Estimation of the mean particle size by sampling in parallel with two Pegasor Particle Sensors

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Introduction

- The Pegasor Particle Sensor (PPS) signal has a size-dependent response to particle size ($\propto d^{1\text{-}1.29}$).
- Errors in the reported particle mass & number are expected when the size distribution differs from the calibration's reference (D_g=50nm, σ_g=1.7).

Scope of this study:

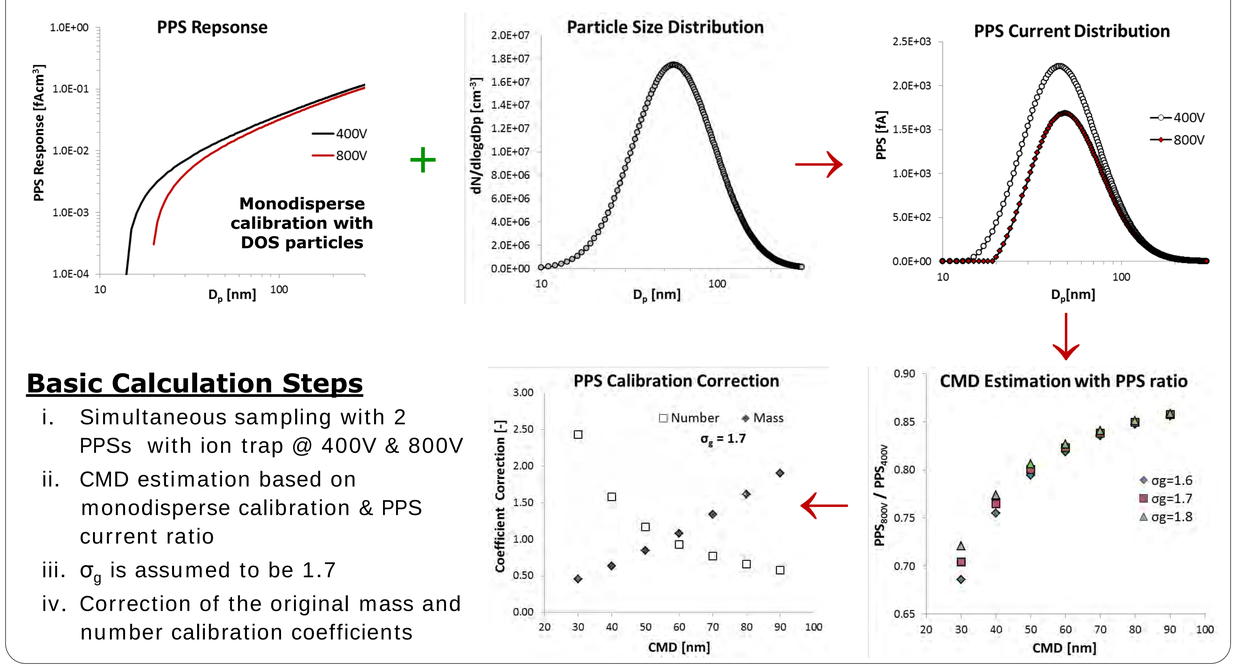
- Estimation of the mean particle size by sampling in parallel with 2 PPSs at different ion trap voltage and correction of the original mass & number calibration formulas.
- Validation of the method with diesel exhaust particles during transient testing.

Theoretical Background

Pegasor Particle Sensor

- Measurement of "escaping current"
- Particles are not collected
- Hot & undiluted sampling directly from the tailpipe
- High resolution and sensitivity (10 Hz, 0.3s response time)

