

What is the area of influence of a vehicle on the road? Theoretical Aspects and Some Empirical Findings



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Presentation Outline

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2. Existing Scientific Work
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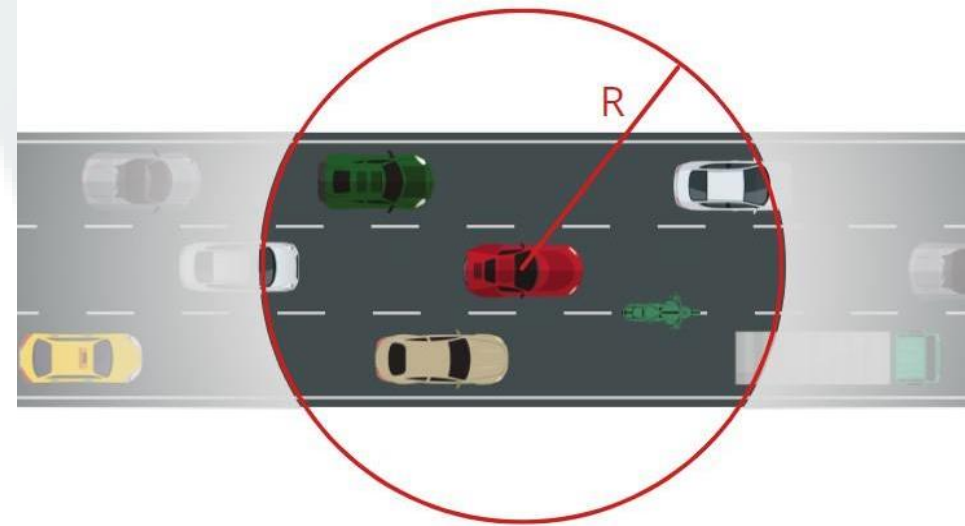


Introduction

- In the future, each vehicle (sender) exchanges messages with its surrounding vehicles (receivers) within the transmission range of the wireless network.
- The range of this vehicular network can be computed through the estimation of the **area of influence** of a man-driven vehicle.

Area of Influence:

The area around the sender inside of which all vehicles influence each other.





Existing Scientific Work

- ❖ The majority of the studies consider the range of the wireless communication network as a fixed number from 140m to 300m.
- ❖ Information theory mainly applied on the short-term traffic flow prediction.



There is a need to compute the range of a vehicular network, not by assuming it as a fixed number, but through the estimation of the area of influence.

Aim of Research

Detailed Vehicle Data

Information Theory

Estimation of the Area of Influence of
a conventional vehicle

Vehicle Type

Road Density



Methodological Approach

Mutual
Information
(MI) between
pairs of
vehicles

Mean of the
MI of the ego-
vehicle with its
neighbors

Critical radius
Estimation

Analysis
Results

Data

Pneuma Dataset

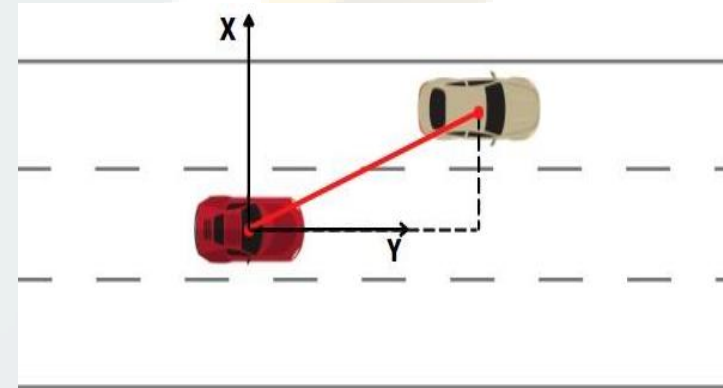
Vehicle I.d.	Vehicle Type	X coordinate	Y coordinate	Speed	Longitudinal Acc.	Lateral Acc.	Time
63	4.00000	2890133.79511	2040849.54281	30.79690	-0.20700	0.11080	1600.00000
64	2.00000	2890133.78080	2040919.92222	11.34350	-0.17740	-0.02060	1600.00000
65	6.00000	2890128.47145	2040992.11787	0.00000	0.00000	0.00000	1600.00000
66	1.00000	2890129.73483	2040997.85672	5.02250	-0.34840	-0.00060	1600.00000
67	5.00000	2890129.93406	2041021.98358	17.83100	0.01960	1.77190	1600.00000

