VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

The significance of forefront road identification for vehicle dynamics and safety

Išankstinio kelio identifikavimo reikšmė automobilio dinamikai ir saugumui

Dr. Vidas Žuraulis

Faculty of Transport Engineering

2018, Vilnius

Meaning of road identification

Merlin machine

Walking profilometers

Comfort
Safety
Stability

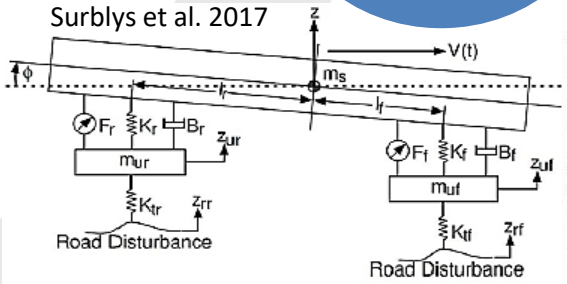
STATIC

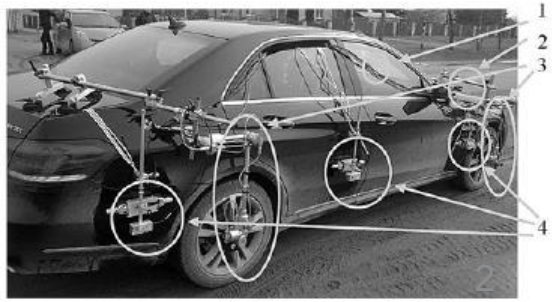
DYNAMIC

Barbosa 2012

RST 28

Surblys et al. 2017



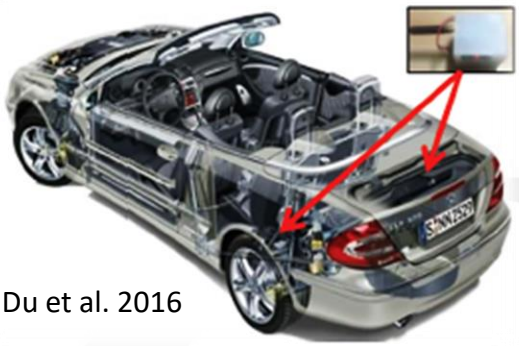


Meaning of road identification

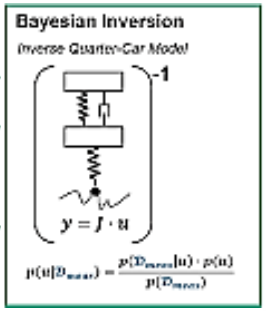
Comfort
Safety
Stability

- System real time adaptation
- System adaptation in advance
- System external informing

