Accomplishments of NIST Stationary Source Emissions Research

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NIST Fluid Metrology Group
Workshop on Improving Measurement for Smokestack Emissions
June 28, 2017

Objectives

- Create an SI-traceable measurement system for monitoring the emissions from coal-burning power plants.
- Provide an economical technical basis for accurately controlling pollutants, including greenhouse gases.
- Reduce the uncertainty of emission measurements from 10 % to 1 %.

What Has NIST Done?

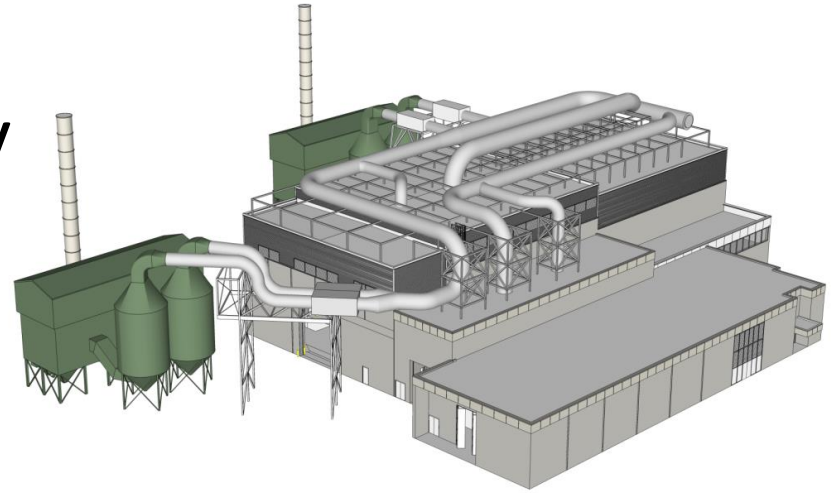
1. Invest in Special Measurement Facilities
2. Established cooperative relationships with stakeholders
3. Facilities are being used to
   A. understand and improve ΔP probe measurements
   B. understand and improve ultrasonic flow meters
   C. test novel flow measurement concepts

Cooperative Research

Electric Power Research Institute (EPRI): a Cooperative Research and Development Agreement will enable field tests in the USA of recommended improvements to RATA.

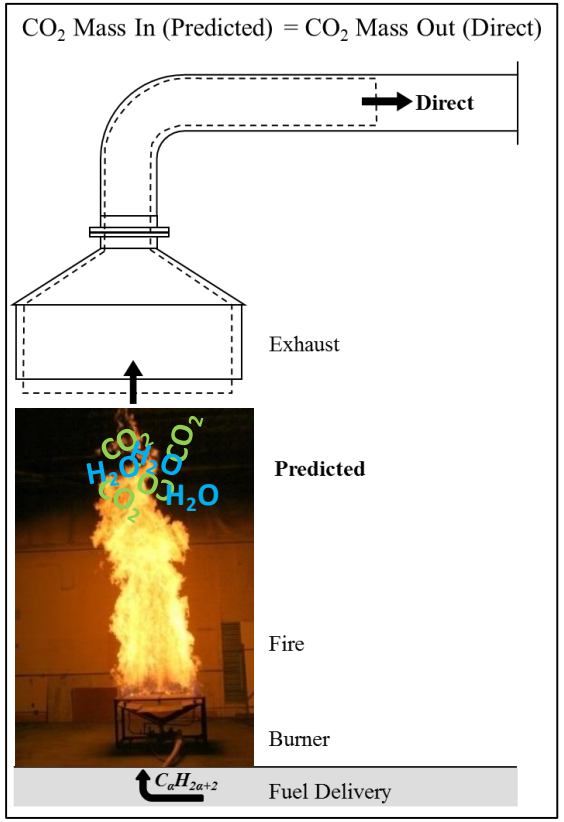
National Metrology Institute of China (NIM) and Korea Institute of Standards and Science (KRISS): a strong, informal working arrangement will enable field tests in China and will facilitate international dissemination of good measurement practices

