中国计量科学研究院
National Institute of Metrology

Development report from NIM, China

Acoustics, Ultrasound & Vibration

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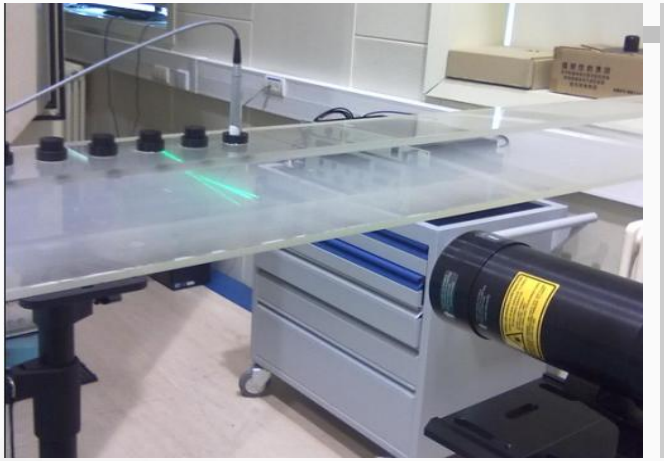
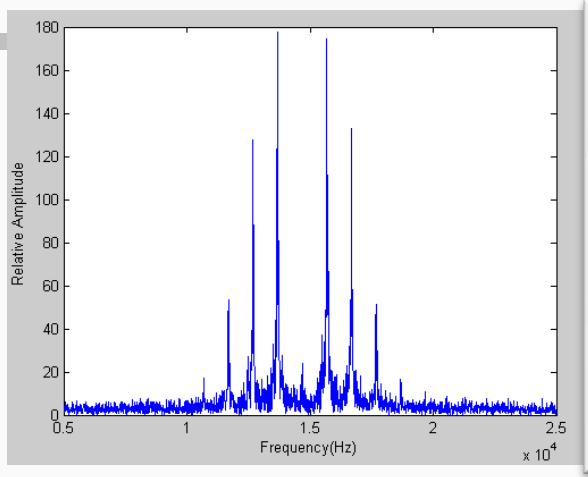
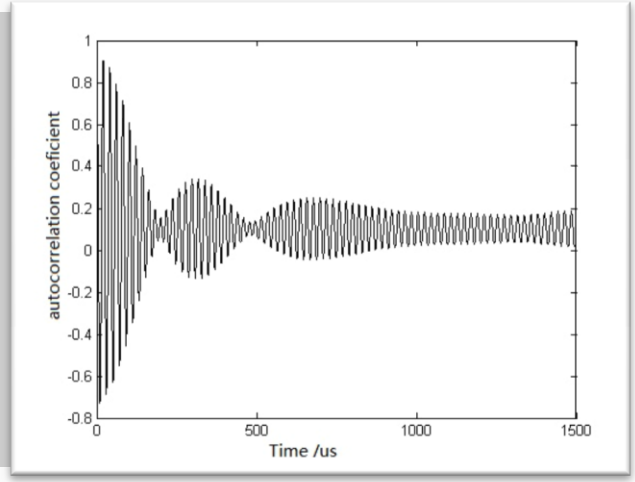
Particle Velocity Measurement by LDA in Air



LDA system *with traveling-wave tube*

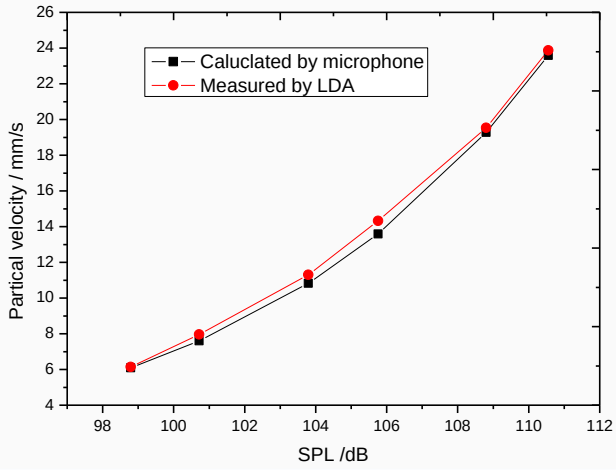


spectral analysis method



Autocorrelation method

- *To measure particle velocity with LDA system*
  - *Spectral analysis of doppler signal*
  - *Autocorrelation of doppler signal*
- *To support air-borne sound pressure unit realization by optical method*



