POLITECHNIKA BYDGOSKA
Wydział Budownictwa, Architektury i Inżynierii Środowiska

Wydział Transportu
Politechnika Warszawska

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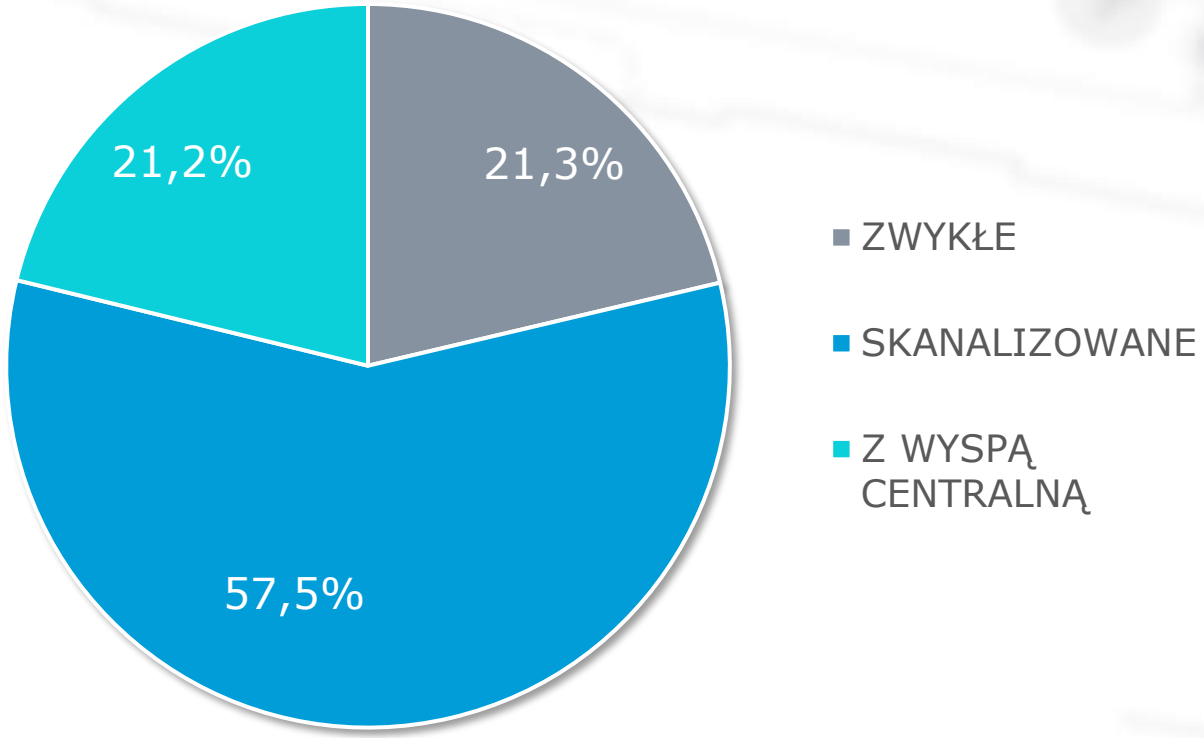
Prędkość kierowców na skrzyżowaniach z sygnalizacją świetlną

Od czego zależy...
dobór prędkości
???