National Fire Research Laboratory

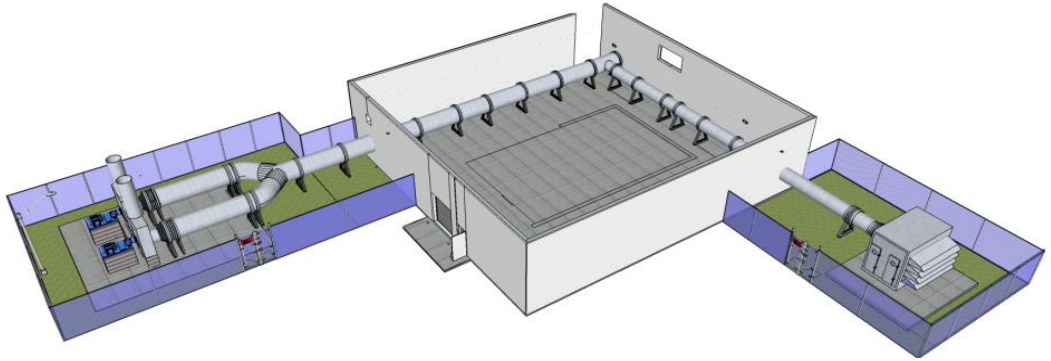


Rodney Bryant, Matt Bundy

- Tracer gas dilution flow measurements (SF_6) in the NFRL exhaust ducts confirmed uniform distribution of the tracer downstream and flow measurement repeatability of ±3 %.
- CO_2 output calculated from 1) natural gas input flow and 2) CEMS agreed within 7 %.



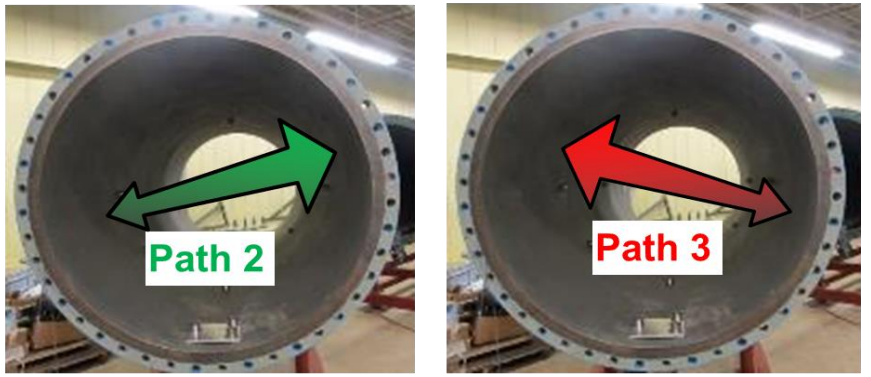
Smoke Stack Simulator

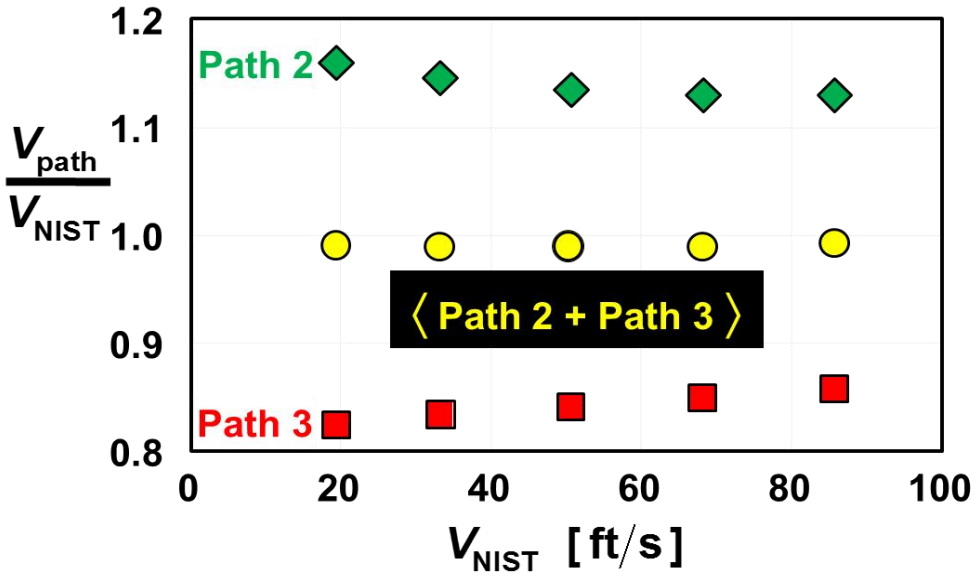


Aaron Johnson, Joey Boyd, Jim Filla

The accuracy of ultrasonic-flow-meter based CEMS can be greatly improved by using two, crossing ultrasonic paths.

