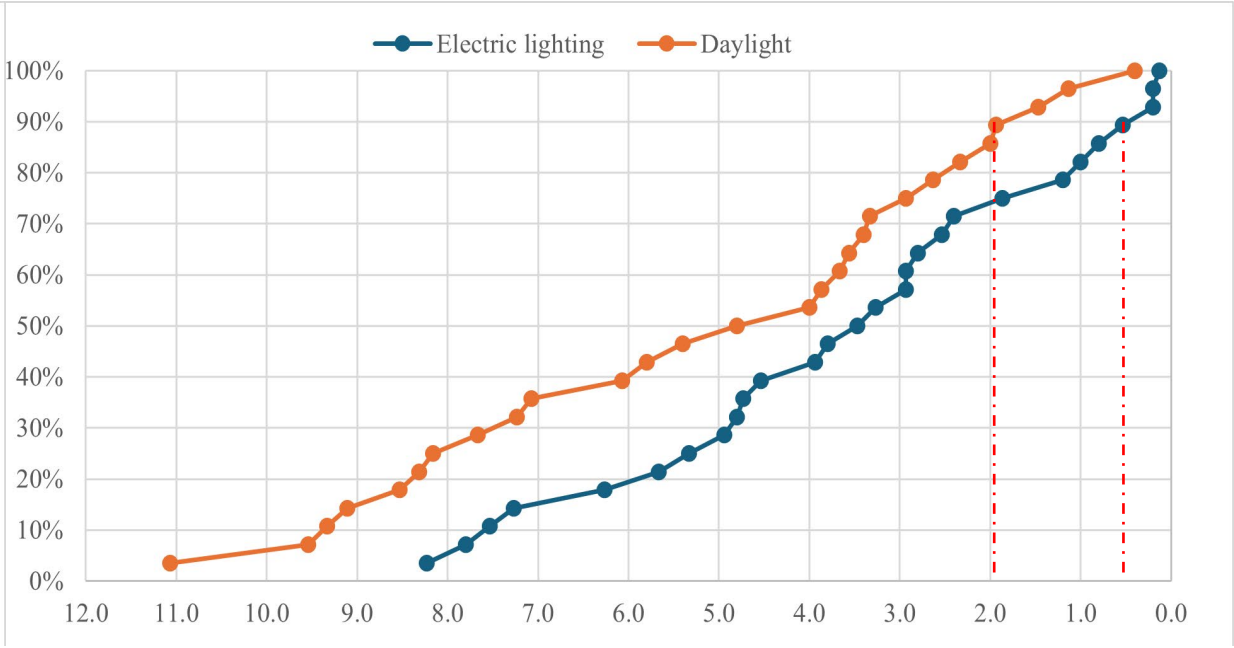
Results:



Longitudinal distance, m



Time to the meeting point, s

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Limitations:

- Small sample size

Future research directions:

- Explore other types of interactions
- Investigate additional objective parameters to measure behavioural responses

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Examples of application of microscopic traffic data extracted from video recordings

Study 1. Understanding the subtle and dynamic behaviours of road users in daily traffic, with a focus on cyclists–method exploration

Study 2. Practical application of SMoS approach in order to find 'better' traffic event severity measure

Lack of methods and tools to provide quick feedback on the effectiveness of various traffic safety measures before implementation – shift toward proactive approaches

Need to find reliable measure of traffic events severity

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- 50+ SMoS indicators *(e.g. Johnsson et al. 2018, Mahmud et al. 2017)*
- Conflicts treated as exposure
- ‘nearness to collision’ only measured (risk of collision)

...but

Safe System approach

‘risk of collision’ → ‘risk of **serious injury** and **fatal** collisions’