Real time operation



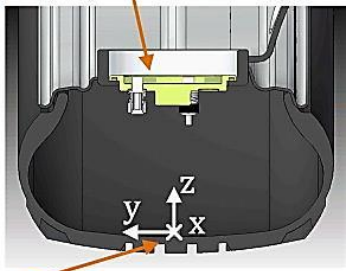
Du et al. 2016



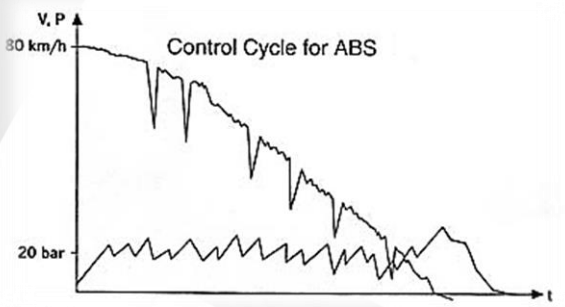
Burger et al. 2018

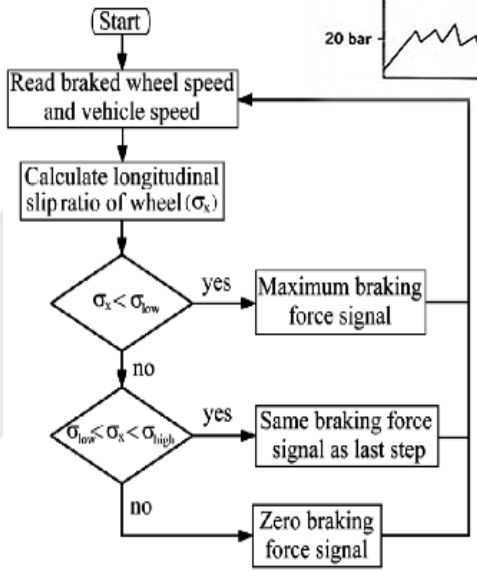
System real time adaptation

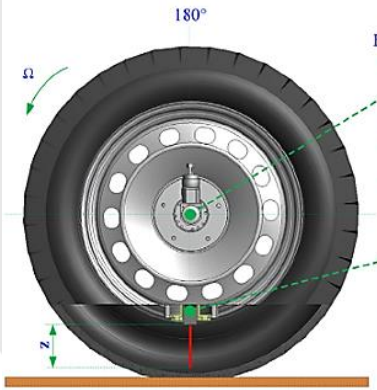
- **Acceleration**
- **Displacement**
- **Initial iterations**