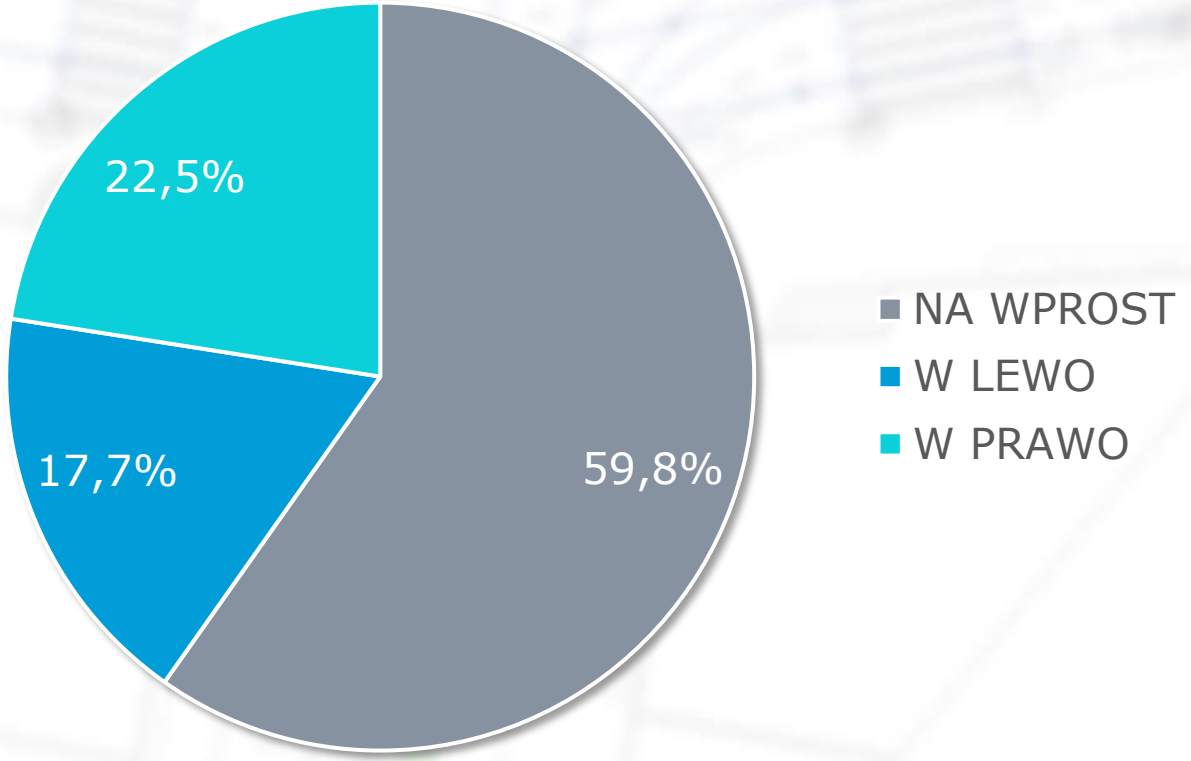
PRÓBA BADAWCZA

PODSTAWOWE DANE STATYSTYCZNE $n = 12751$

RODZAJ SKRZYŻOWANIA



RODZAJ RELACJI PRZEJAZDU PRZEZ SKRZYŻOWANIE



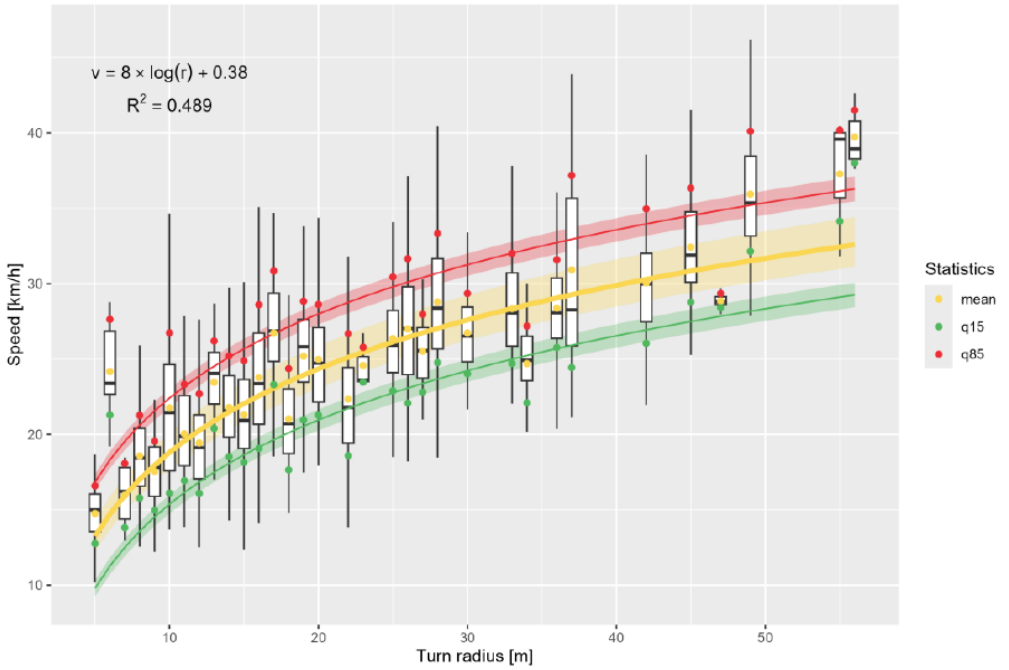
PRÓBA BADAWCZA

CO BADALIŚMY

$$v = \beta_0 + \sum_{i=1}^{n} \beta_i \cdot x_i + \varepsilon_i$$

- rodzaj relacji (L,W,P),
- typ skrzyżowania (zwykłe, skanalizowane, z wyspą centralna),
- rodzaj sygnału (ogólny, kierunkowy),
- promień krawędzi korytarza skrętnego (5÷50 m),
- liczba pasów ruchu,
- szerokość pasa ruchu,
- rodzaj przekroju drogi doprowadzającej do wlotu skrzyżowania,
- szerokość wlotu,
- organizacja ruchu na wlocie,
- pochylenie podłużne (-3,5%÷+3,5%),
- obecność i rodzaj wysp kanalizujących na wlocie,
- obecność przejazdu tramwajowego,
- obecność przejścia dla pieszych,
- obecność przejazdu dla rowerów,
- obecność budynków przy krawędzi jezdni (< 10 m),
- obecność innych przeszkód bocznych (drzewa, ogrodzenia itp.).

$$v_t = \beta_0 + \beta_i \cdot \log(\rho) \sum_{i=1}^{n} \beta_i \cdot x_i + \varepsilon_i$$