We need reliable measure of severity

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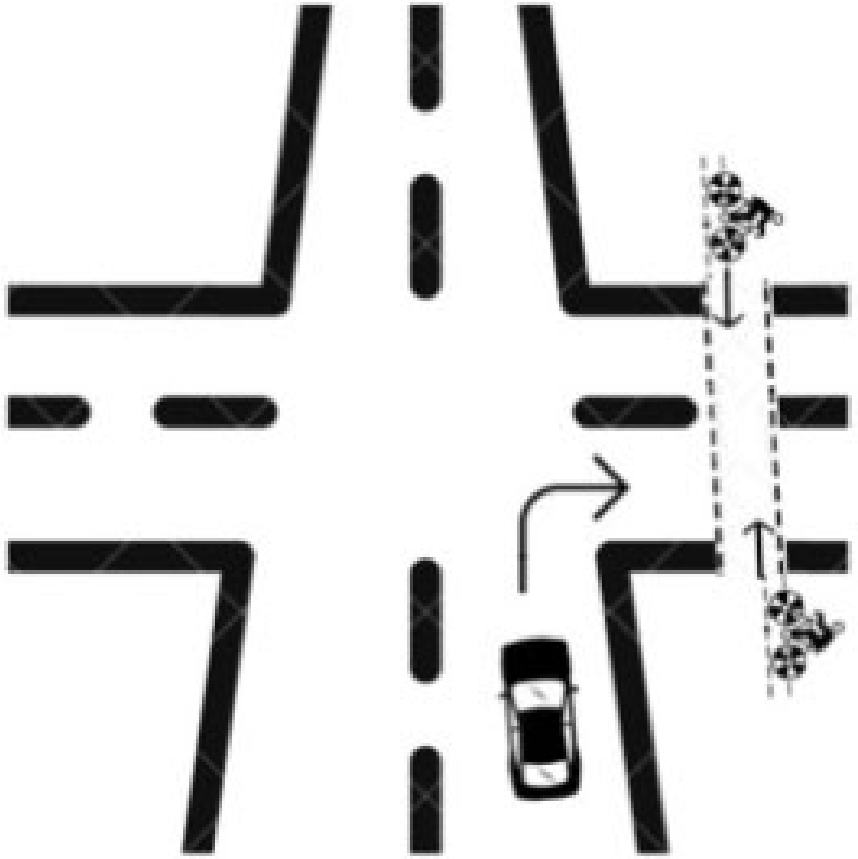

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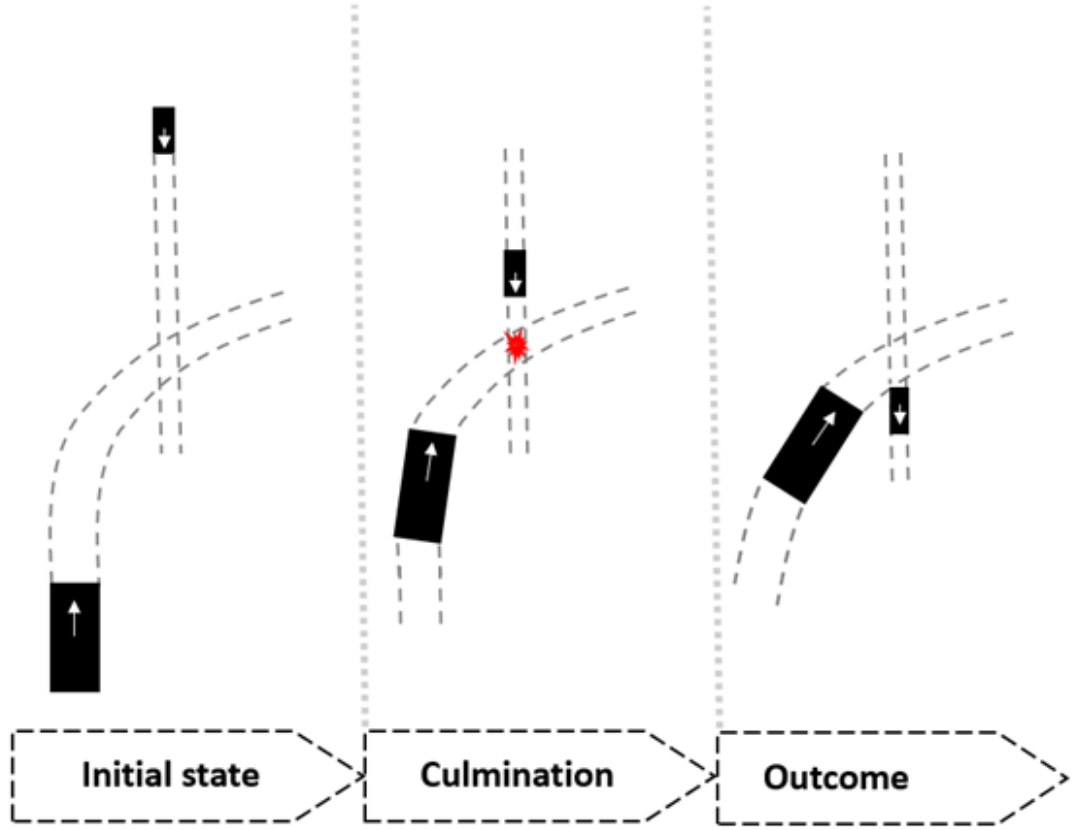
Kruysse, H. W., G. J. Wijlhuizen (1992) **Why are experts not better in judging the danger of filmed traffic conflicts?** Accident Analysis & Prevention 26 (3), 227-235: 10.1016/0001-4575(92)90002-Z.