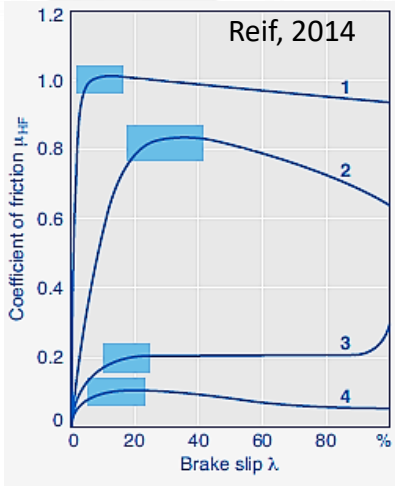
Tuononen et al. 2017



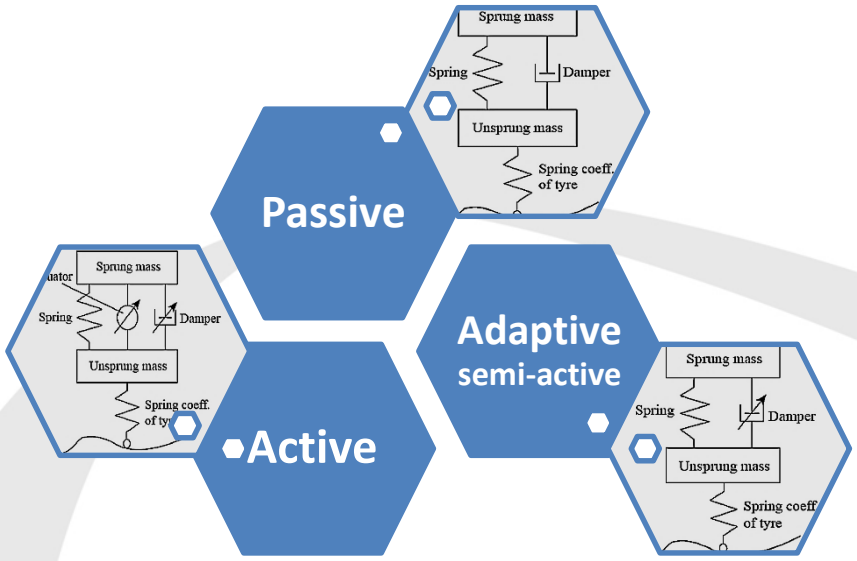




SKF



Forefront sensing



System real time adaptation

- Acceleration
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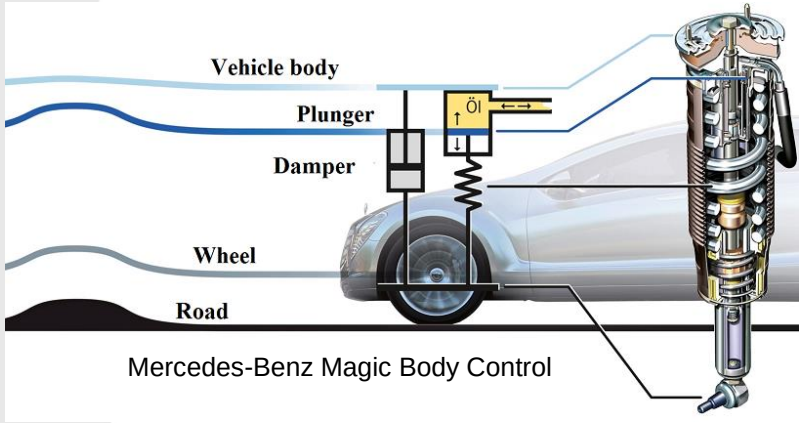
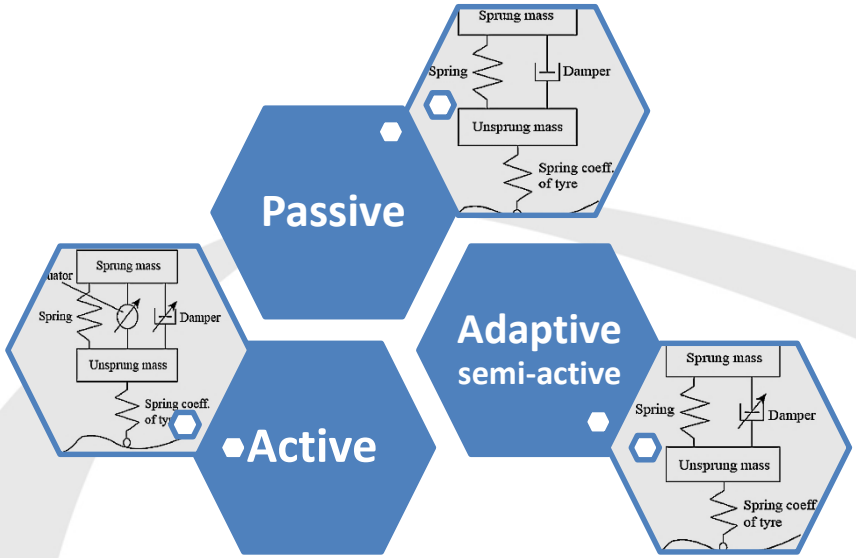
System adaptation in advance