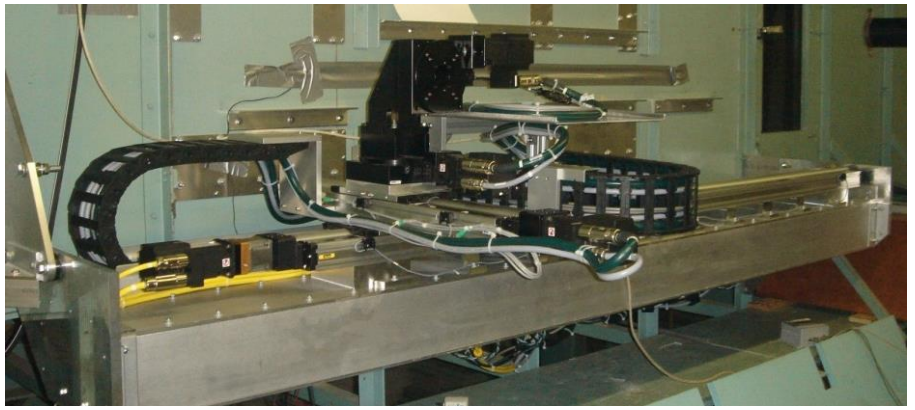
Velocity data from paths 2 and 3 differ from NIST's standard V_{NIST} by up to 17 %. Yellow circles: the average of the X-pattern paths agrees with V_{NIST} within ±1 %.



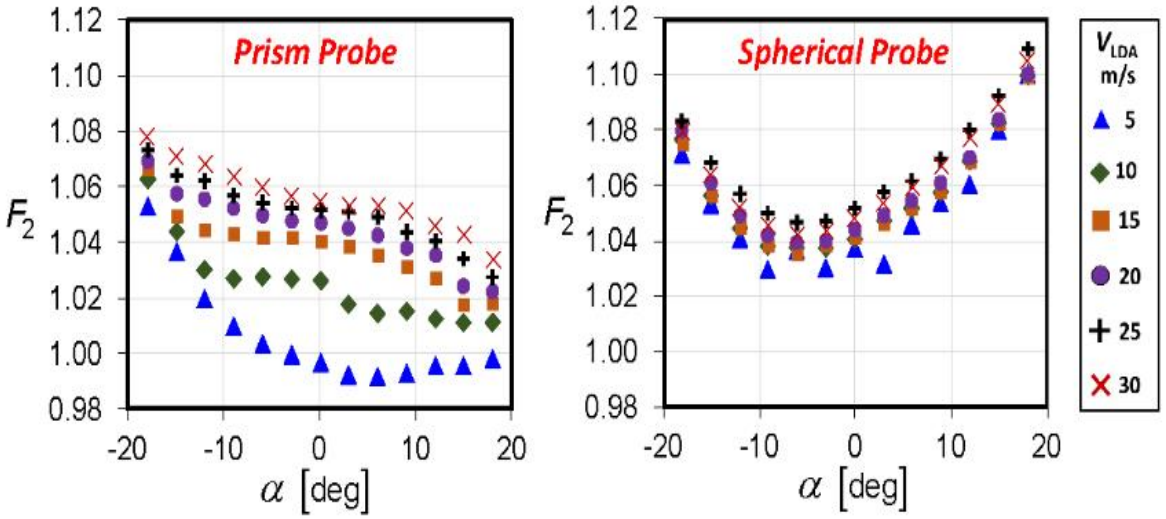


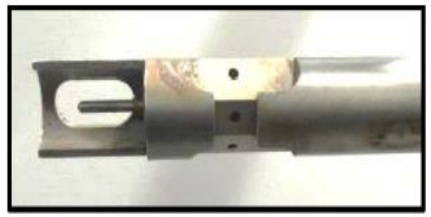
Air Speed Calibration Facility

Iosif Shinder, Vladimir Khromchenko,
Michael Moldover, Aaron Johnson



- The NIST Wind Tunnel calibrates Pitot probes as a function of: (1) air speed, (2) pitch angle, (3) yaw angle, and (4) turbulence intensity.
- Assuming the S-probe calibration factor is 0.84 leads to errors on the order of 5 % for moderate pitch angles such as ±10 °.
- Non-nulling probes have 2 % accuracy and reduce RATA testing time by a factor of 5.

