



# Assessment of speed variance

In Response to GRVA-17-11

(TF ADAS issues to seek guidance from GRVA)

*EC JRC with the support of UTAC*

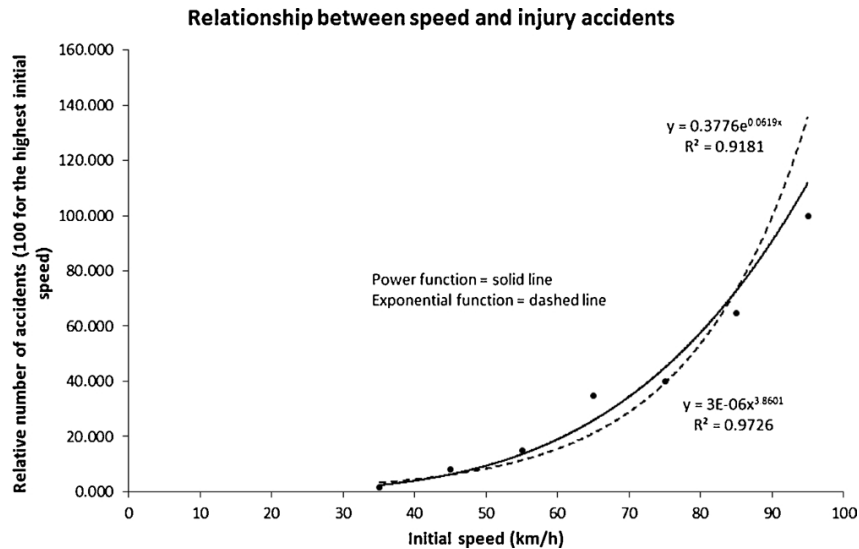
# Content

- Influential factors
- Statistical model
- Experience from Intelligent Speed Assistance (ISA) from UTAC (FR)
- Estimation of risk of perturbed traffic flow

# Influential factors of risk of crash

## Mean speed

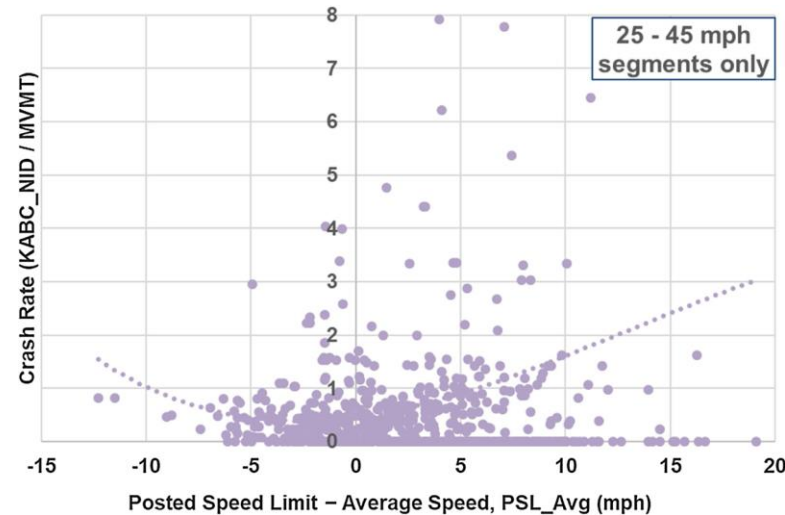
$$\text{Risk} \sim \exp(\alpha \text{ Mean}(v))$$



compare the average speed and the number of crashes before and after a speed management measure

## Mean speed, speed variation(s)

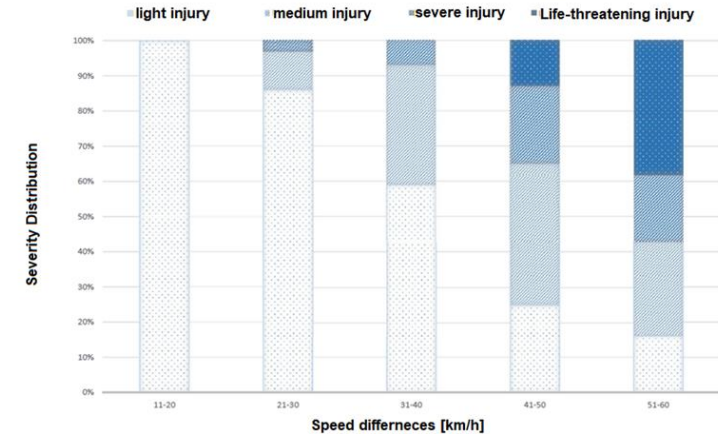
$$\text{Risk} \sim \exp(\alpha \text{ Mean}(v) + \beta \text{ Std}(v))$$