D33 Measurement for Piezoelectric Material

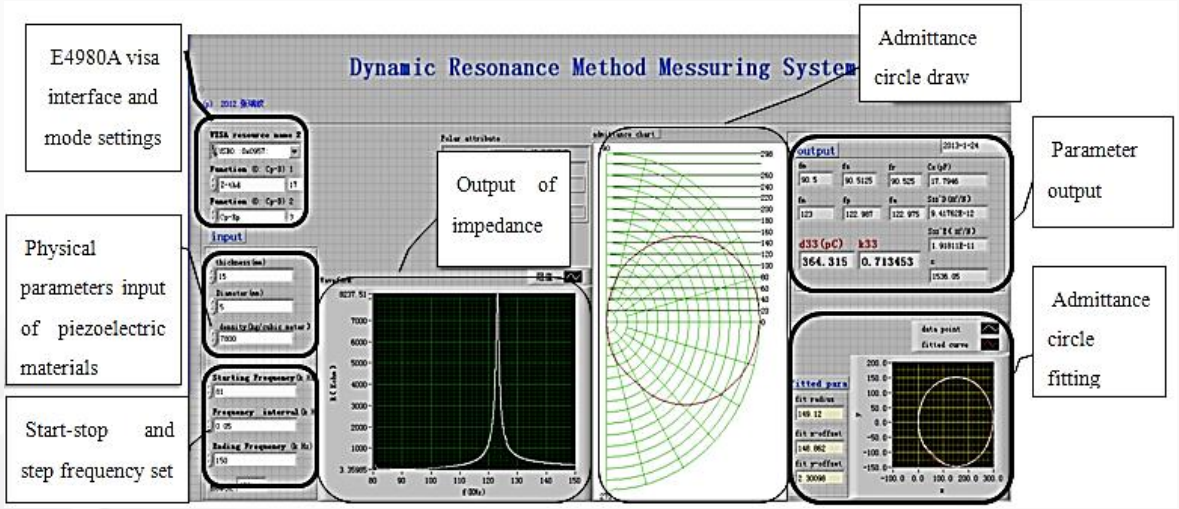


Fig. X d_{33} Measurement System Interfac of dynamic resonance method

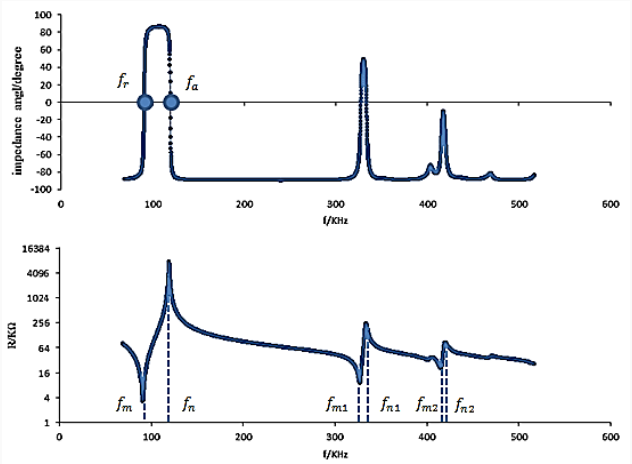
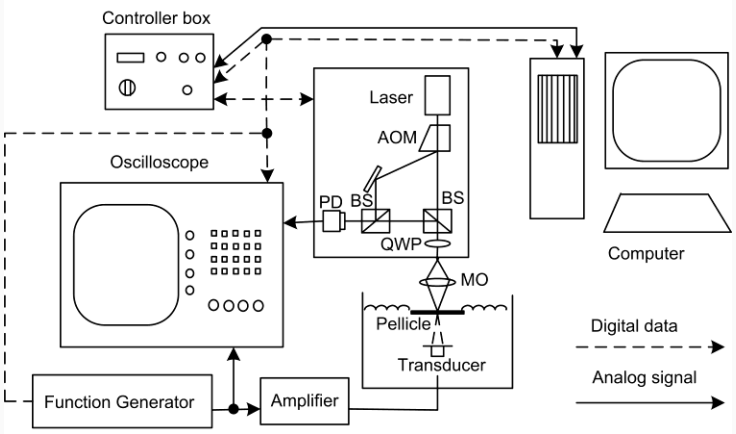