Implementation

- Defining the **neighboring vehicles** of each vehicle

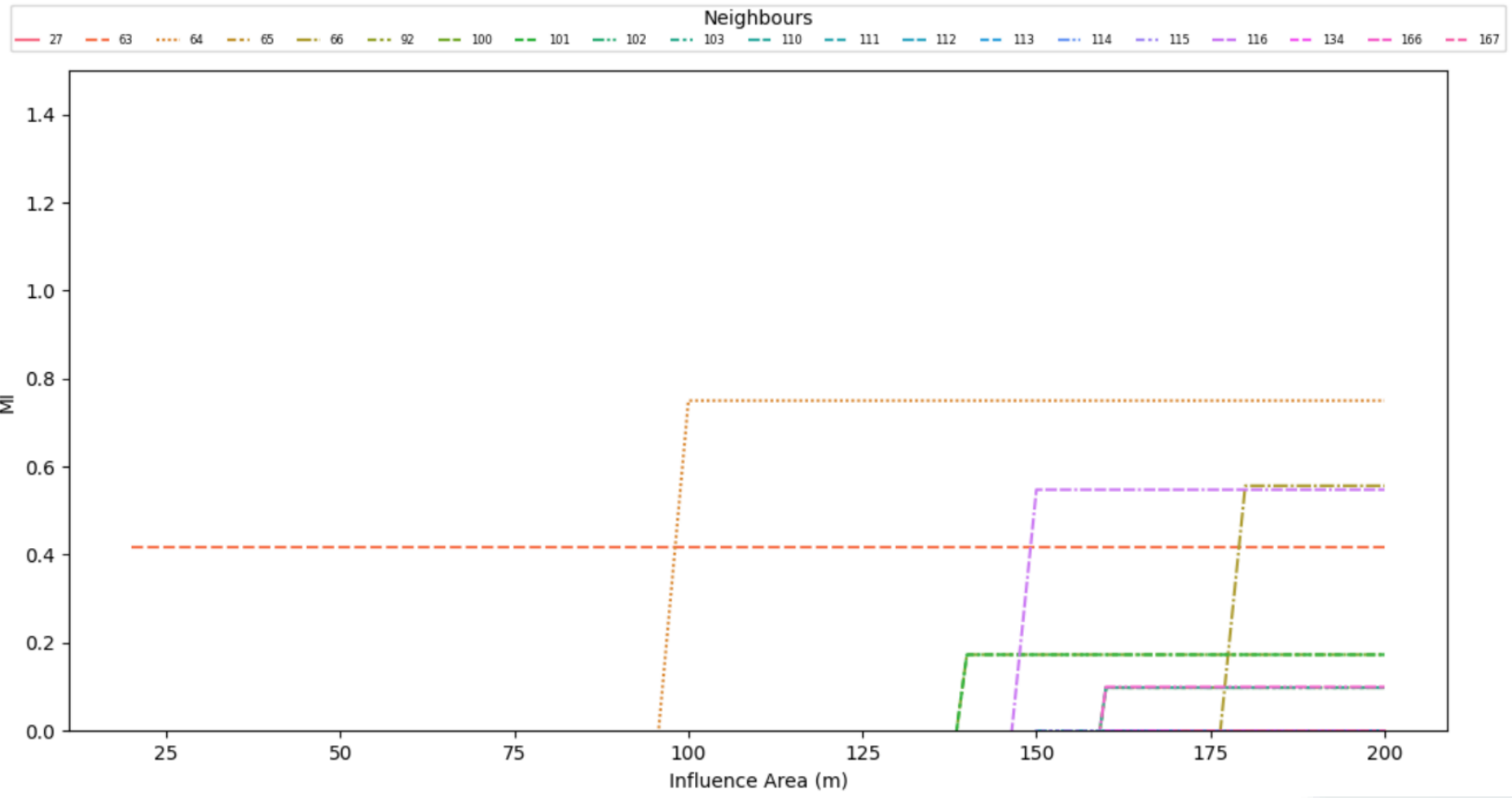


The vehicles whose distance from the ego-vehicle is within the examining radius (10-200m) for at least 13 consecutive dataset points.