Path analysis of traffic flow

## Speed difference

$$\text{Risk} \sim v^2$$



$$\Delta v = V_{\text{post impact}} - V_{\text{pre impact}}$$

Forensic and accident reconstruction experts to describe accident severity

Source: JRC - UNR157-07-09

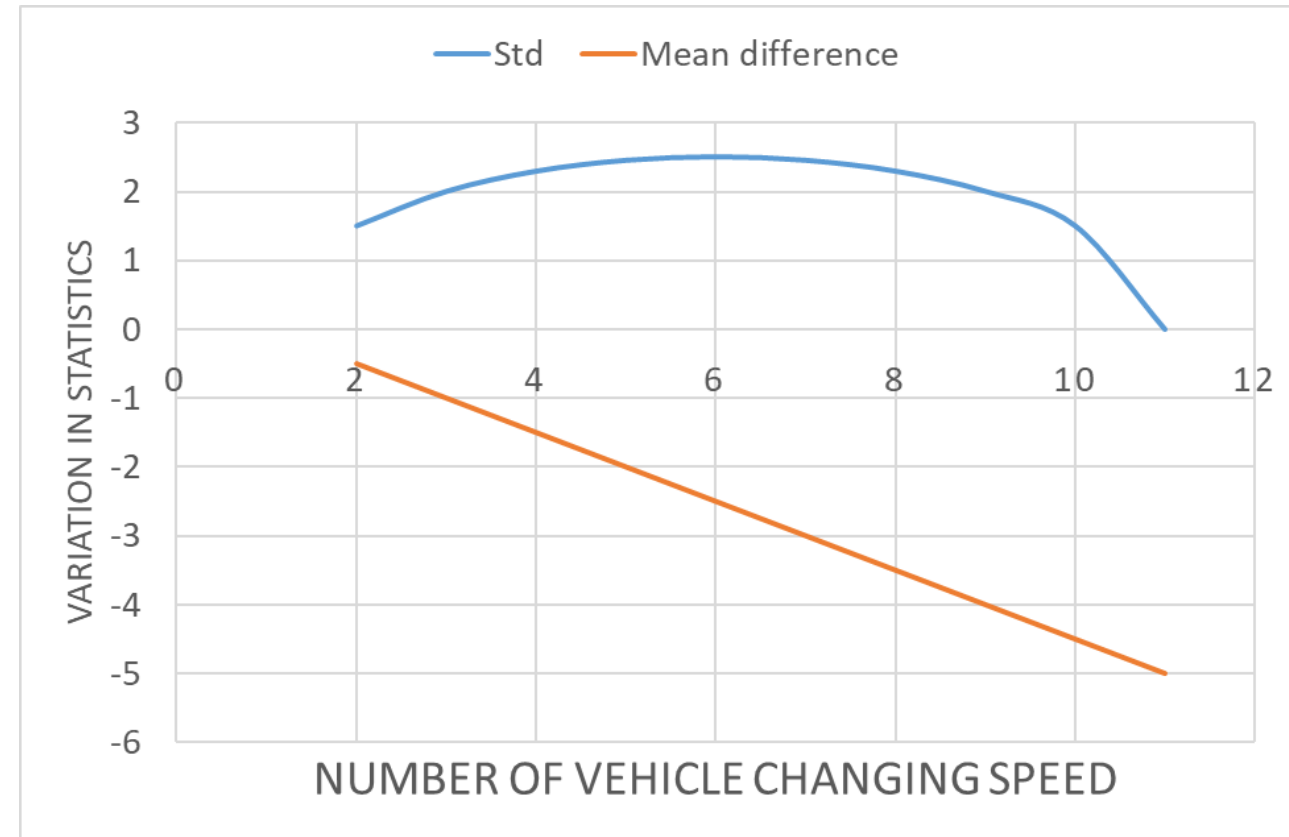
# Speed variation in traffic flow

- speed differences among vehicles
- speed changes of individual vehicles
- between lanes speed variance

Wang et al, Accident Analysis and Prevention 113 (2018)  
Choudharya, Accident Analysis and Prevention 121 (2018)

Simple model:

- All travelling at the same speed at the beginning
- 10 vehicles in the lane
- 5 km/h speed reduction per vehicle



# Experience from ISA

City Entrance and Exit – No traffic sign



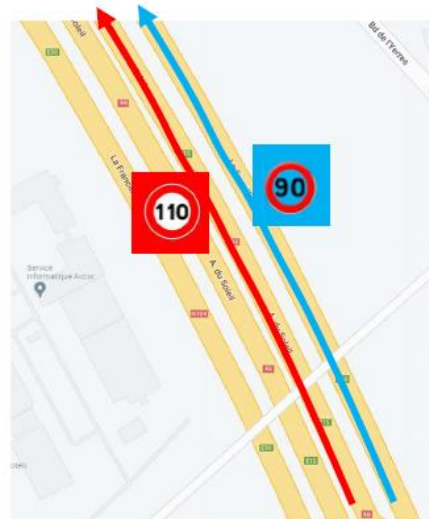
Traffic sign is missing in our direction but is presented in opposite direction

ISA regulation asks to exclude in this case. Some system could continue to limit at 30kph for a long time.