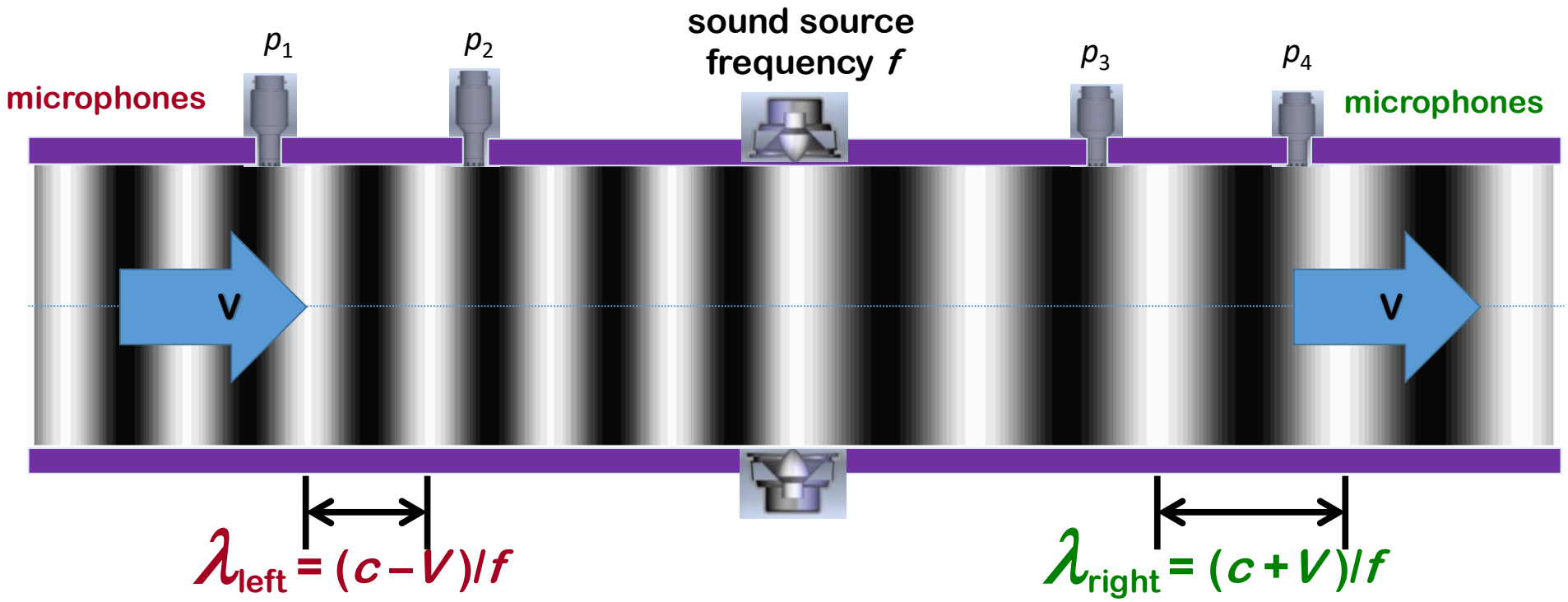




Long Wavelength Acoustic Flow Meter

Keith Gillis, JohnPaul Abbott, Lee Gorny

Using a 1/100th scale model stack, we have shown that a LWAF can measure the average velocity of a turbulent, swirling, wet, air flow with an uncertainty of less than ±1 %.



We will soon answer the following questions

1. Can 3-D probes make the RATA accurate?
   If yes, can a non-nulling 3-D probe be devised?

2. Can multipath ultrasonic meters replace the RATA?
   If yes, how many paths? What configurations?

3. Can tracer flow measurements be made accurately?
   If yes, special, full-scale tests could confirm ultrasonic installations

4. Can we understand flow-generated noise well enough to use a LWAF as a flow standard?
   If yes, special, full-scale tests could confirm ultrasonic installations

Thanks and enjoy your tours!