Fig. X The impedance angle and impedance values

- **The dynamic resonance method could supply reference samples for commercial apparatus based on quasi-static method**
- **the relative uncertainty of piezoelectric constant d_{33} is evaluated as 0.96%(k=2)**

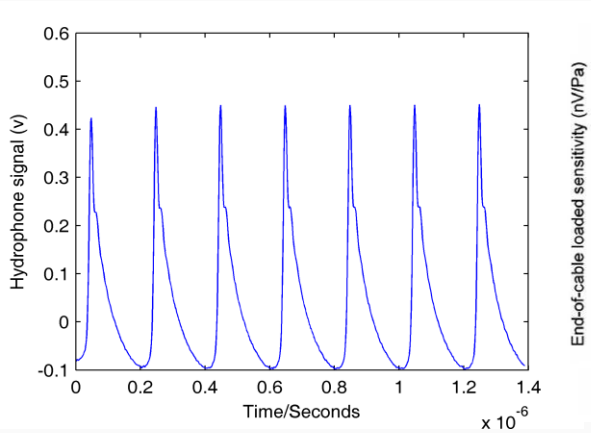
High Frequency Hydrophone Calibration by Heterodyne Interferometer



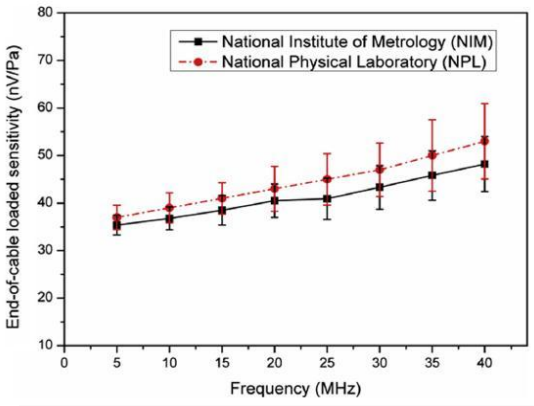
Schematic Picture of the Heterodyne Interferometer

Picture of the system

High frequency hydrophone calibration was carried out based on a commercial heterodyne interferometer, with the proper configuration.
Rather good calibration agreement was achieved between homodyne system.