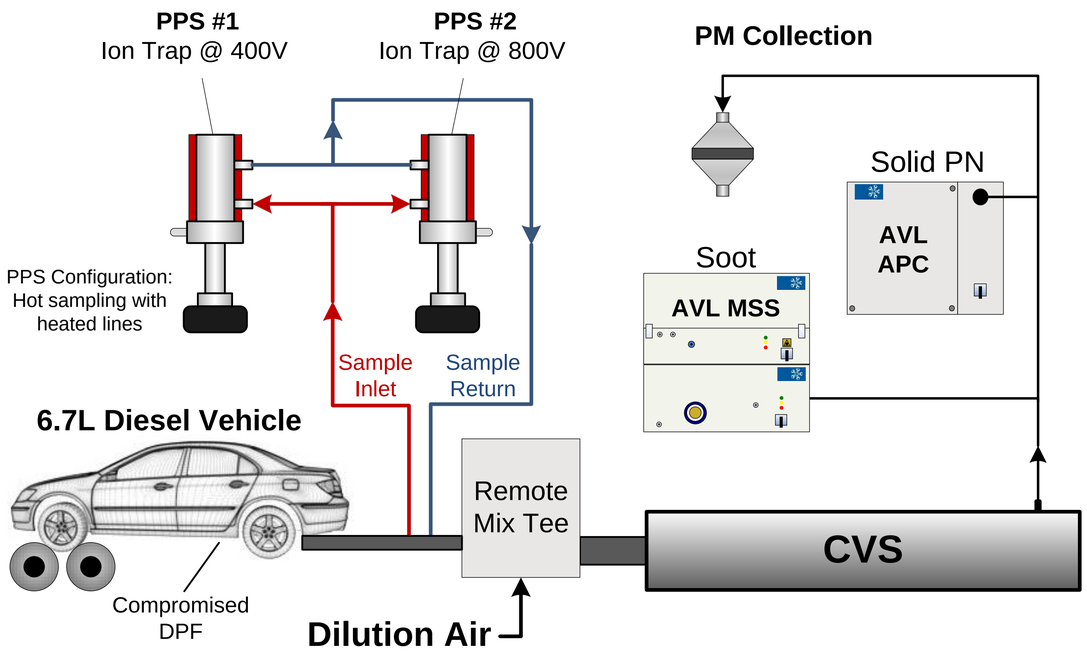
CMD Estimation Methodology



Basic Calculation Steps

i. Simultaneous sampling with 2 PPSs with ion trap @ 400V & 800V
ii. CMD estimation based on monodisperse calibration & PPS current ratio
iii. σ_g is assumed to be 1.7
iv. Correction of the original mass and number calibration coefficients