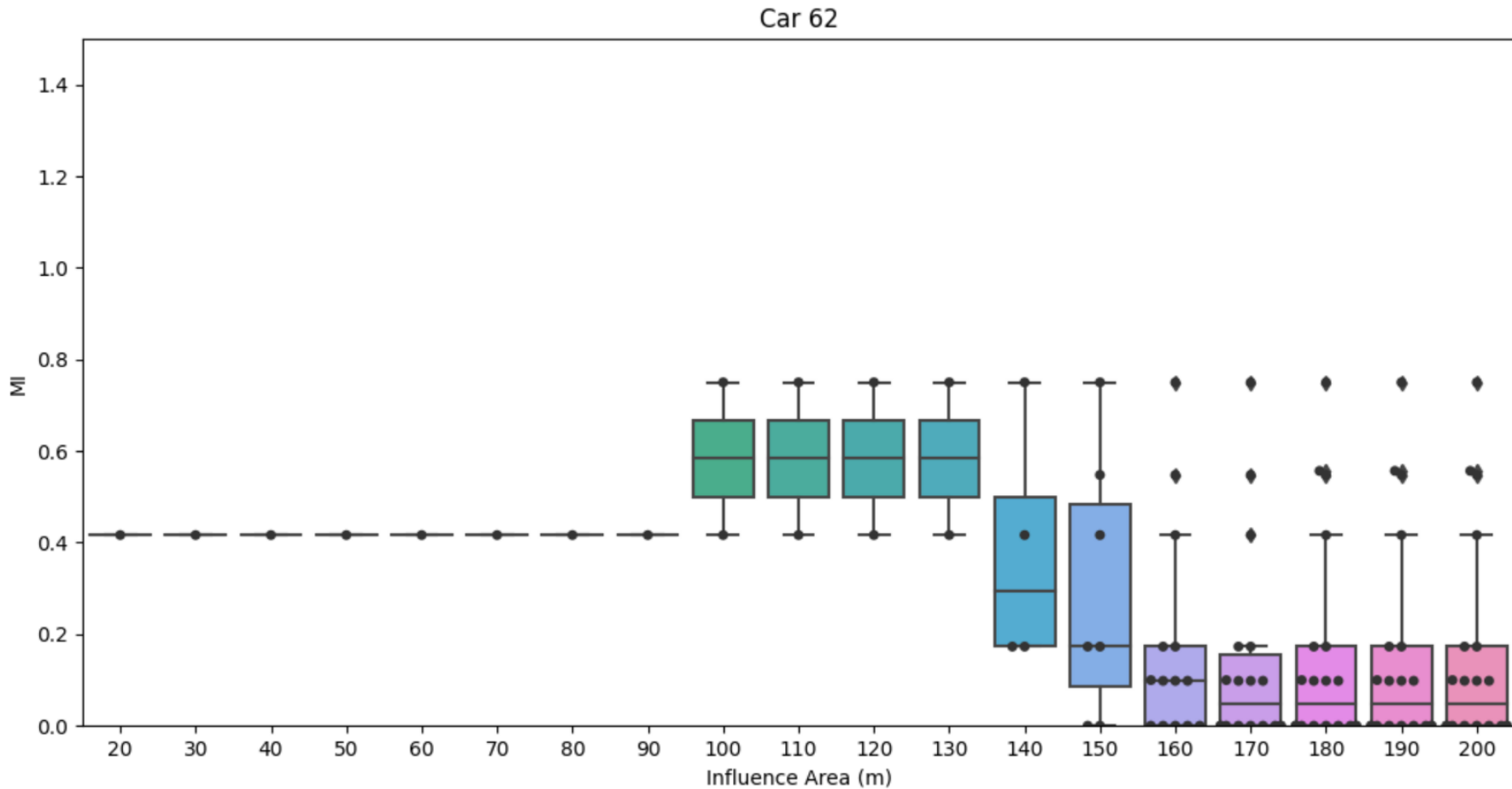
- Computation of the MI of the ego-vehicle with each neighbor vehicle individually
- Minimum value of the average of MI ego-vehicle shared with neighboring vehicles ← **critical radius**