Hydrophone voltage waveform

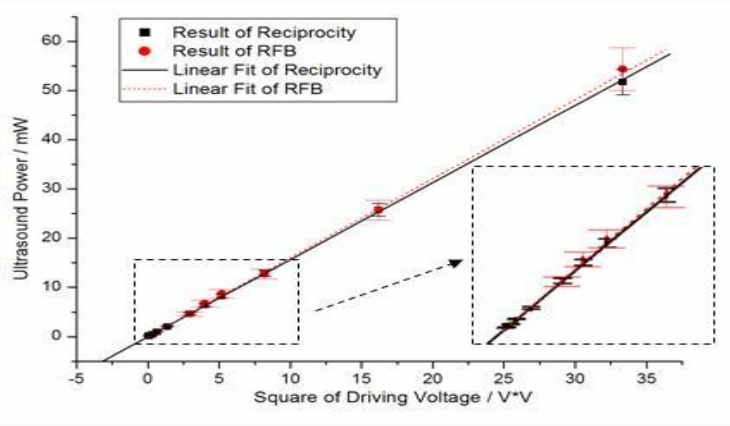


Comparison of calibration

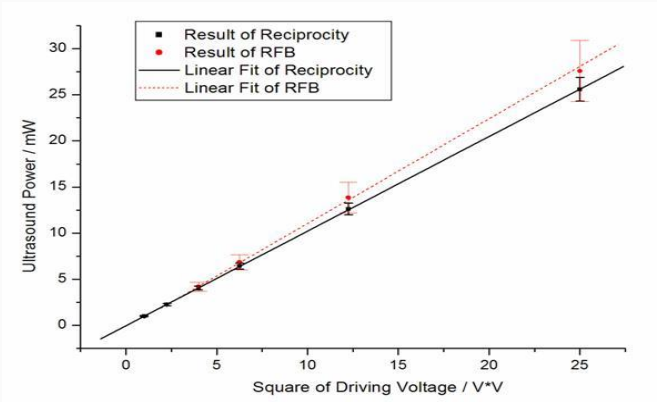
Measure Low Level and High Frequency Ultrasound Power by Reciprocity Method – Plane Piston Transducer

$$W = \frac{P_{tr}^2}{2\rho c} A = \frac{U_l I_k e^{2ad}}{4rD(2\mathrm{d})}$$

Based on the reciprocity theorem. The output acoustic power can be calculated from the emitting current and the reflected voltage. For the good performance of the current and voltage measurement in low amplitude and high frequency, this method can measure the low level (0.1mW) and high frequency ultrasound power (～25MHz).



Comparison experiment of RFB and Reciprocity Method (1 MHz)



Comparison experiment of RFB and Reciprocity Method (25 MHz)

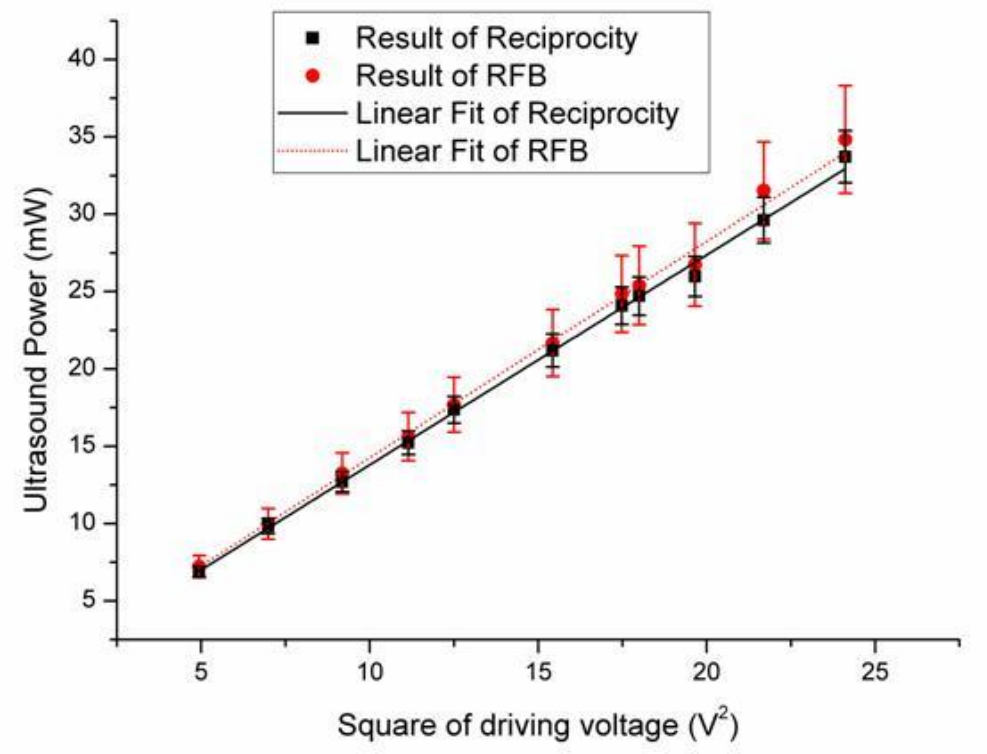
Measure Low Level and High Frequency Ultrasound Power by Reciprocity Method – Focused Transducer

$$P = \frac{2Fc}{1+\cos\beta}\exp(2\alpha d)$$

The ultrasound power measurement by reciprocity method is extended to focused case.