- **Laser scanning**
- **Image analysis**



Mercedes-Benz Magic Body Control

Forefront sensing



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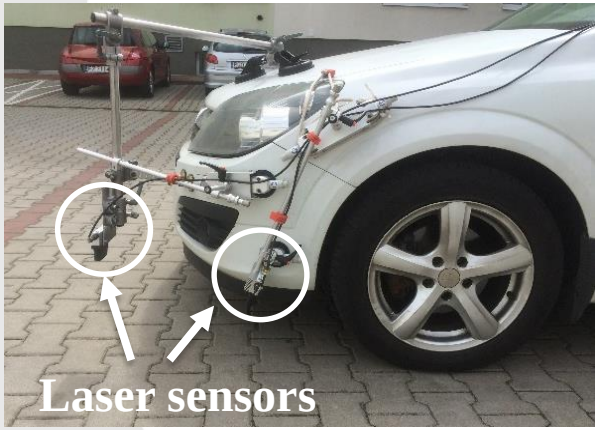
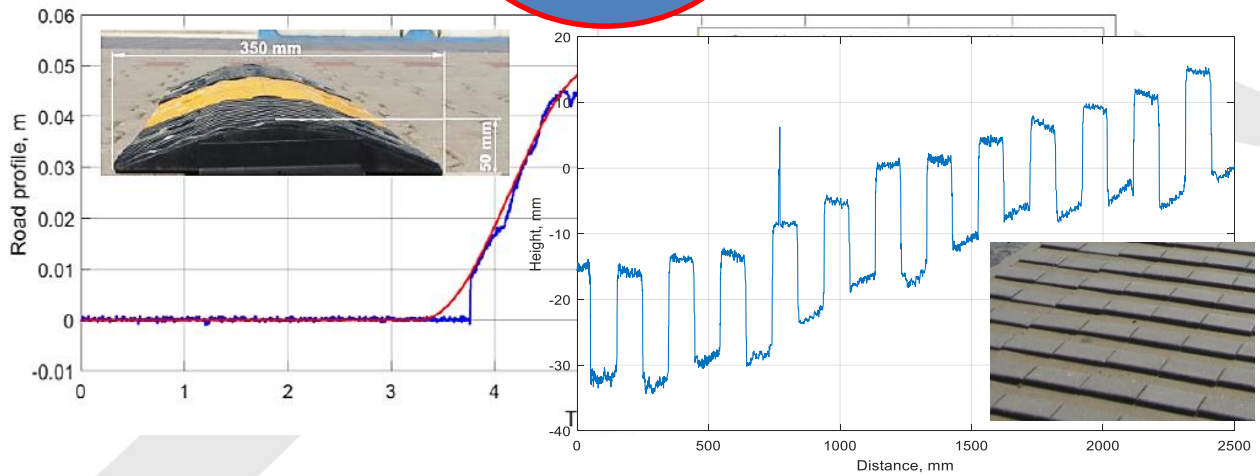
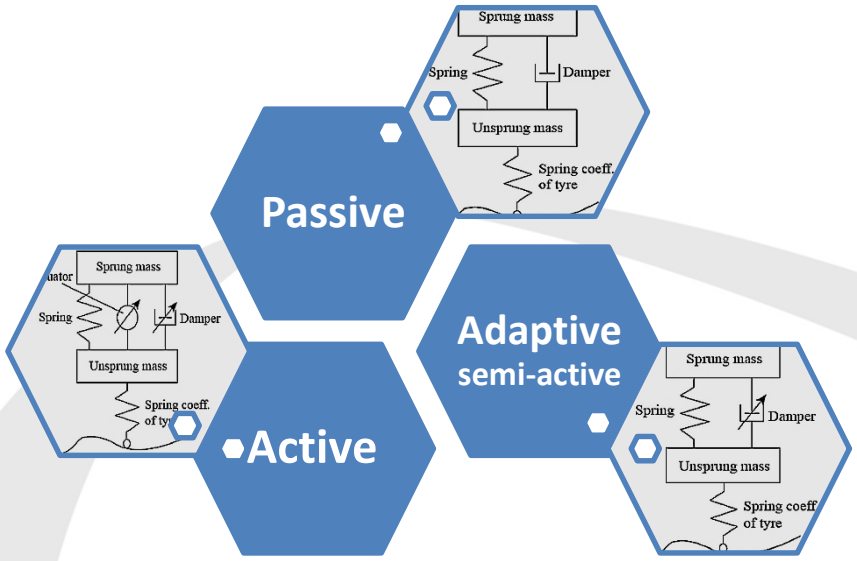




Forefront sensing



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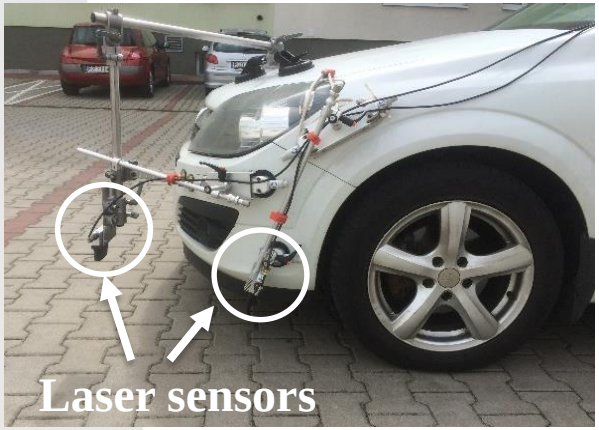