Traffic sign mis use– adjacent lane



Traffic sign for adjacent road is recognized.



Human driver could also be wrong, regulation asks to exclude.

## ISA

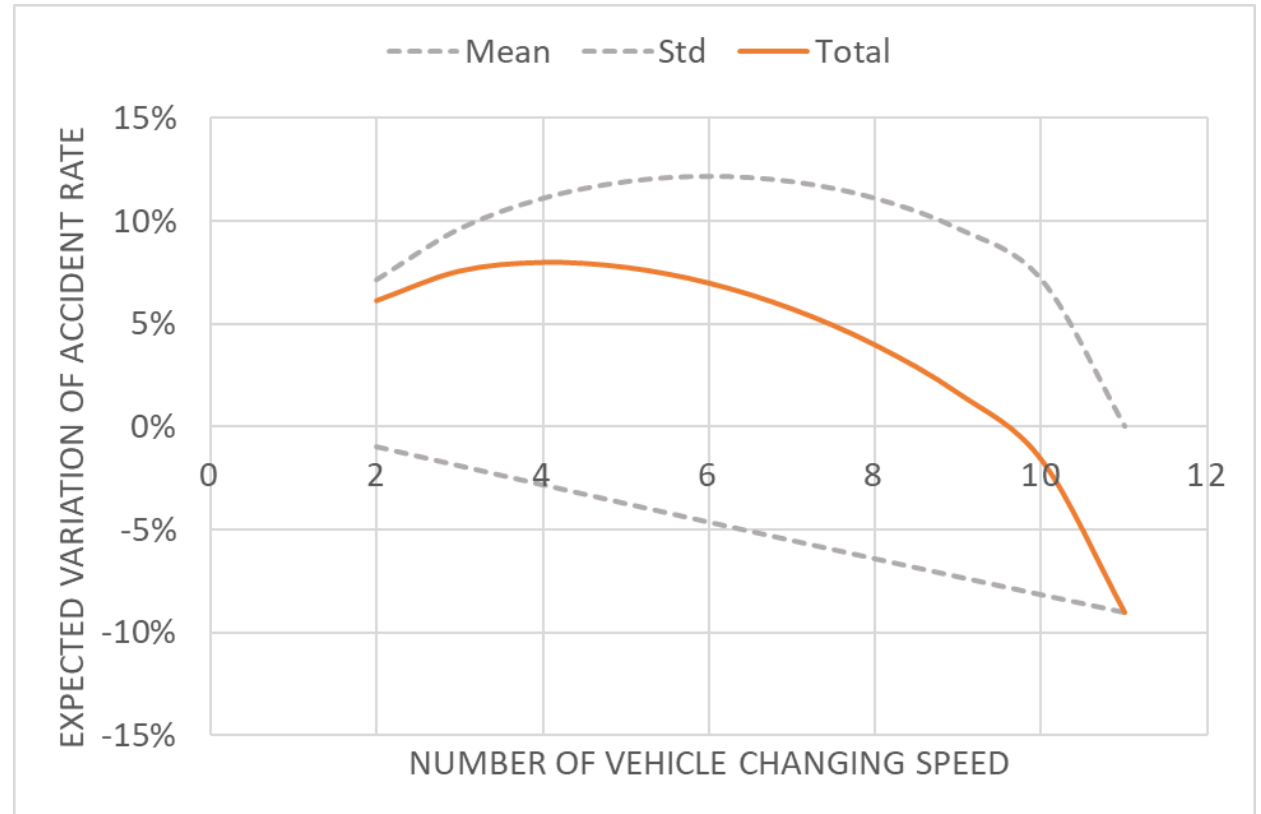
- §5.3.1 – Traffic sign is partly obstructed or clearly not well positioned
- §5.3.2 – Traffic sign is missing or positioned ambiguously
- §5.3.3 – Ambiguous, additional, complementary or diverging informations

- According to UTAC internal procedure to conduct the test:
- Latest test campaign shows following rate: **40km over 400km 10% is excluded** from the calculation of the system performance

# Effect of unintended speed reduction

- 1% increase in mean speed resulted 0.7% increase in crash frequency
- 1% increase in speed variation resulted in 0.74% increase in crash frequency

Wang et al, Accident Analysis and Prevention 113 (2018)



Simple model:

- All vehicles travelling at the same speed at the beginning
- 10 vehicles in the lane
- 5 km/h speed reduction per vehicle

# Summary

- String (in)stability is an important factor to be considered in reduction of crashes. The chance of unintentional speed change shall be minimised
  - Mattas et al., <https://doi.org/10.1016/j.trb.2023.102785>
  - Ciuffo et al., <https://doi.org/10.1016/j.trc.2021.103305>
- ISA field experience: 10% ambiguous cases are excluded from the performance calculation
- 90 % correct recognition is required (ISA)
- **Human supervision of speed limit detected by the system is essential before it is applied**
- Speed management measures shall be applied to all vehicles

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# Thank you



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