Phase	Definition	Time instance notation	Indicators	Included in model
Initial state	The onset of the first evasive action	**EA**	*EA, T_2, T_{Adv}, DR_{mv}^{min}, DR_{MV}, V_{mv}, V_{bike}, V_{rel}, $KE_{mv,}$ KE_{bike}, $Impulse_{mv}$, $Impulse_{bike}$, $DeltaV_{mv}$, $DeltaV_{bike}$, D_1, D_2, Who takes EA*	D
Culmination	The moment when T_2 reaches its lowest value during the event.	$\mathbf{T_2^{min}}$	*T_2, T_{Adv}, DR_{mv}^{min}, DR_{mv}, V_{mv}, V_{bike}, V_{rel}, $KE_{mv,}$ KE_{bike}, $Impulse_{mv}$, $Impulse_{bike}$, $DeltaV_{mv}$, $DeltaV_{bike}$, D_1, D_2*	A,B,C,D
	The moment when the accumulated travel-to-collision-point distance of each road users reaches its lowest value during the interaction.	$\boldsymbol{D_2^{min}}$	*T_2, T_{Adv}, DR_{mv}^{min}, DR_{mv}, V_{mv}, V_{bike}, V_{rel}, $KE_{mv,}$ KE_{bike}, $Impulse_{mv}$, $Impulse_{bike}$, $DeltaV_{mv}$, $DeltaV_{bike}$, D_1, D_2*	A,B,C,D
Outcome	The moment when the first road user (who reached the conflict area first) arrive at the area of a potential collision.	$\mathbf{T_1}$	*T_2, T_{Adv}, DR_{mv}^{min}, DR_{mv}, V_{mv}, V_{bike}, V_{rel}, $KE_{mv,}$ KE_{bike}, $Impulse_{mv}$, $Impulse_{bike}$, $DeltaV_{mv}$, $DeltaV_{bike}$, D_1, D_2, Who leaves the conflict area first*	A,B,C,D
	The moment when the second road user is arriving at the area of a potential collision.	$\mathbf{T_2}$	*PET*	A,B,C,D



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Binary Logistic Regression Analysis

Human’s judgements ~ Objective indicators

(‘0’ or ‘1’) (transformed to a weight vector)