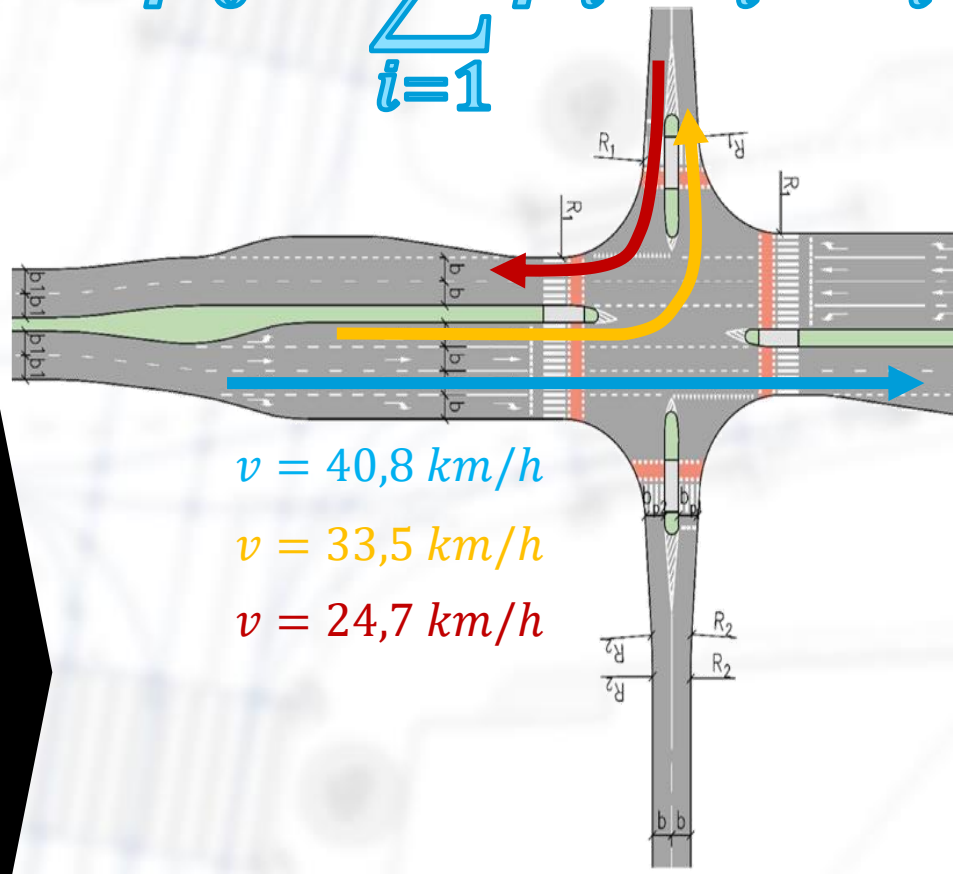
WYNIKI BADAŃ

ZBIORCZA TABELA REZULTATU MODELOWANIA

Variable	Coeff	95% CI[1]	p-value
(Intercept)	34	33, 35	**<0.001**
Type of movement at the intersection			
Straight-through	0.00	—	
Left turn	-12	-12, -11	**<0.001**
Right turn	-18	-18, -18	**<0.001**
Type of intersection and traffic organization			
I-1_B-1	0.00	—	
I-1_B-2	-0.91	-2.6, 0.74	0.3
I-1_B-3	4.4	3.5, 5.3	**<0.001**
I-1_B-3/H-8	-1.7	-2.9, -0.56	**0.004**
I-2_B-1	5.8	4.8, 6.7	**<0.001**
I-2_B-3	12	11, 13	**<0.001**
I-3_B-1	3.5	2.0, 5.0	**<0.001**
I-3_B-1/D-3	13	12, 14	**<0.001**
I-3_B-3	8.4	6.8, 9.9	**<0.001**
Signal type			
Direction-only	0.00	—	
General	0.61	0.04, 1.2	**0.035**
Number of lanes			
2	0.00	—	
3	0.54	0.05, 1.0	**0.030**
4	-4.0	-4.6, -3.5	**<0.001**
5	-6.4	-7.4, -5.4	**<0.001**
Cross-section entry type			
(1/2)	0.00	—	
(1/4)	8.4	7.1, 9.7	**<0.001**
(2/2)	-0.69	-1.4, -0.01	**0.047**
(2/3)	3.4	2.8, 4.1	**<0.001**

Variable	Coeff	95% CI[1]	p-value
Longitudinal slope at approach			
(-3.5, -1.5]	0.00	—	
(-1.5, 1.5]	-2.4	-3.3, -1.5	**<0.001**
(1.5, 3.5]	-3.1	-4.3, -2.0	**<0.001**
Channelized type			
None	0.00	—	
Horizontal marking	2.5	-0.29, 5.3	0.079
Island with curb	3.4	2.2, 4.7	**<0.001**
Bicycle crossing presence			
None	0.00	—	
Both	1.9	1.3, 2.4	**<0.001**
Approach only	6.7	6.0, 7.3	**<0.001**
Exit only	4.4	3.8, 5.1	**<0.001**
Tram crossing presence			
No	0.00	—	
Yes	-1.7	-2.1, -1.3	**<0.001**
Buildings presence			
No	0.00	—	
Yes	-1.6	-2.1, -1.2	**<0.001**
Other obstacles presence			
No	0.00	—	
Yes	-2.2	-2.6, -1.8	**<0.001**
[1]CI = Confidence Interval			
R^2 = 0.647; AIC = 89,458; p-value ≤ 0.001			

$$v = \beta_0 + \sum_{i=1}^{n} \beta_i \cdot x_i + \varepsilon_i$$



$v = 40{,}8\ km/h$

$v = 33{,}5\ km/h$

$v = 24{,}7\ km/h$

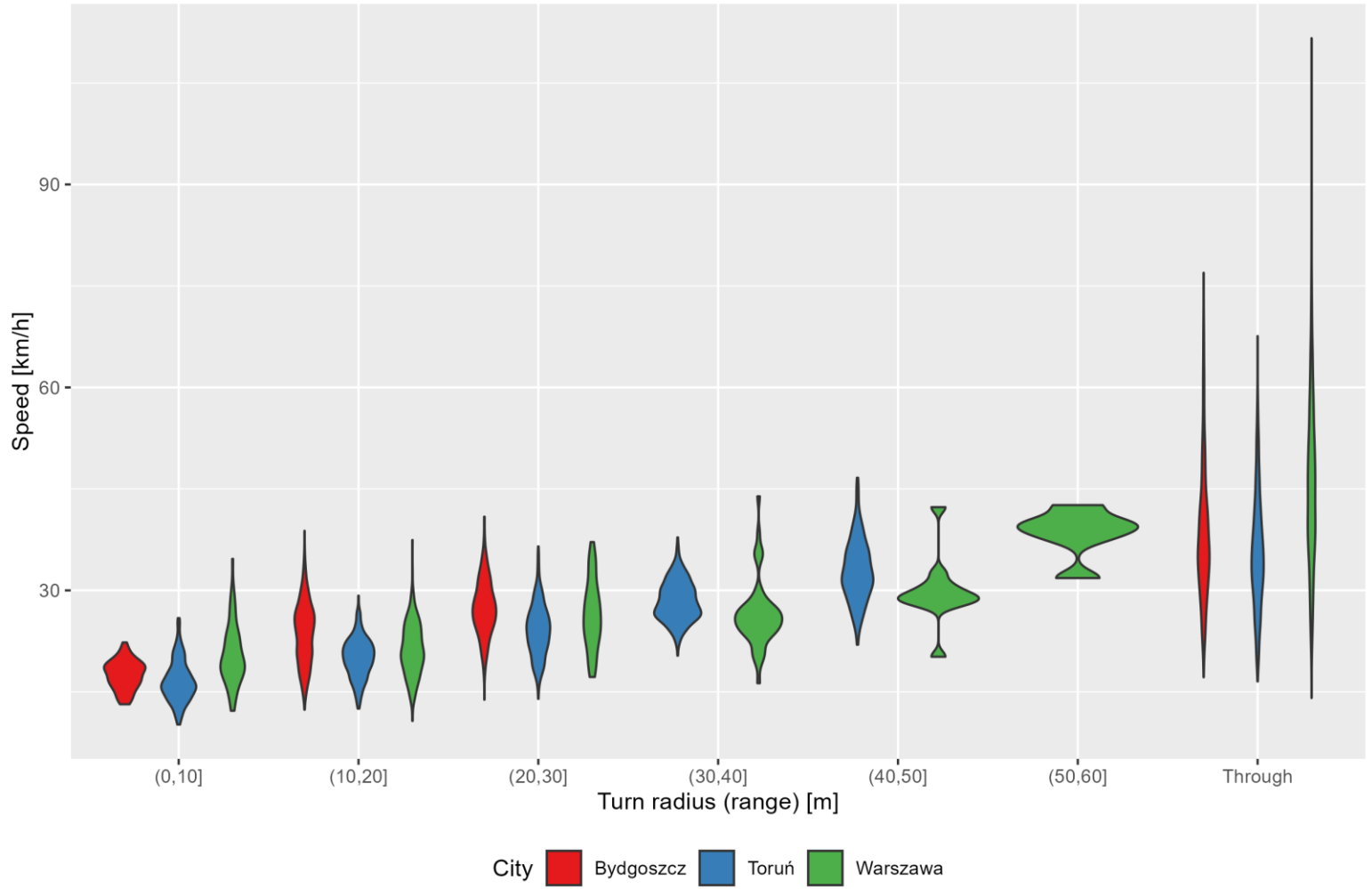
Przykład „dla lewoskrętu”
z wlotu <u>podporządkowanego</u>:

$$v = 34 - 12 + 5{,}8 - 2{,}4 + 3{,}4 + 1{,}9$$

$$v = 30{,}7\ km/h$$

WYNIKI BADAŃ

REZULTATY OGÓLNE



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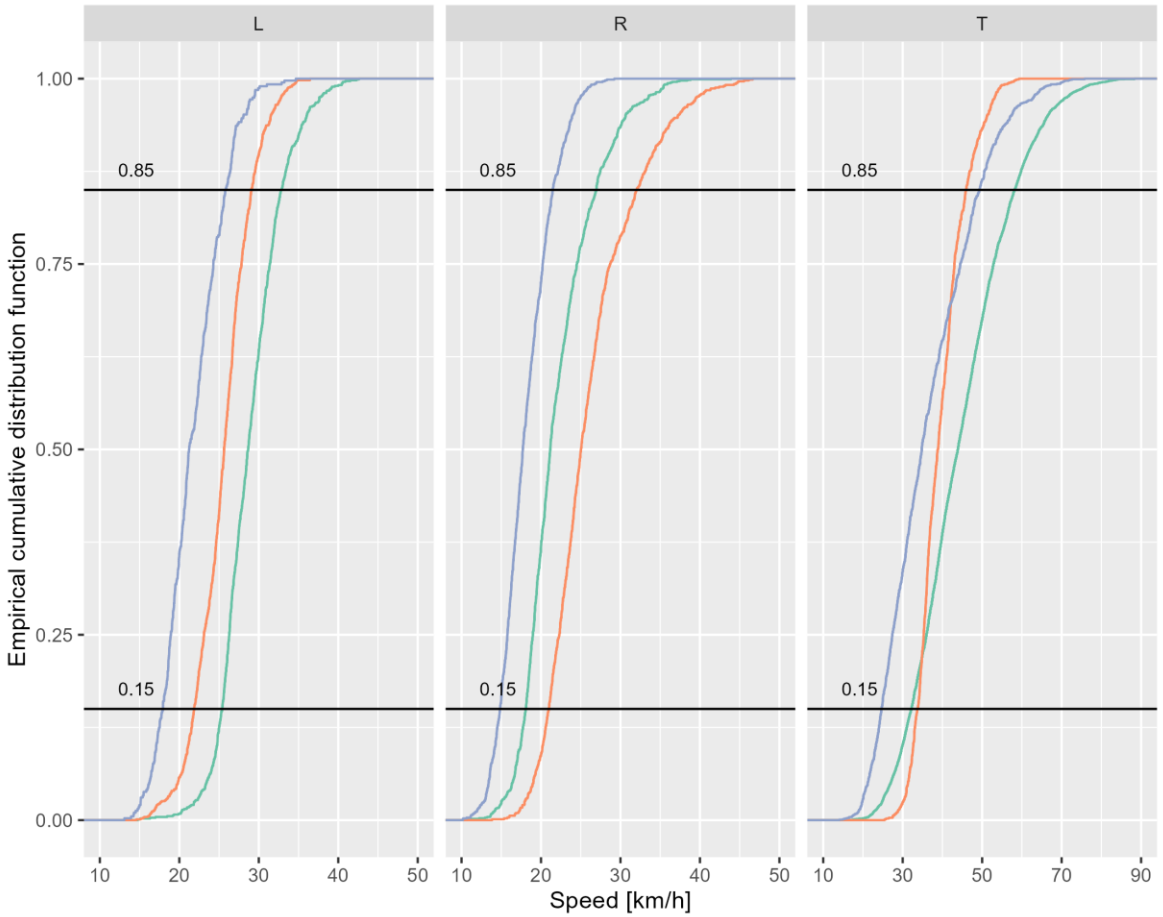
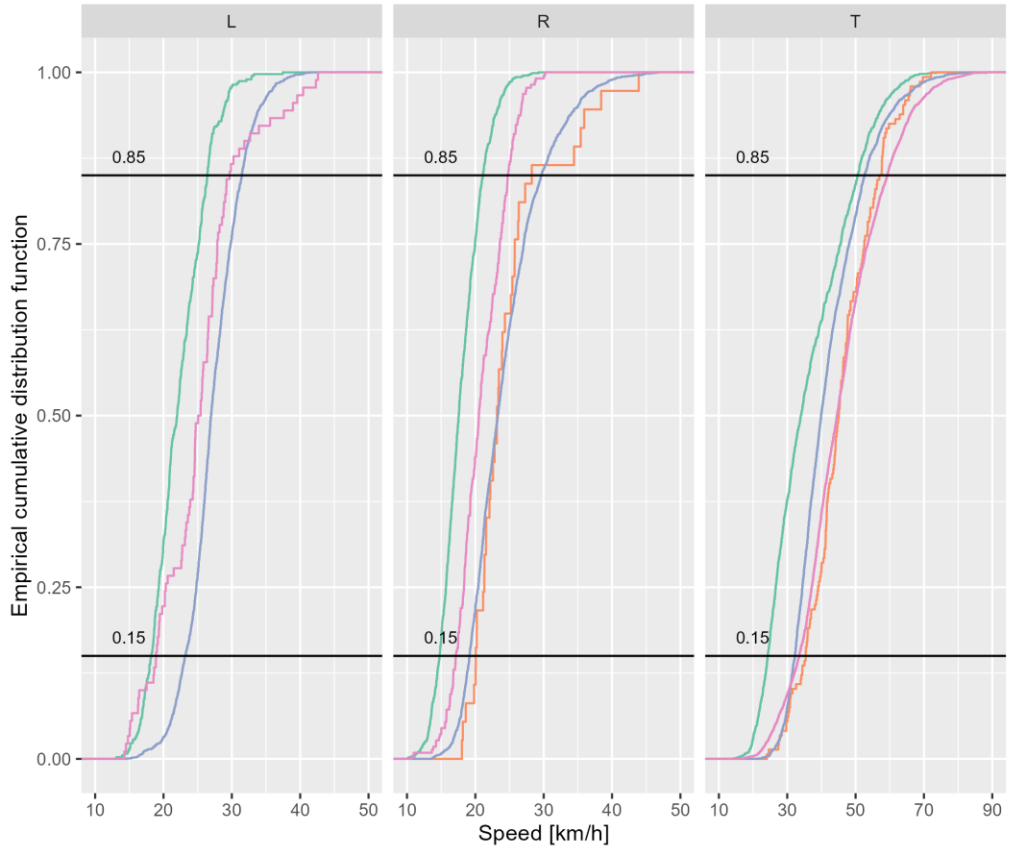
REZULTATY SZCZEGÓŁOWE