Results (1)



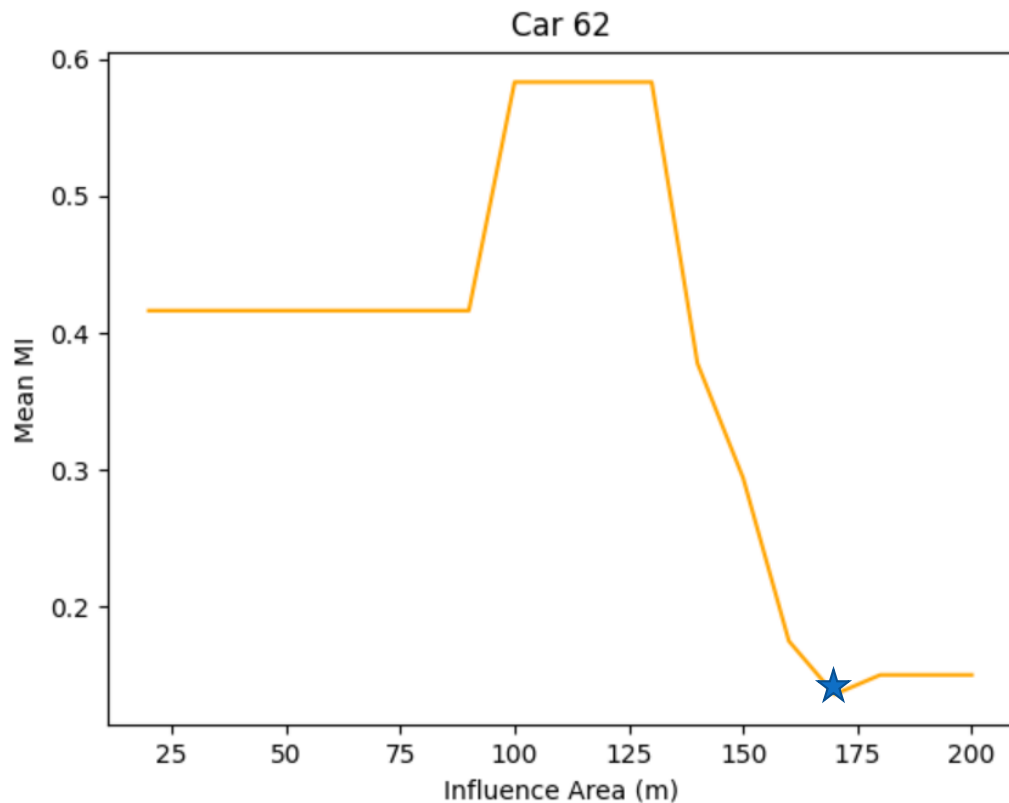
Neighbors line plot for car 62 at first time period

Results (2)



Neighbors box plot for car 62 at first time period

Results (3)