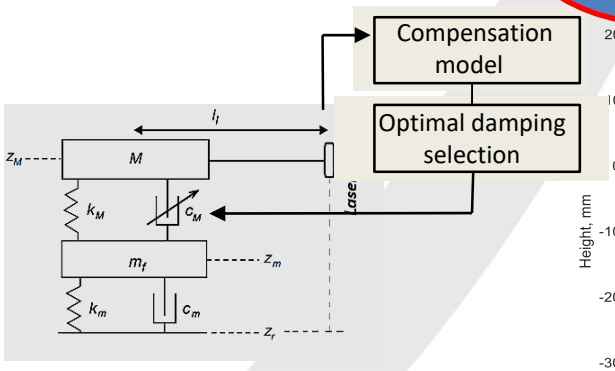

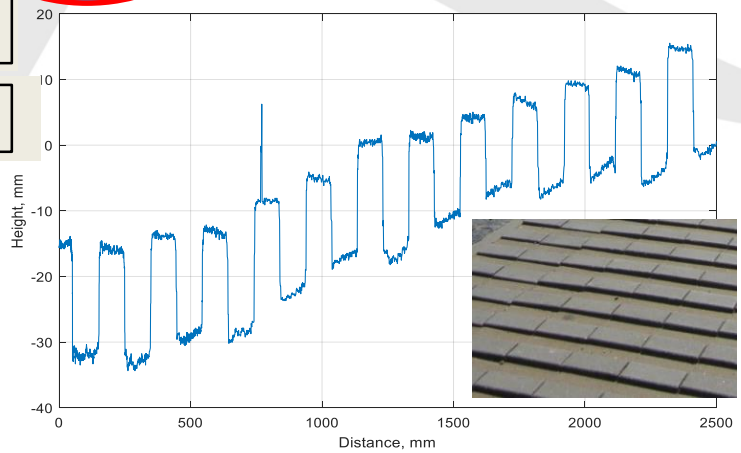

Forefront sensing

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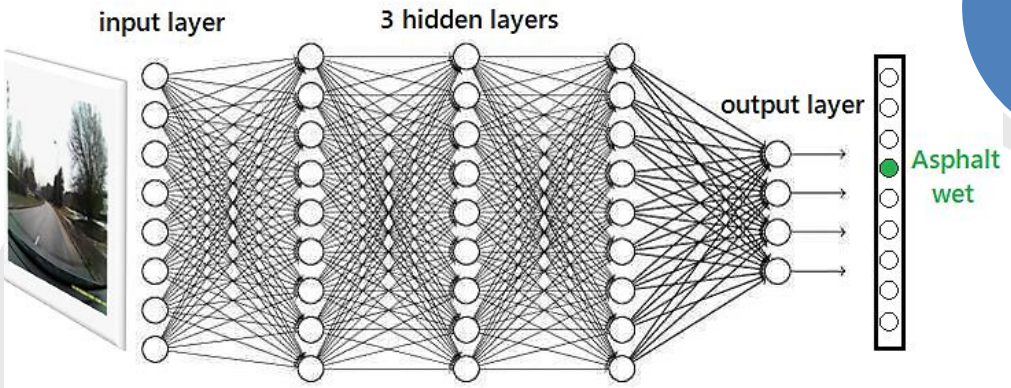
- **Image analysis**

- **Artificial intelligence**
- **Deep Neural Networks**
- **Dataset of 250K+ images created**
- **12 different road surface types**