Intersection type
- channelized
- rotary
- simple

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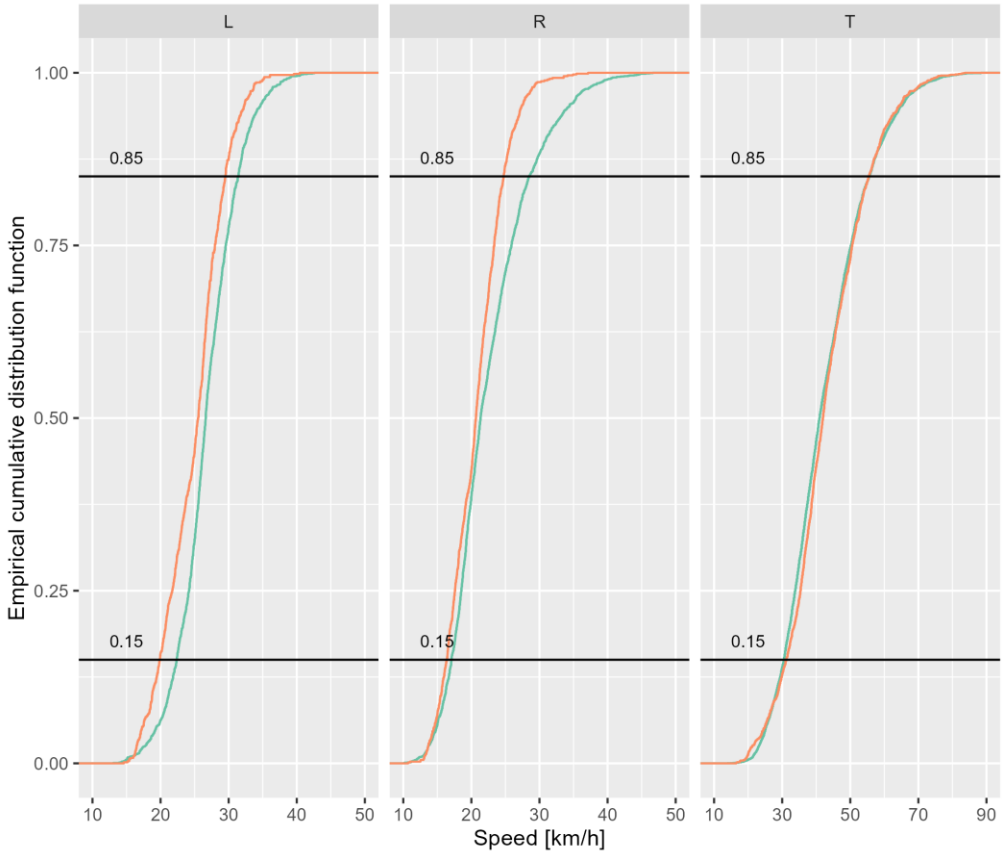
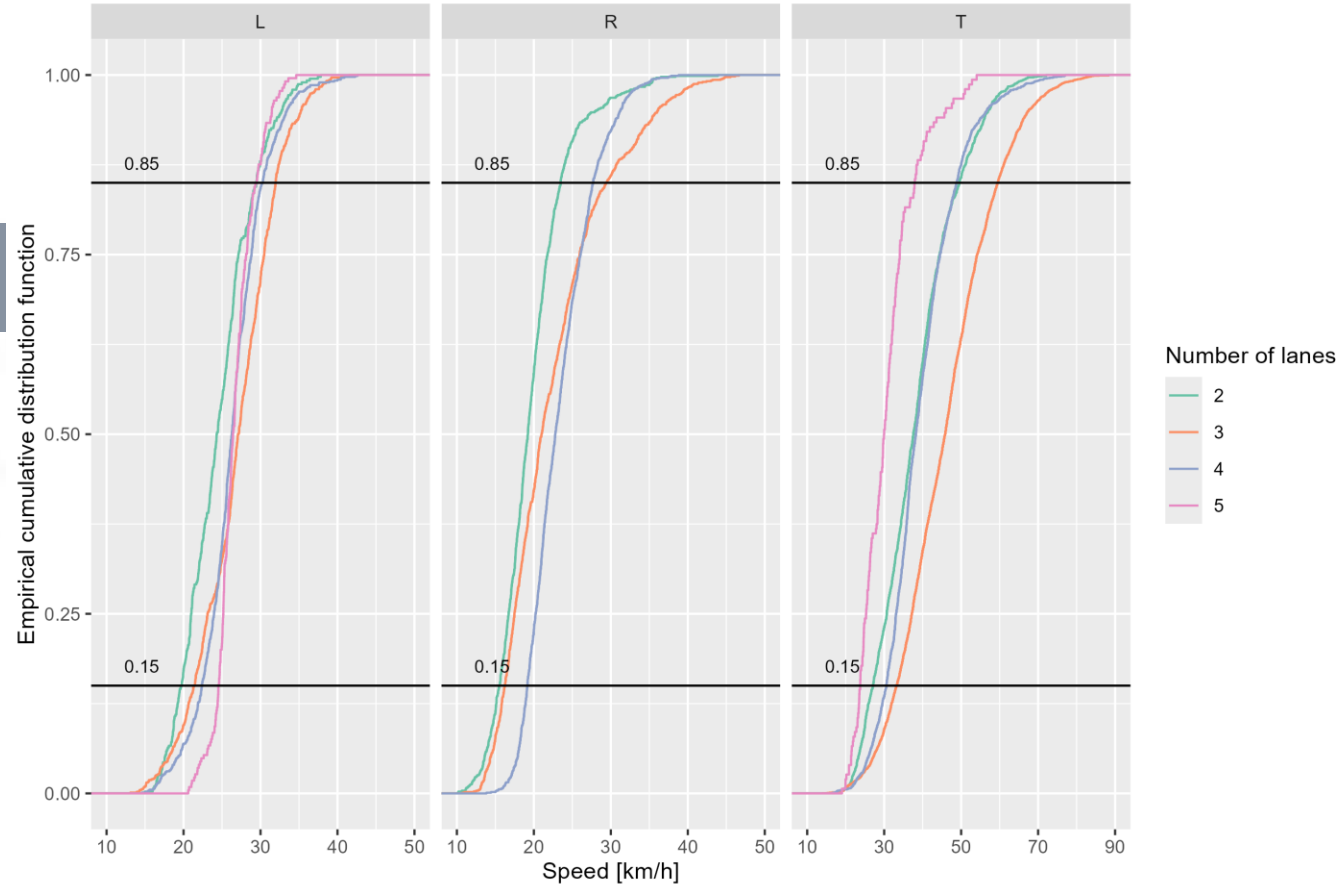
REZULTATY SZCZEGÓŁOWE





