NEXT GENERATION PEMS: IDENTIFYING A PM "HIGH EMITTER" USING A MULTIPLEXED SENSOR MEASUREMENT

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Outline of Presentation

- Background
- Current Diesel I/M
- Description of System
- Combining Signals into PSN
- Blind Test and Results

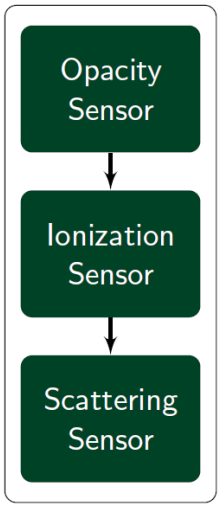
Background

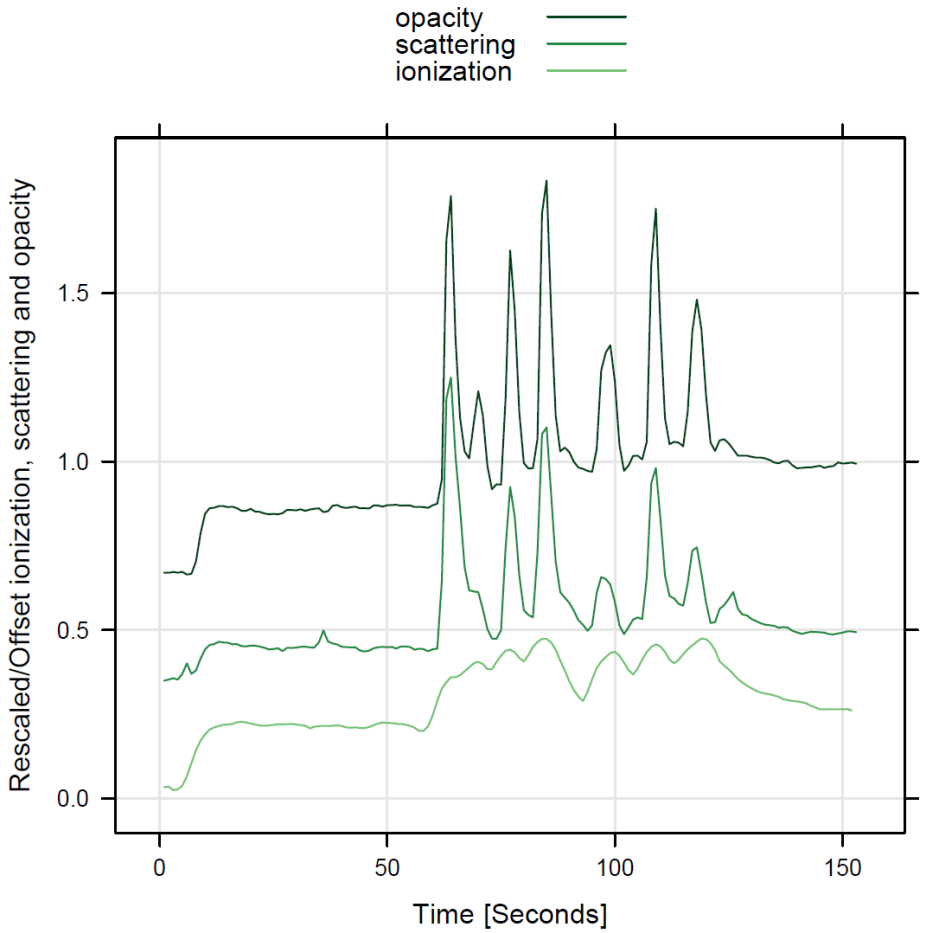
- Now that most diesel engines have exhaust aftertreatment systems, identifying excessive diesel emitters with broken emissions controls is important.
  - 90+% emissions reductions means a partially functioning control system can emit many times more pollution than a fully functioning one.
- The old methods of identifying excessive PM emitters are inadequate for diesels with DPFs.
  - Excessive relative to what?
- If they can be cost-effectively adapted to the single-purpose inspection/maintenance market, “next generation” PEMS could provide a basis for I/M measurement equipment with the required sensitivity for PM.

Current I/M Methods for PM

- Opacity
  - Pilot program to develop pass/fail cutpoints
  - SAE-J1667
- Filter Smoke Number (FSN)
  - Aethalometer approach
- Visual
  - Any visible plume

Description of Next Generation PEMS: parSYNC





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parSYNC Number (PSN)

- PSN combines the three PM signals into a single analog of PM emissions.