Forefront sensing



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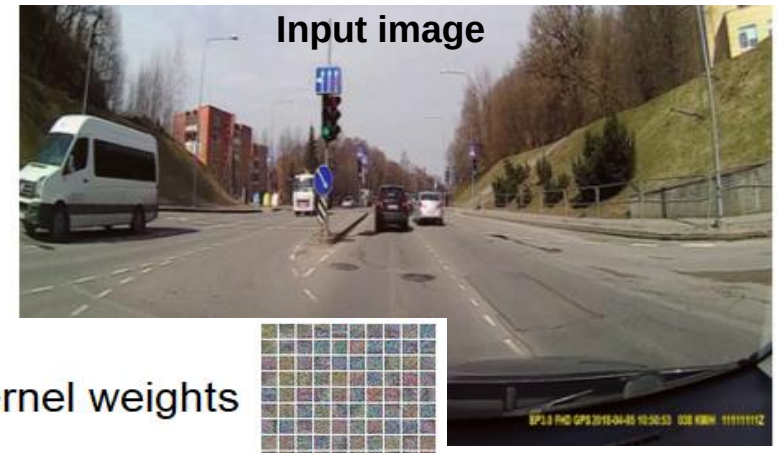
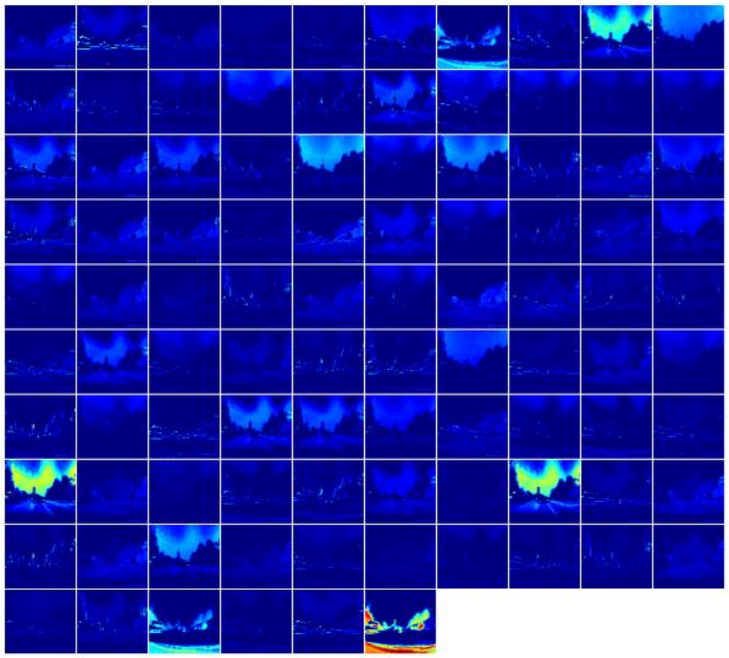


Kernel weights

Feature maps



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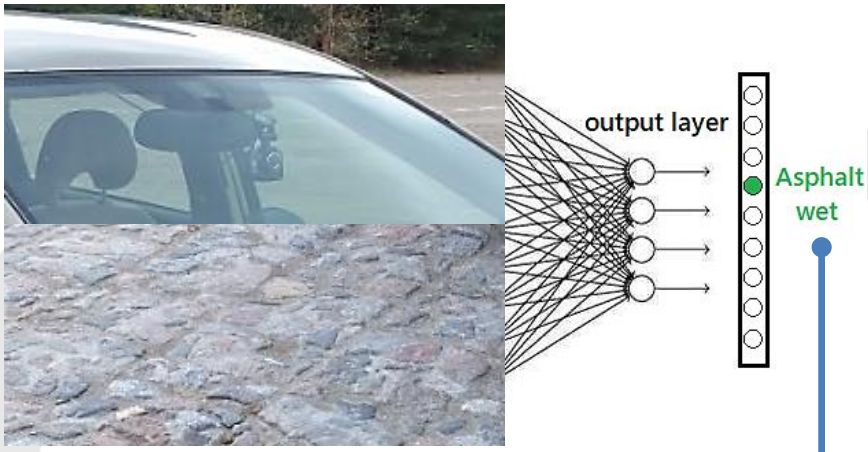
Forefront sensing

Forefront sensing

- **Autonomous emergency braking (AEB)**
- **Adaptive cruise control (ACC)**



System real time adaptation

- Acceleration
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System adaptation in advance