Other obstacles
in the vicinity of the road
No
Yes

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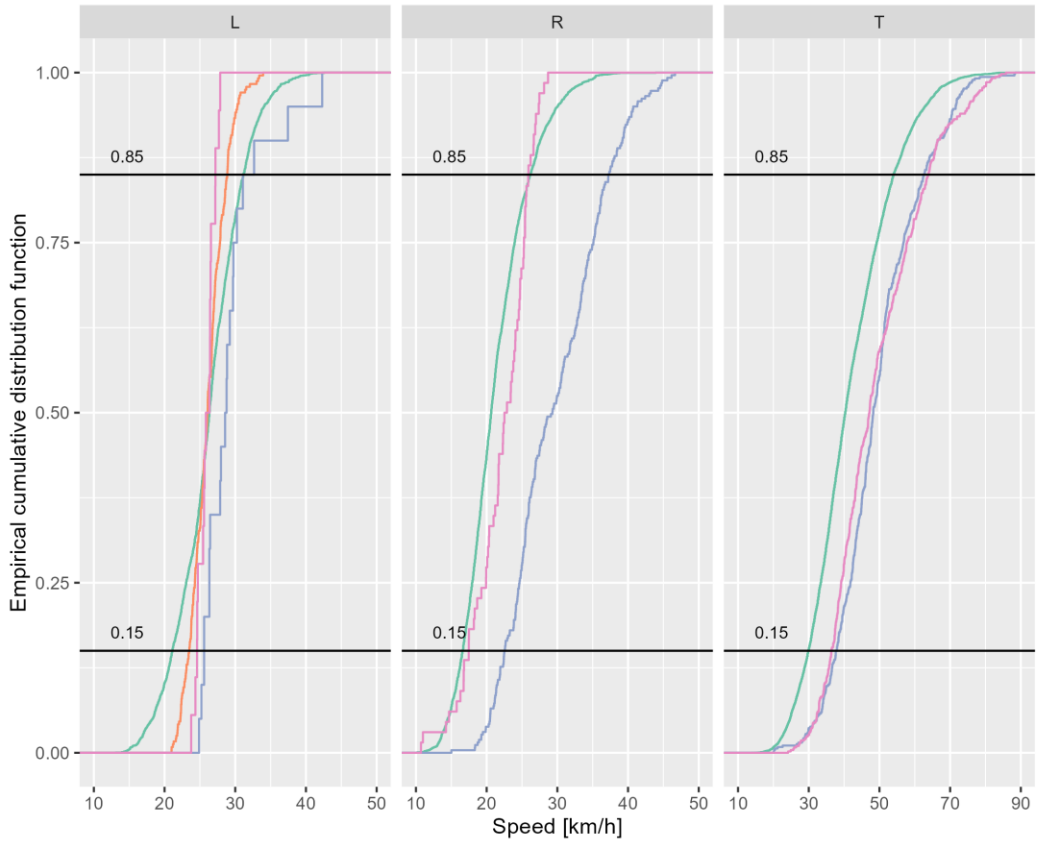
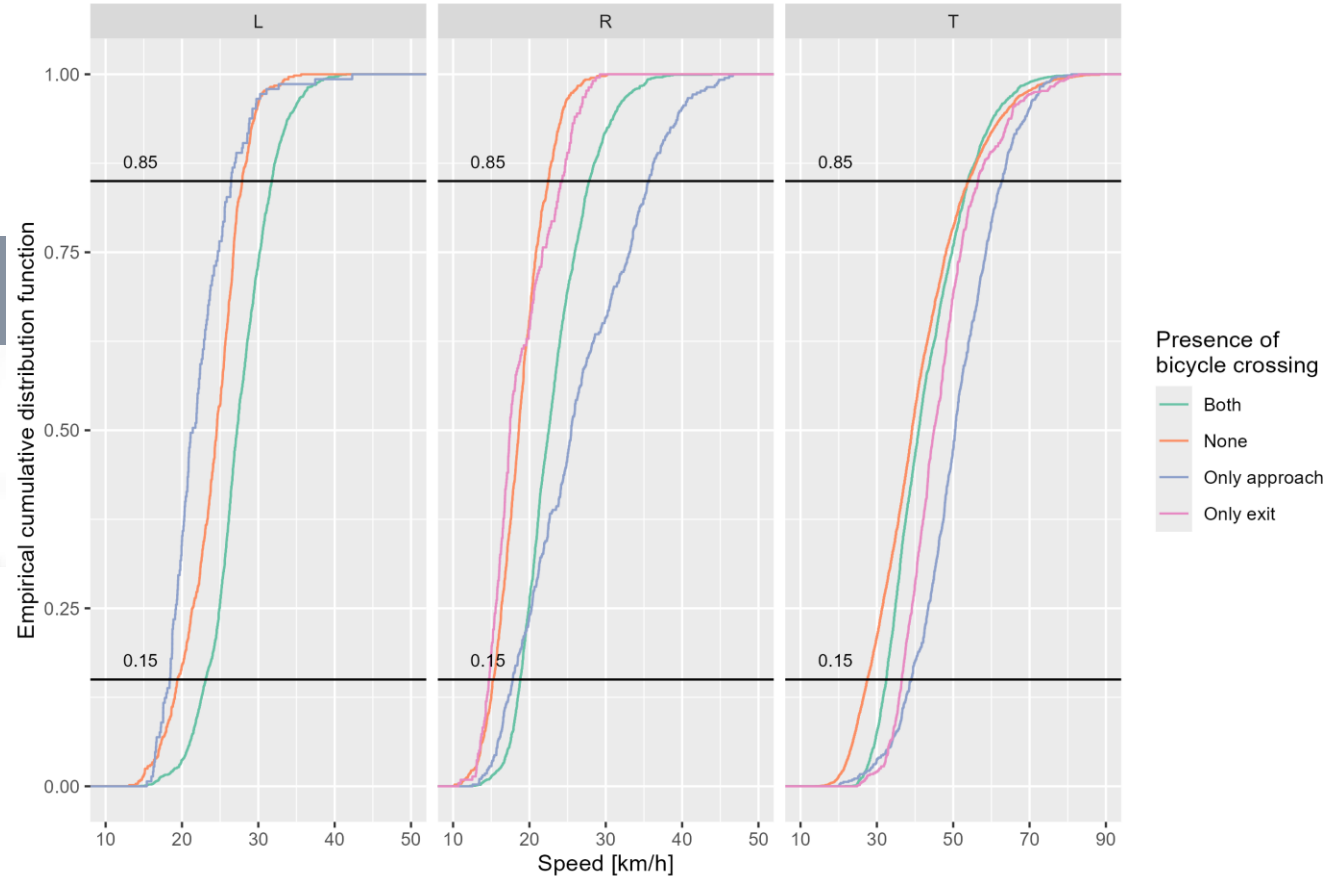
REZULTATY SZCZEGÓŁOWE