Mean MI for every radius value for car 62, 1st period

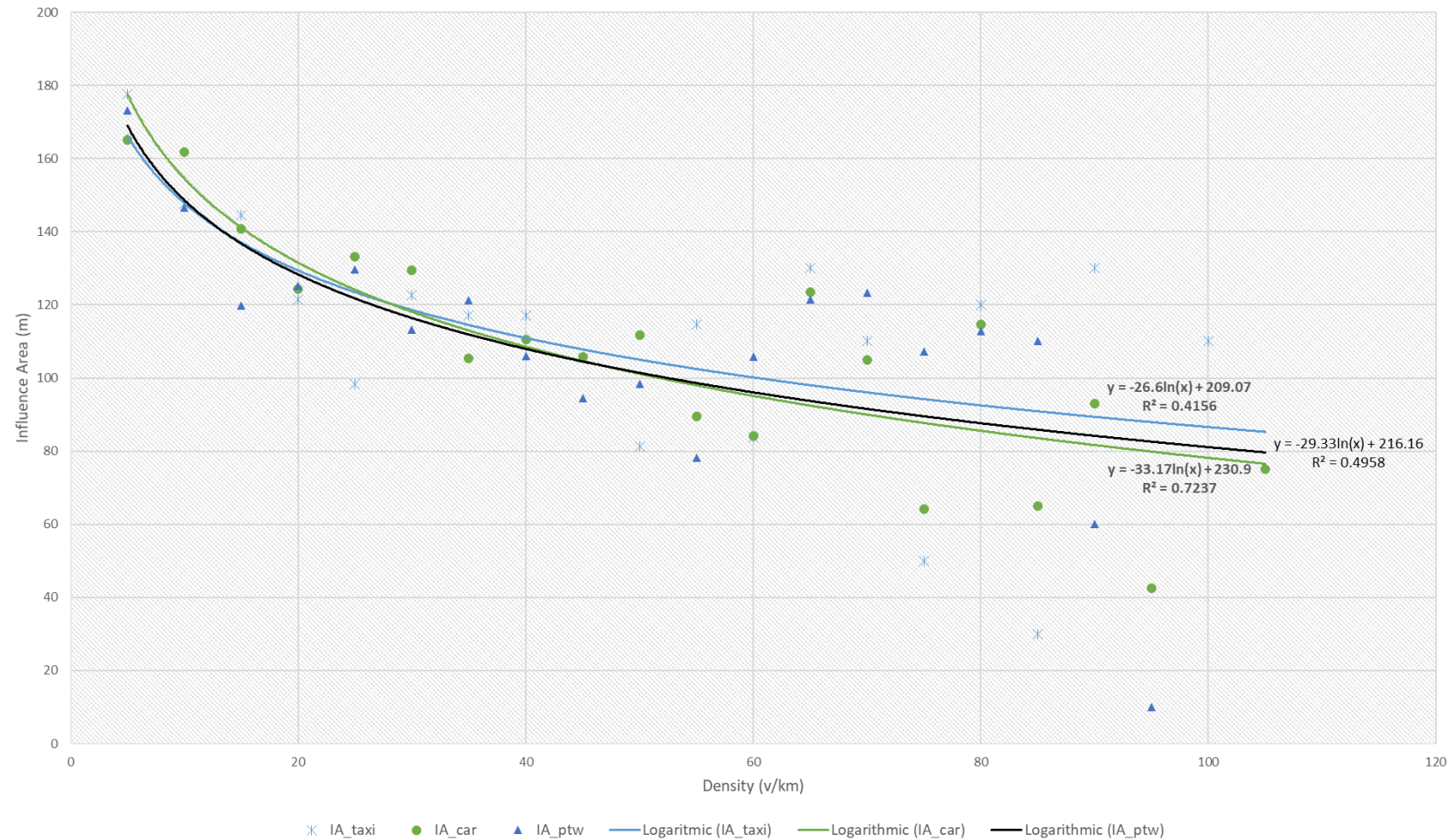


Time Period	Vehicle I.d.	Vehicle Type	Road Density (v/km)	Influence area (m)
1	27	1	60	10
1	44	2	15	150
1	45	2	10	30
1	48	2	20	50
1	54	2	20	200
1	62	2	10	170

