Title: **Black sheep - detecting sooty vehicles on the road using roadside particle measurement**

Author: **Jan Skácel, Czech Technical University in Prague,** Address: Roztoky, Prilepska 1920, 252 63 Roztoky u Prahy, e-mail: jan.skacel@fs.cvut.cz, Tel.: +420 608.667.587

Introduction & Background

Automotive emissions have been environmental and health issue since mass expansion of internal combustion engine. In the past, the challenge has been to develop technology that would make engines clean, Today efficient and affordable aftertreatment technology is available. Challenge remains to secure in use performance as low durability, poor maintenance or deliberate tempering with aftertreatment results in much higher real world emissions compared to nominal values.

Most harmful pollutant for human health is fine particle air pollution (PM2.5), causing almost 430.000 premature deaths in Europe each year. Key contributor to PM2.5 in urban areas is diesel engine. Despite strict regulation since 2011 EURO 5b that induced use of diesel particulate filters (DPF) for all new diesel vehicles, PM2.5 levels do not show notable reduction.

Periodic technical inspection (PTI) proves to be largely ineffective due to mild test procedures, obsolete instrumentation, relaxed limits and ways to circumvent it. Poor air quality leads some cities to extreme measures like limiting or banning vehicles entering them.

Objective

Goal of our study is to detect the high PM emitting vehicles, so that majority of vehicles that are clean can stay on the road. Specifically to identify vehicles that should have DPF, but for some reason is not operational.

Methodology

For effective detection of excessive polluting vehicles, 3-step method is envisioned:

1 – Pre-selection – roadside measurement w/o traffic interference

2 – Mobile emission test – selected vehicles stopped by police and measured – “field PTI”

3 – Official technical inspection –official PTI in nearest test facility

Roadside measurement serves two purposes –to get real emissions from real use (impossible to fix or stage for like PTI) – and to pre-select vehicles as only about 5-10% have excessive emissions. Sampling method was developed to detect particulate mass and number emissions from passing vehicles, using additional CO2 measurement to determine specific particle emissions per liter of fuel.

Results & Conclusions

Roadside sampling was successfully tested on campus where no or partly working DPF was clearly identified. In addition, 2 week measurement campaign was run in Prague in October 2017 with over 25 thousand vehicles. Particulate number and mass in roadside measurement are being assessed with goal to generate

- Vehicle fleet Emission Distribution
- High particulate mass emitters identification
- Comparison with technical data from vehicle registry based on vehicle registration plate
- Judgement if vehicle OK / NOK

Results showed that relatively small percentage of vehicles constitutes majority of the particulate emissions. Therefore efficient air pollution improvement measure would affect small percentage of vehicles that would have to be fixed or kept off the road.

Key challenge appears to be matching vehicle and emission trace due to high frequency of passing vehicles and variability in sampling delay.

Czech Ministry of Transport together with Traffic Police are interested in trial run of the 3-step field inspection.

Outlook

Further development of this approach could lead to fundamental change in the way PTI is performed. In use checks of PM emissions could be performed in high impact areas like city centers, similar to vehicle speed measurements to prevent accidents. High emitters will be identified and responsible drivers will not have to pay penalty for unscrupulous ones.