- Laser scanning
- **Image analysis**

$$\mu$$

$$a_{max} = \mu g$$

$$S_{min} = v_o t_r + \frac{v_o^2}{2a_{max}}$$

$$TTC_{min} = \frac{S_{min}}{v_{rel}}$$

$$TTC_{min} \geq TTC$$

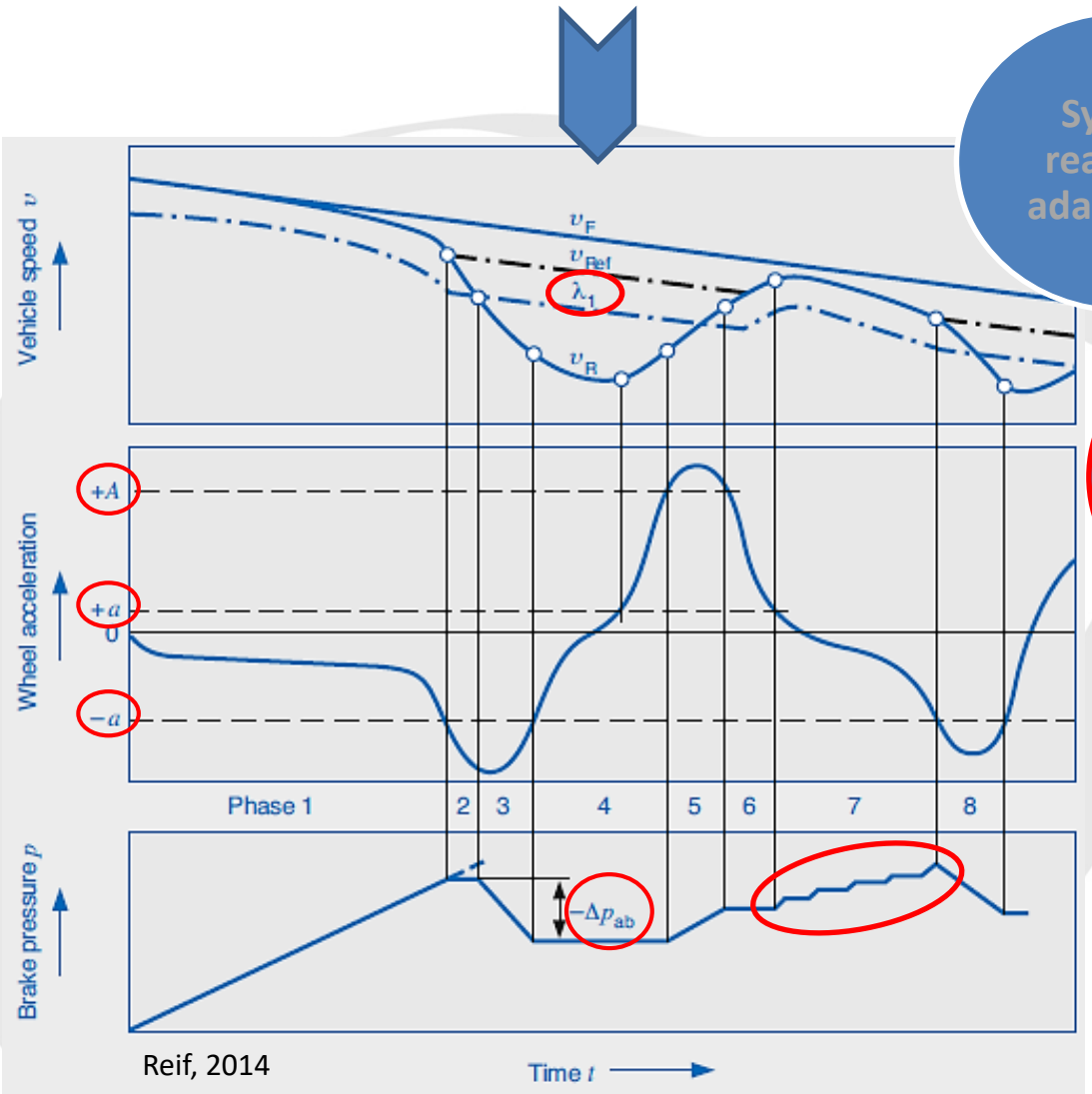
Yes

Full braking

$$TTC = \frac{S_{rel}}{v_{rel}}$$ (0,8-3,05 s)