Results analysis with respect to the vehicle type and road density

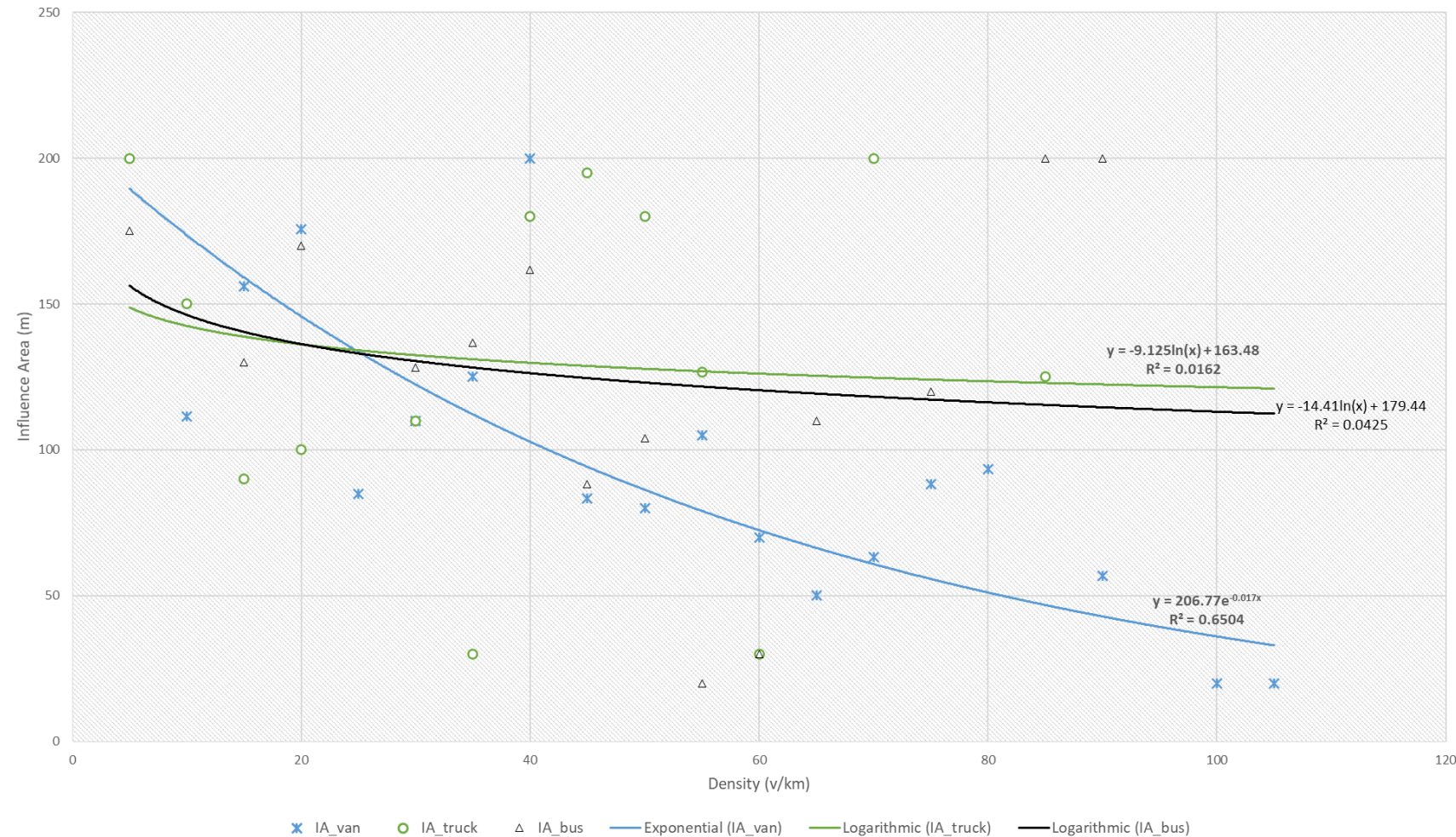
Results (4)

- Logarithmic equations of power-two wheelers, cars and taxis
- Coefficient R^2
 - Cars: $R^2 = 0.50$
 - PTW: $R^2 = 0.72$
 - Taxis: $R^2 = 0.42$
- Downward trend