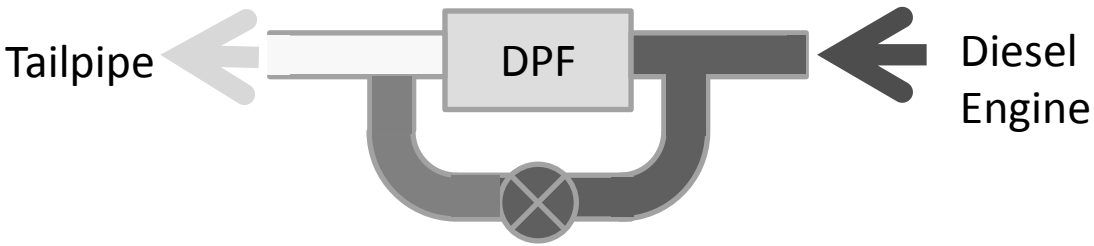
$$PSN = Cb + (Ci*I) + (Cs*S) + (Co*O)$$

where I is ionization, S is scattering and O is opacity.

  - Coefficients scale the outputs to specifically identify DPF engines that are excessive PM emitters.

Exhaust DPF Bypass

- DPF bypass can be set to mimic 12 emissions levels, from fully functioning DPF to no DPF.
  - Vehicle owner has already determined what settings represent passing (normal emitter) versus failing (excessive emitter).



12-position
Bypass Valve

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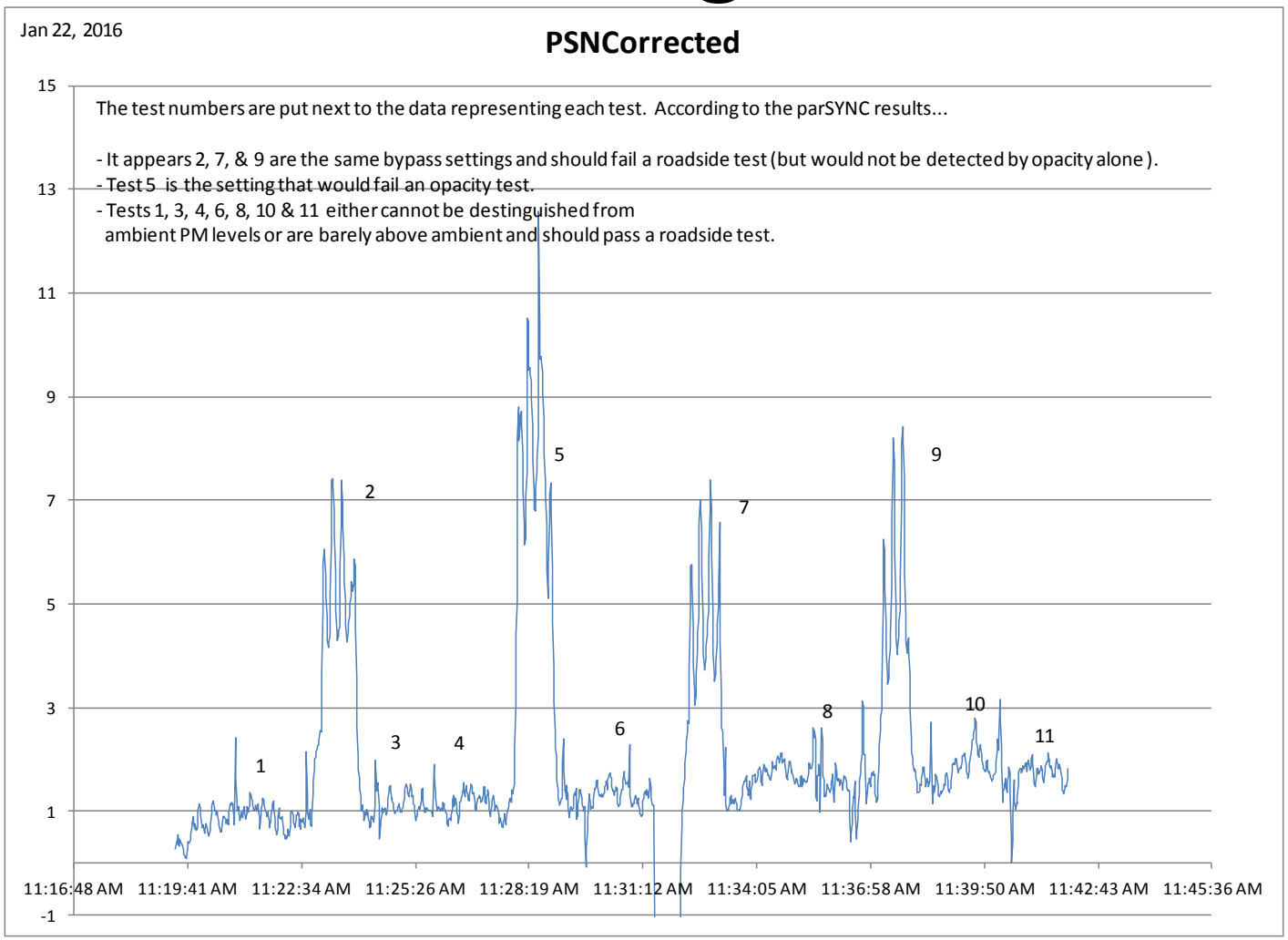
Blind Test Approach