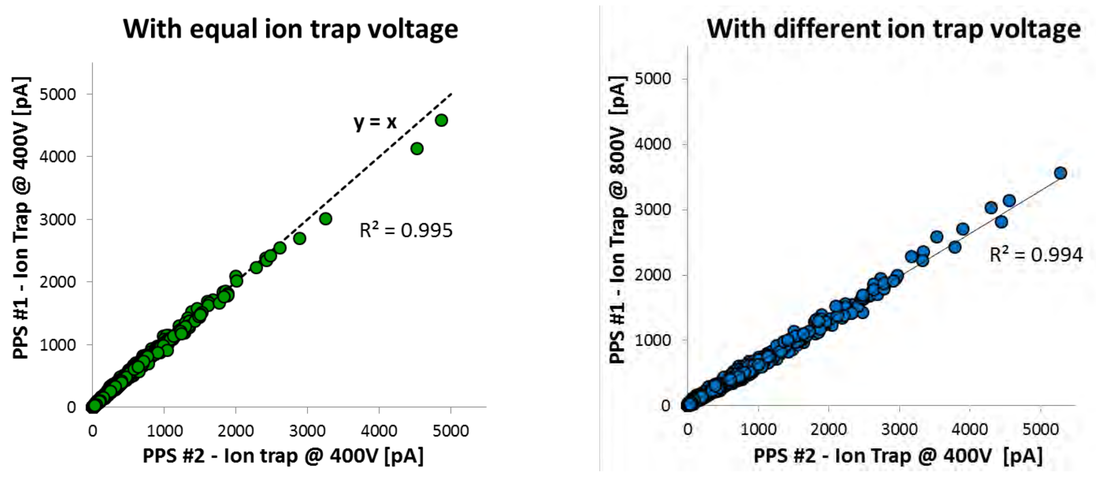
Experimental



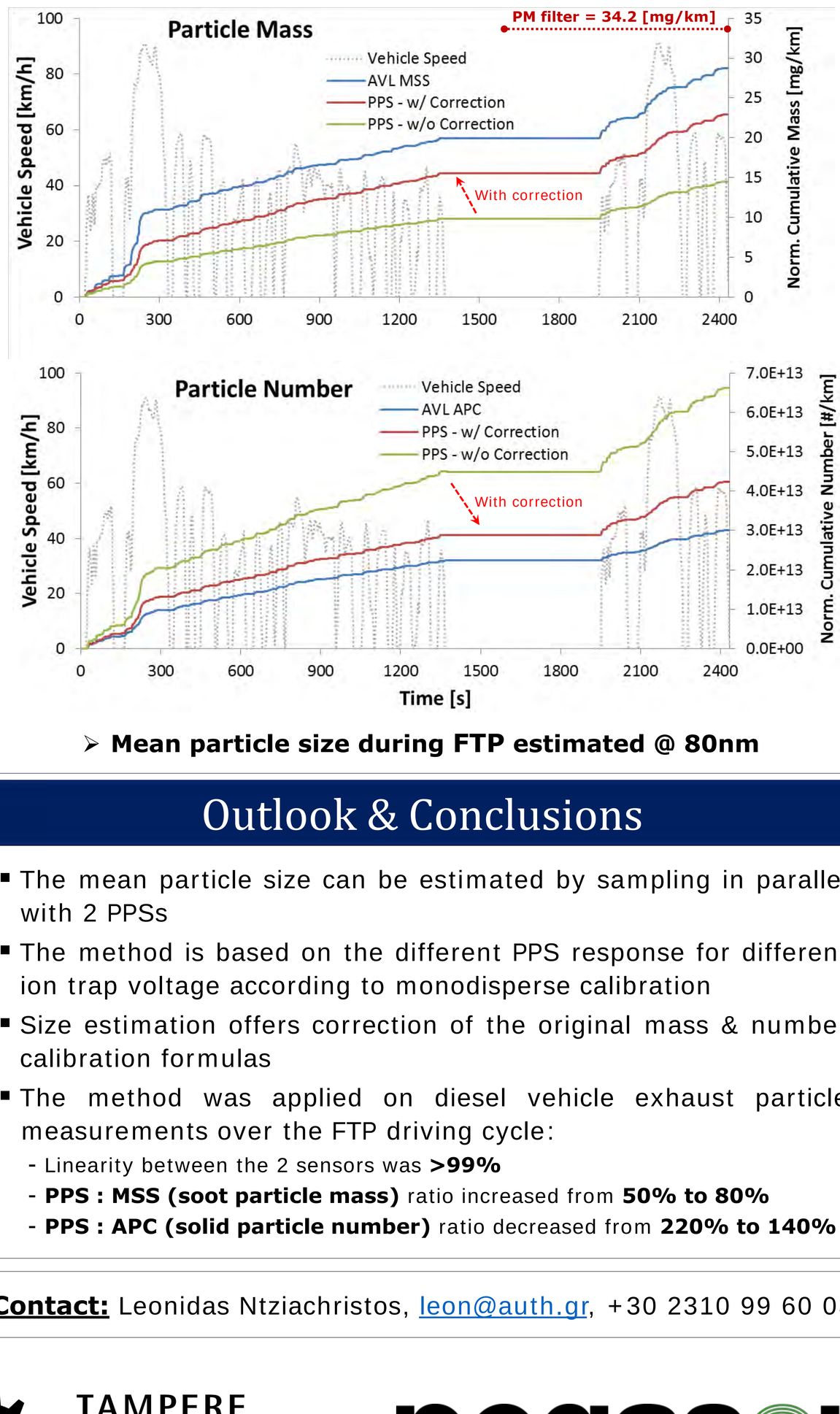
The vehicle was run over the FTP driving cycle

PPS Linearity

Correlation of the 2 PPS signals during the FTP



Results



➢ **Mean particle size during FTP estimated @ 80nm**

Outlook & Conclusions

- The mean particle size can be estimated by sampling in parallel with 2 PPSs
- The method is based on the different PPS response for different ion trap voltage according to monodisperse calibration
- Size estimation offers correction of the original mass & number calibration formulas
- The method was applied on diesel vehicle exhaust particle measurements over the FTP driving cycle:
  - Linearity between the 2 sensors was **>99%**
  - **PPS : MSS (soot particle mass)** ratio increased from **50% to 80%**
  - **PPS : APC (solid particle number)** ratio decreased from **220% to 140%**

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pegasor