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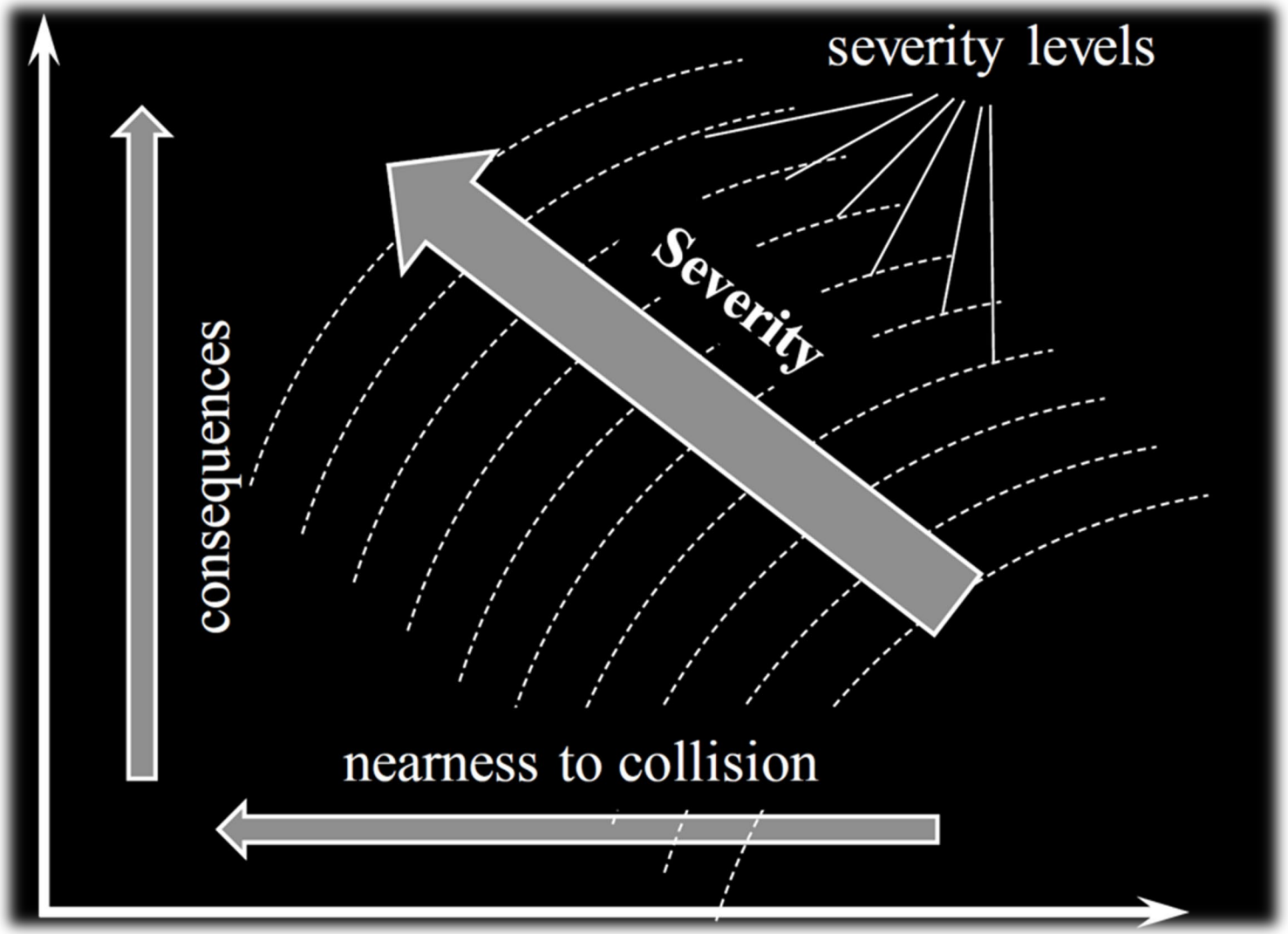
Key findings:



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Limitations:

- Included only left/right turning motor vehicle-cyclists interactions: speed was not found as significant

Future research directions:

- Dataset can be extended by including other types of interactions, maybe longer observations

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