BEZPIECZEŃSTWO RUCHU DROGOWEGO

WPŁYW NA WYNIKI OBLICZEŃ TMZ

National model						Proposed model					
Basic statistic ; N = 980											
Min.	**1st Qu.**	**Med.**	**Mean**	**3rd Qu**	**Max.**	**Min.**	**1st Qu.**	**Med.**	**Mean**	**3rd Qu**	**Max.**
-4.664	2.176	3.470	3.737	5.143	12.469	-6.454	1.797	4.164	4.267	6.641	16.887

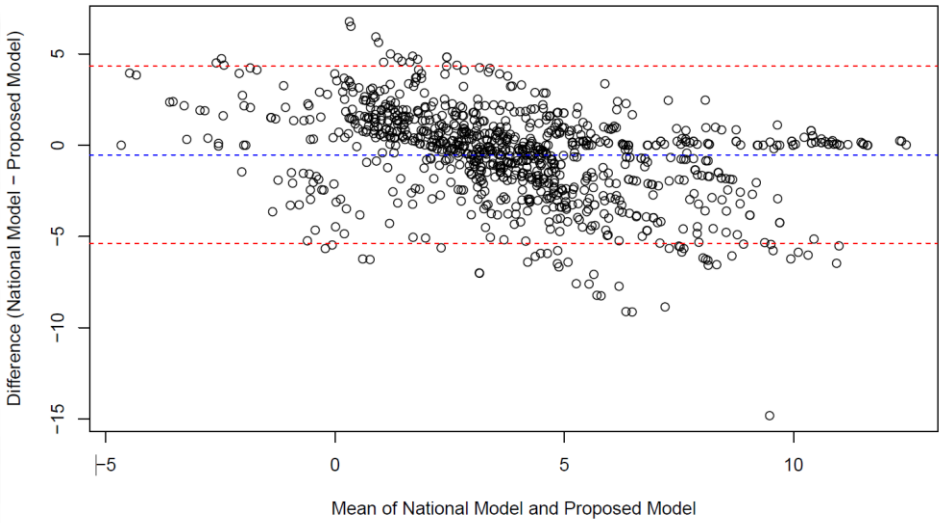
Shapiro-Wilk normality test			
W statistic	**p-value**	**W statistic**	**p-value**
0.97023	**<0.001**	0.99524	**0.004**

Wilcoxon signed rank test with continuity correction

Tested probe	V statistic	p-value
All intersection types	184,569	**<0.001**
I-1	667	**<0.001**
I-2	14,092	**0.018**
I-3	81,026	**0.001**

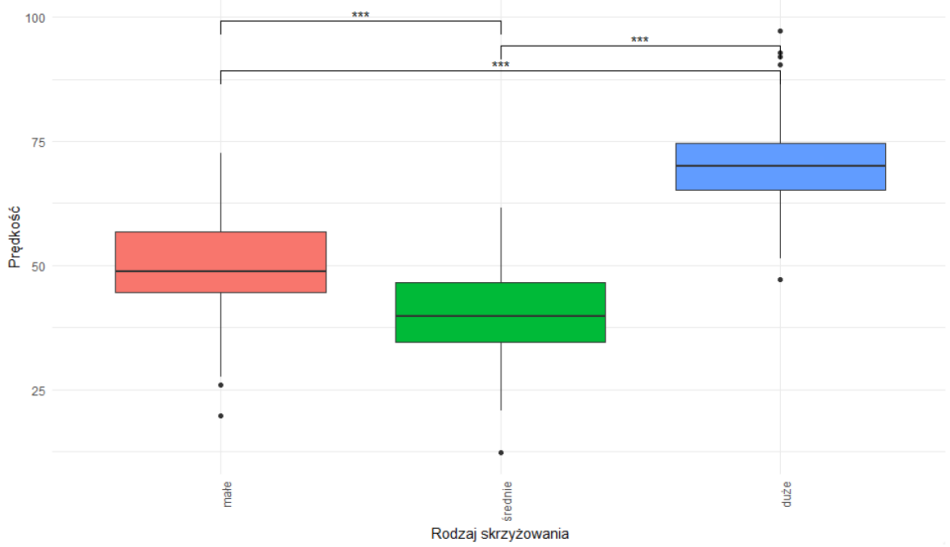
Root Mean Squared Error RMSE [s]

