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Portable emission measurement system (PEMS) for exhaust aerosols

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Background

- Vehicle emissions in the laboratory conditions differ from the real driving situations (Keskinen & Rönkkö 2010, Weiss *et al*. 2012)
- Portable emission measurement systems (PEMS) have been developed to measure emissions of real world driving.
- Commercial PEMSs available have been designed for measuring legislated emissions and fixed to certain technologies (gas concentrations, particle mass).
- We wanted a versatile system for exhaust aerosol studies, allowing different sampling methods to be used in order to mimic real world dilution.

Construction

The developed PEMS consists of 4 units (Figs. 1 and 2).

- Energy supply: Battery (2), DC power supply
- Main unit
- Tailpipe sampling
- Exhaust plume sampling

The measurement instruments are connected to the main unit which consists of the following components

- Pumps, filters and flow measurement for dilution air
- CO_2 sensors (4) with a common pump
- Temperature controllers for dilution and evaporation
- Inverter
- Datalogger: temperatures, additional sensors…

The diluters are installed into a rail which is bolted into a towing hook of the vehicle. The diluter is placed inside the tailpipe or close to the end of the tailpipe

- First dilution stage: ejector type or porous tube type
- Second dilution ejector type
- Possibility for evaporation chamber after the first stage
- CO_2 sensors are used to define the dilution ratio

Fig. 1 PEMS installed into a GDI passenger car, a CPC and an EEPS as measuring instruments. The plume sampling is shown on the right hand side.

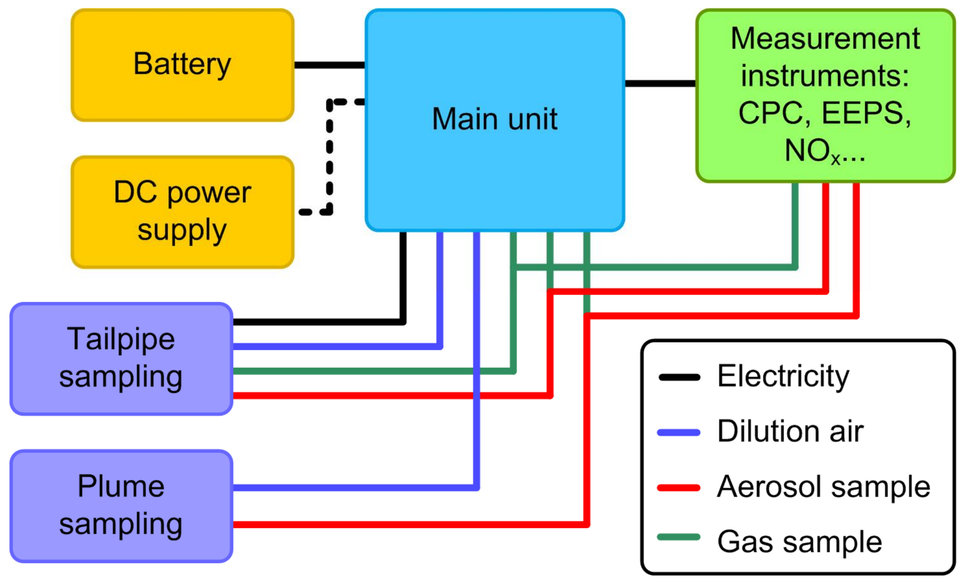

Fig. 2 Simplified schematics of the PEMS.

Tests

PEMS has been tested in laboratory and during driving on public roads, with both diesel and GDI vehicles. The measurements shown here are for a GDI passenger car. In this case, cold porous tube dilution followed by ejector dilution was used. The route consisted of urban driving including stops and accelerations as well as 2 x 4.5 km highway stage. An EEPS and a CPC were used as measuring instruments.

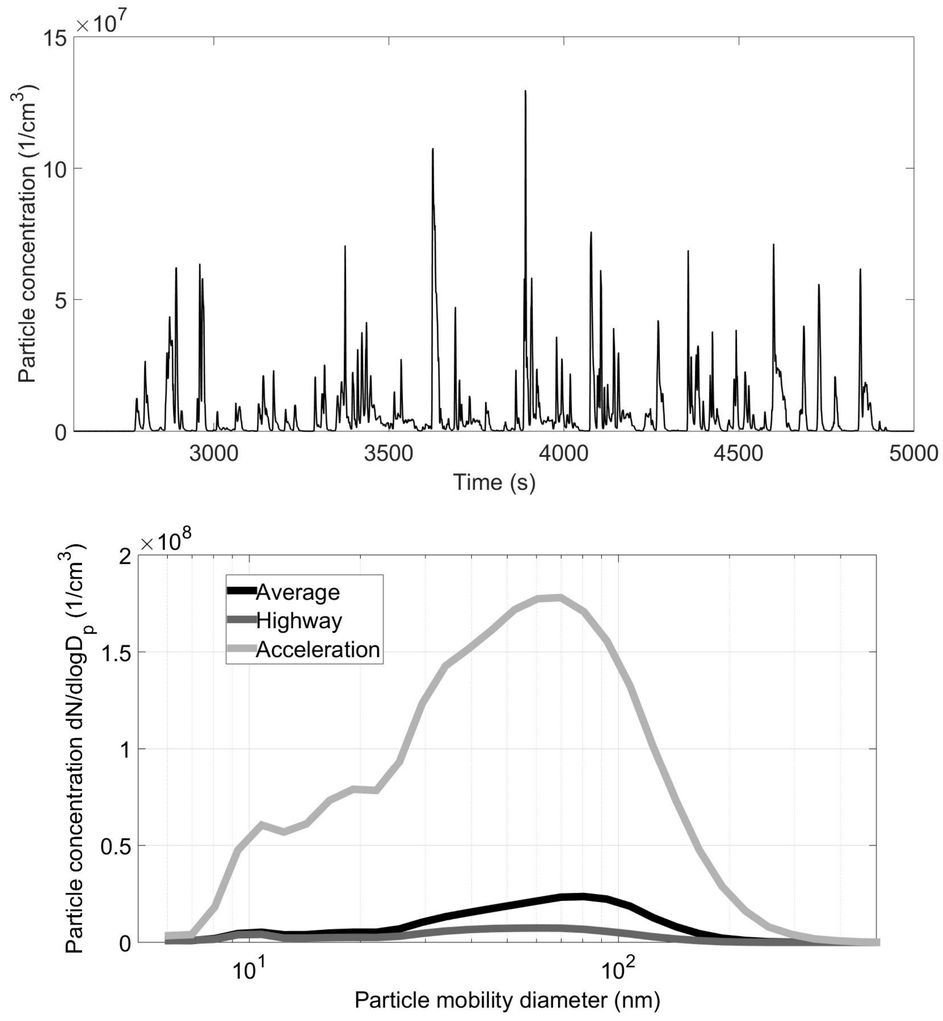

Fig. 3 GDI vehicle particle number concentrations measured during normal driving (above). Aerosol number size distributions measured with the EEPS (below).

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