1. Vehicle owner adjusts DPF bypass to setting unknown to testers.
2. Testers give signal when ready for test measurement.
3. Vehicle owner performs “snap acceleration” while testers monitor result.
4. Repeat steps 1, 2, & 3 for a total of 11 tests.

Resulting PSN



Going Forward

- Test additional vehicles with DPF and/or SCR "failures."
- Begin looking at how the three signals can be analyzed to identify types of failure and possible repairs.
- Consider pilot program on a larger scale to develop optimal coefficient values to identify normal versus excessive emitters.

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Q? ➔ A!

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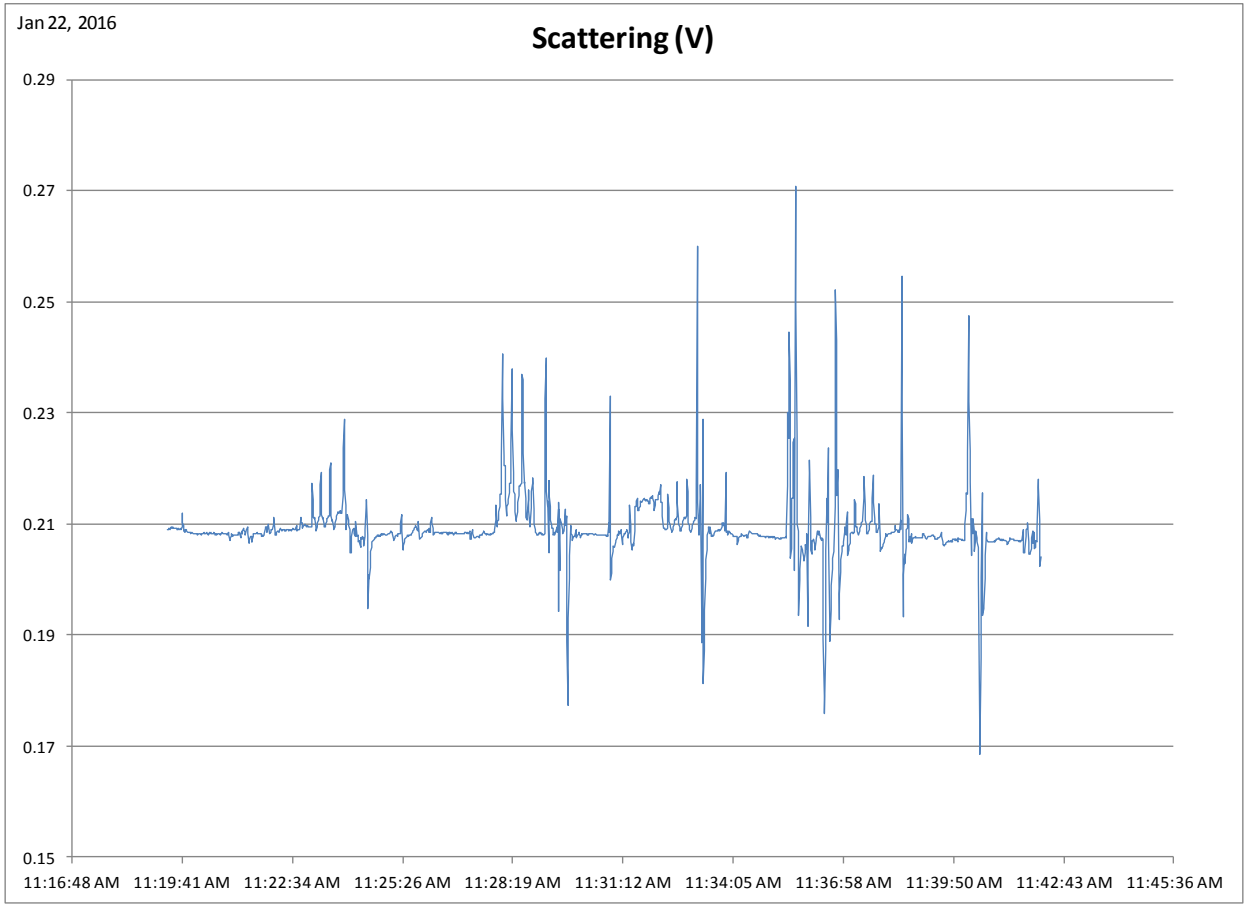
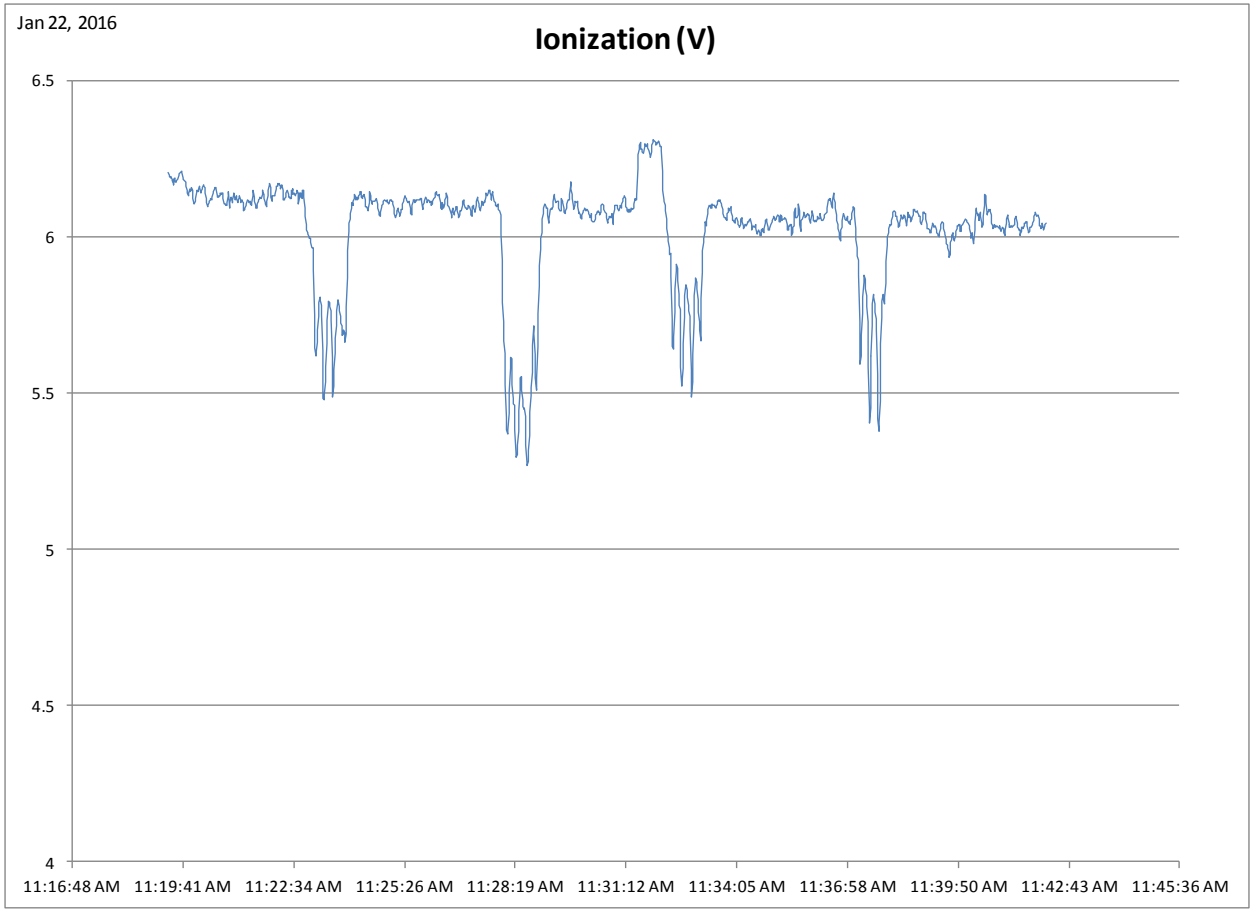
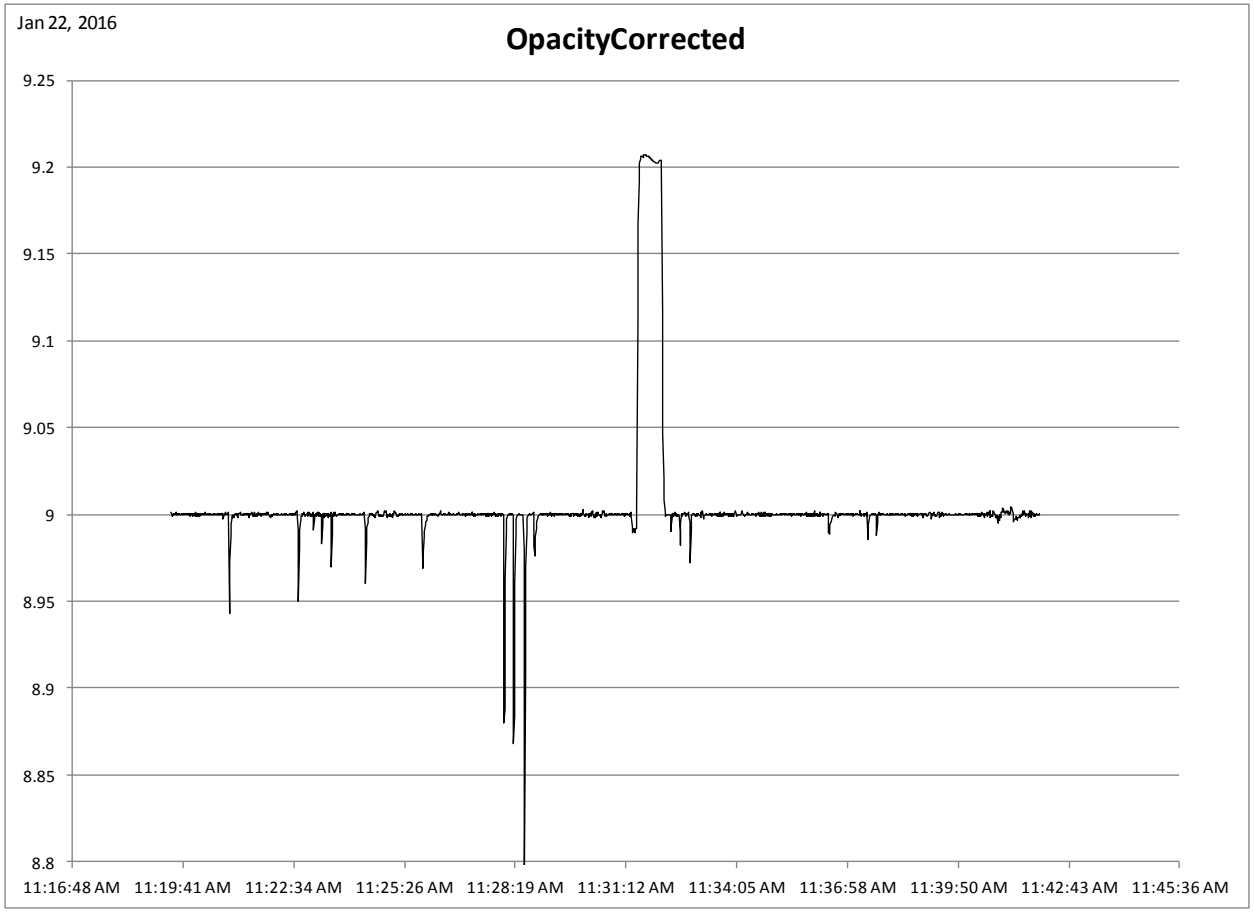
Scattering from Blind Test



Ionization from Blind Test



Opacity from Blind Test



Identifying Fail Type