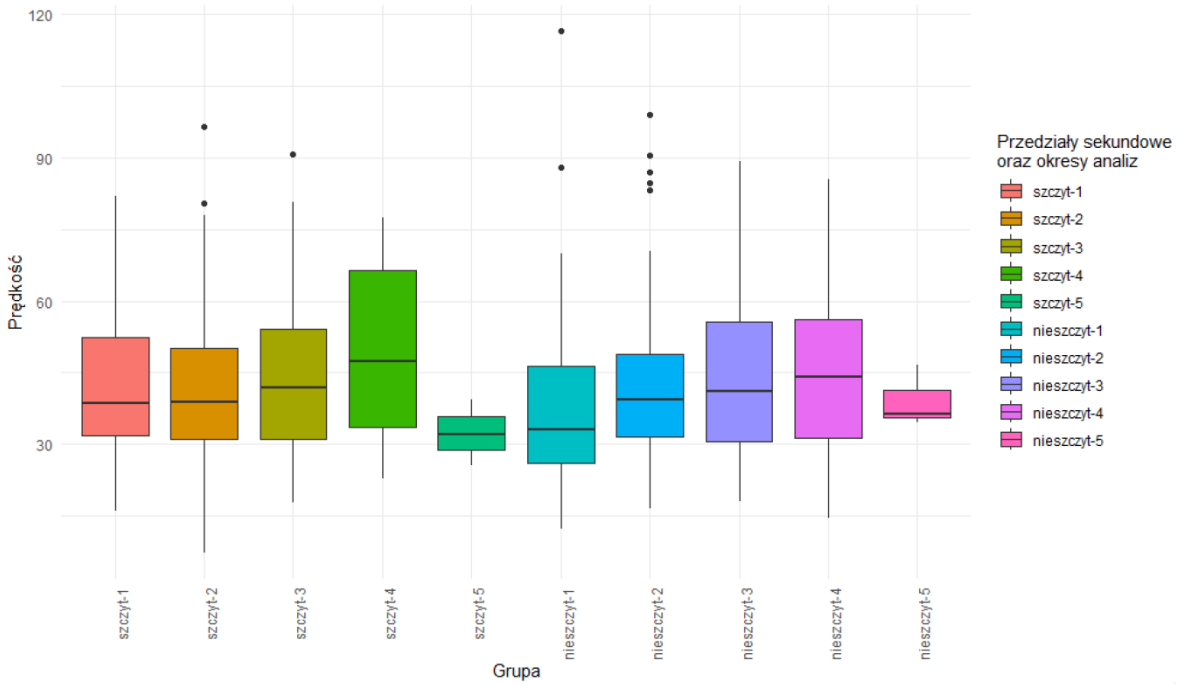
All intersection types	I-1	I-2	I-3
2.53	2.67	2.49	2.52



PODSUMOWANIE

- uzyskane prędkości są zdecydowanie niższe niż dopuszczalne,
- zasadne jest uwzględnienie tego faktu podczas obliczeń minimalnych czasów międzyzielonych,
- w badaniu różne próby dla różnych kombinacji czynników,
- wskazane badania na większej próbie,
- wskazane badania podczas ewakuacji pojazdów…





MDPI

sustainability

Article

Evaluation of selected factors affecting the speed of drivers at signal-controlled intersections in Poland

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Abstract: In traffic engineering, vehicle speed is a critical determinant of both the risk and severity of traffic incidents, a fact that holds particularly important for signalized intersections. Accurately selecting vehicle speeds is crucial not only for minimizing accident risks but also for ensuring the proper calculation of intergreen times, which directly influences the efficiency and safety of traffic flow. Traditionally, the design of signal programs relies on fixed speed parameters, such as the posted speed limit or the operational speed, typically represented by the 85th percentile speed from speed distribution data. Furthermore, many design guidelines allow for the selection of these critical speed values based on the designer's own experience. However, such practices may lead to discrepancies in intergreen time calculations, potentially compromising safety and efficiency at intersections.

Our research underscores the substantial variability in the speeds of passenger vehicles traveling intersections under free-flow conditions. This study encompassed numerous intersections with the highest incidence of accidents, using unmanned aerial vehicles to conduct surveys in three Polish cities: Toruń, Bydgoszcz, and Warsaw. The captured video footage of vehicle movements at predetermined measurement sections was analyzed to find space-speeds for various travel maneuvers through these sections, encompassing straight-through, left-turn, and right-turn relations. Our analysis focused on how specific infrastructure-related factors influence driver behavior. The following were evaluated: intersection type, traffic organization, approach lane width, number of lanes, longitudinal road gradient, trams or pedestrian or bicycle crossing presence, and even roadside obstacles such as buildings, barriers or trees and others. The results reveal that these factors significantly affect drivers' speed choices, particularly in turning maneuvers. Furthermore, it was observed that the average speeds chosen by drivers at signalized intersections did not reach the permissible speed limit of 50 km/h as established in typical Polish urban areas.

A key outcome of our analysis is the recommendation for more precise speed model that contribute to the design of signal programs, enhancing road safety and aligning with sustainable transport development policies. Based on our statistical analyses, we propose adopting more sophisticated model to determine actual vehicle speeds more accurately. It was proved that using the developed model, the results of calculating the intergreen times are statistically significantly higher. This recommendation is particularly pertinent to the design of signal programs. Furthermore, by improving speed accuracy values in intergreen calculation models with a clear impact on increasing road safety, we anticipate reductions in operational costs for the transportation system with, contributing to both economic and environmental goals.

Keywords: driver behavior, traffic lights, traffic safety, intergreen time, velocity

Citation: To be added by editorial staff during production.

Academic Editor: Firstname Last-name

Received: date
Revised: date
Accepted: date
Published: date

DZIĘKUJEMY ZA UWAGĘ

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