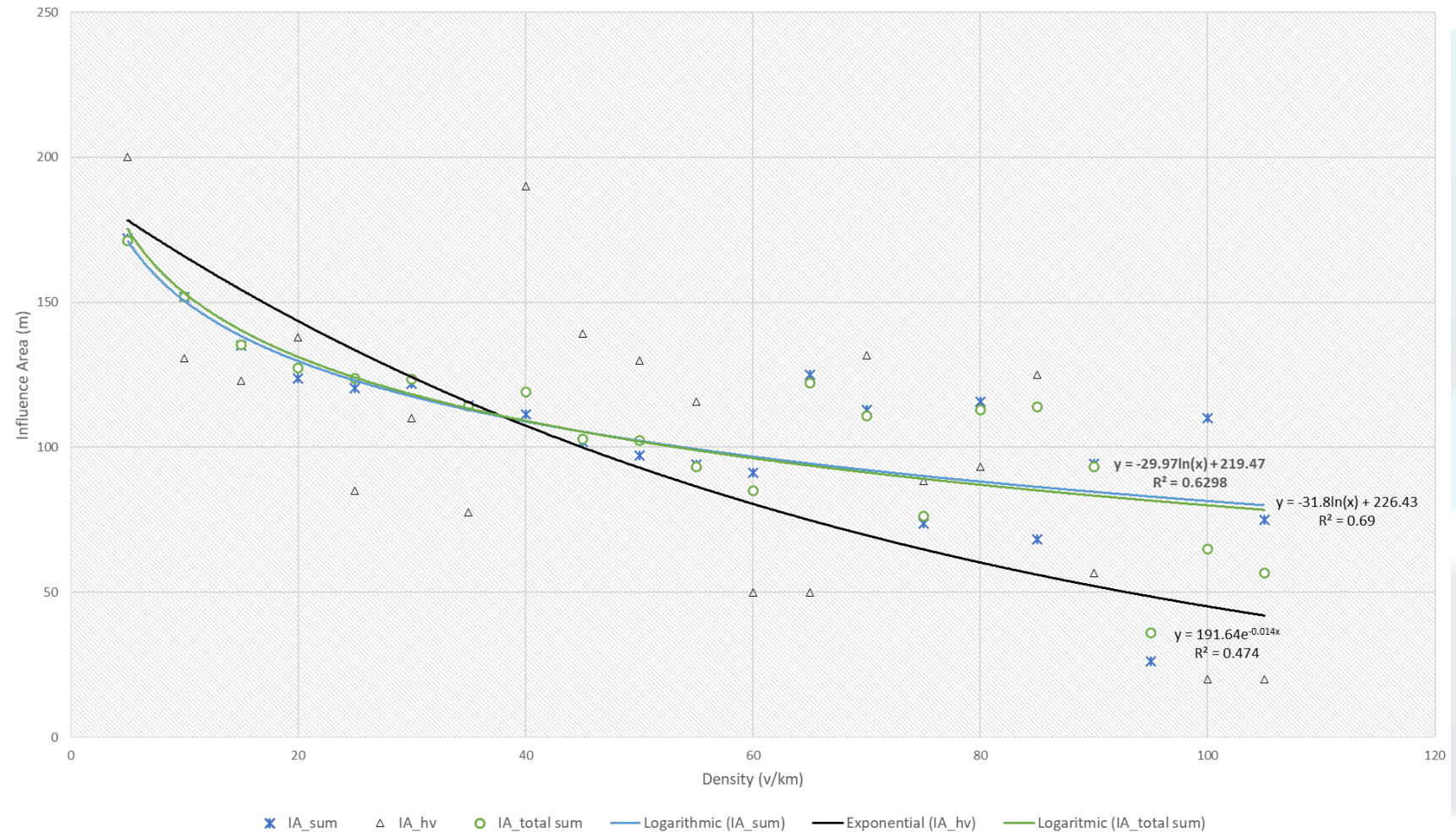
Results (5)

- Logarithmic and exponential equations of trucks, buses and vans
- Coefficient R^2
 - Trucks: $R^2 = 0.0$
 - Buses: $R^2 = 0.0$
 - Vans: $R^2 = 0.65$
- Downward trend only for the vans.



Results (6)

- Logarithmic and exponential equations of vehicles' sets.
- Resulting equation of all vehicles describes 70% of the cases.





Conclusions

Speed capable of providing reliable results.

Road density is an important factor of the area of influence for vehicles as a whole.

Buses and trucks seem to be slightly depended on the road density.

The results presented reliable for all vehicle types except for the trucks and the buses.



Future work



Results analysis based on other factors

Evaluation of the use of different traffic parameters as metrics

Control strategies for both manually driven and autonomous vehicles in a simulation environment

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Thank you for your attention.