Forefront sensing

Pavament friction from image analysis



Reif, 2014

System real time adaptation

- Acceleration
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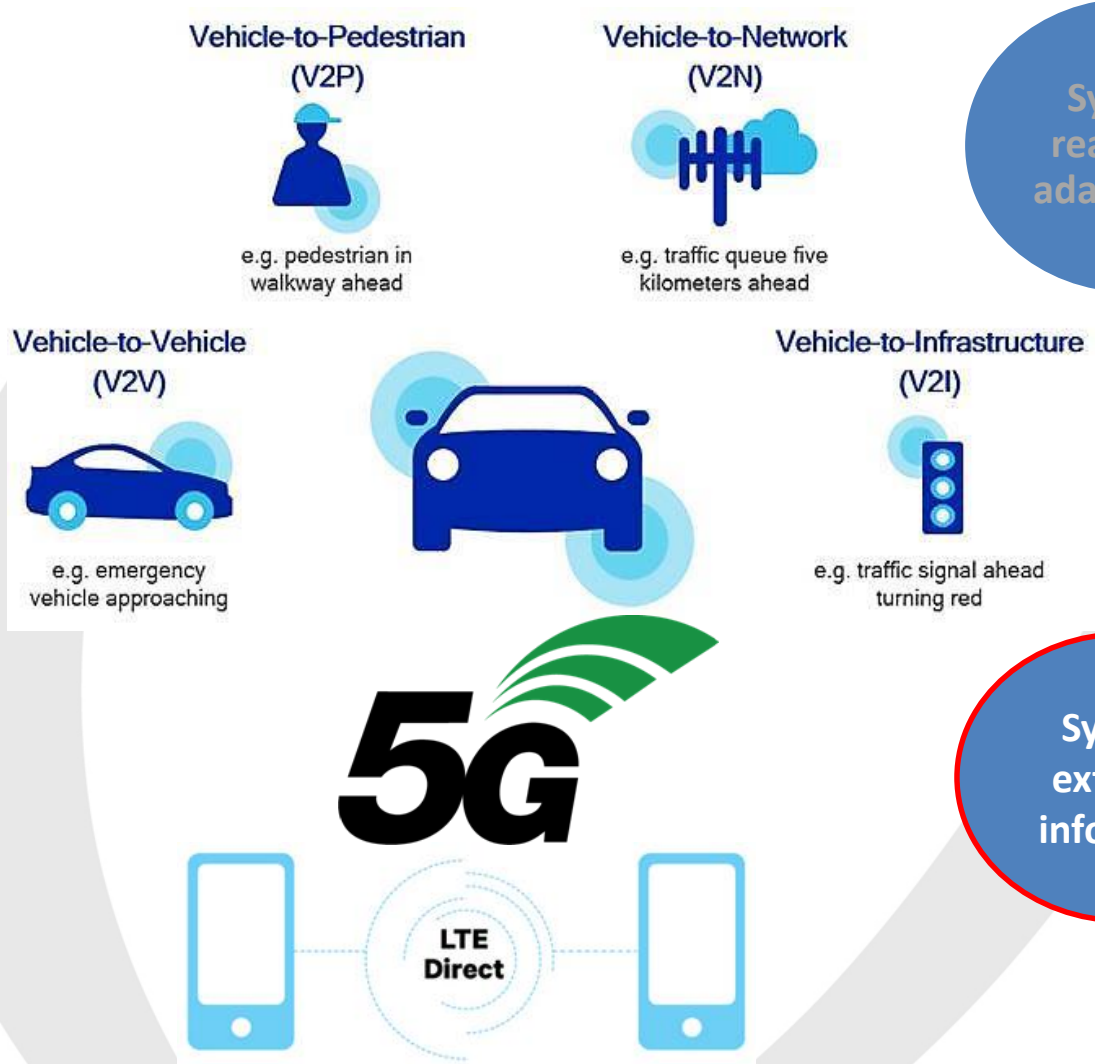
System adaptation in advance

- **Laser scanning**
- **Image analysis**

Pavament roughness from laser scanning

Engaging external information

https://www.qualcomm.com/news/onq/2016/06/07/path-5g-paving-road-tomorrows-autonomous-vehicles



System real time adaptation

- Acceleration
- Displacement
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System adaptation in advance

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- Image analysis

System external informing

- **Communication**
- **V2X** = V2V+V2I+V2N+…

Risks and limitations

Thank you for your attention!

Ačiū!

VILNIUS GEDIMINAS
TECHNICAL UNIVERSITY

Dr. Vidas Žuraulis
vidas.zuraulis@vgtu.lt