In the focused case, the upper frequency limit is proved valid about 15 MHz.

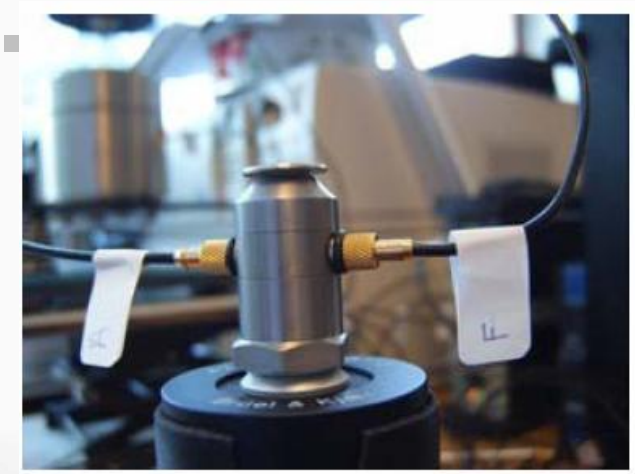
One domestic national standard is being drafted based on this method.



Comparison experiment of RFB and Reciprocity Method (5 MHz)

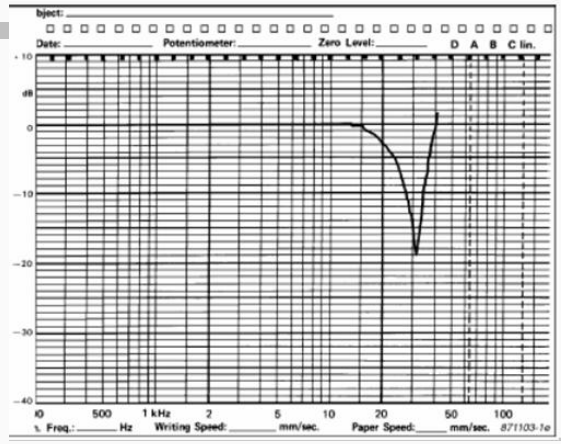
0.75-inch diameter, Olympus V308

Comparison Technique Research on Artificial Mastoid （APMP TC Initiative Project）



Step 1 Calibration of Impedance Head

Step 2 Mass Compensation



Step 3 Calibration of Artificial Mastoid

Impedance Head parameters:
1) Acceleration Sensitivity
2) Force Sensitivity

1) Measuring on the condition that impedance head and artificial mastoid are of no contact
2) calculate compensation

Artificial Mastoid parameters:
1) Mechanical Impedance
2) Force Sensitivity

Attendees----NIM (China), NMIA

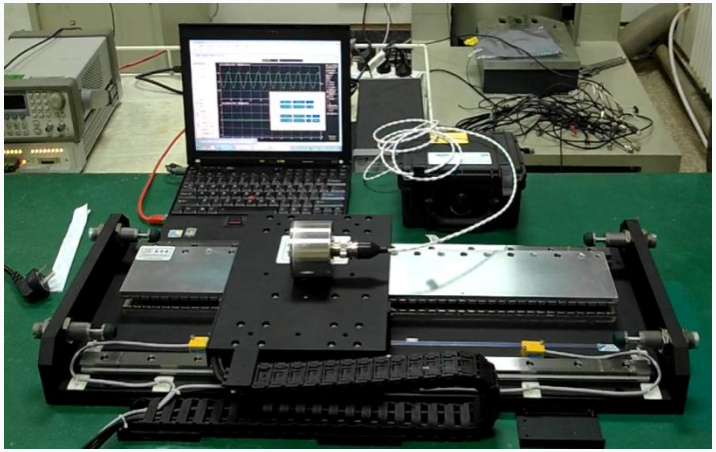
In-situ and On-site Vibration Calibration

Monitoring vibration transducers

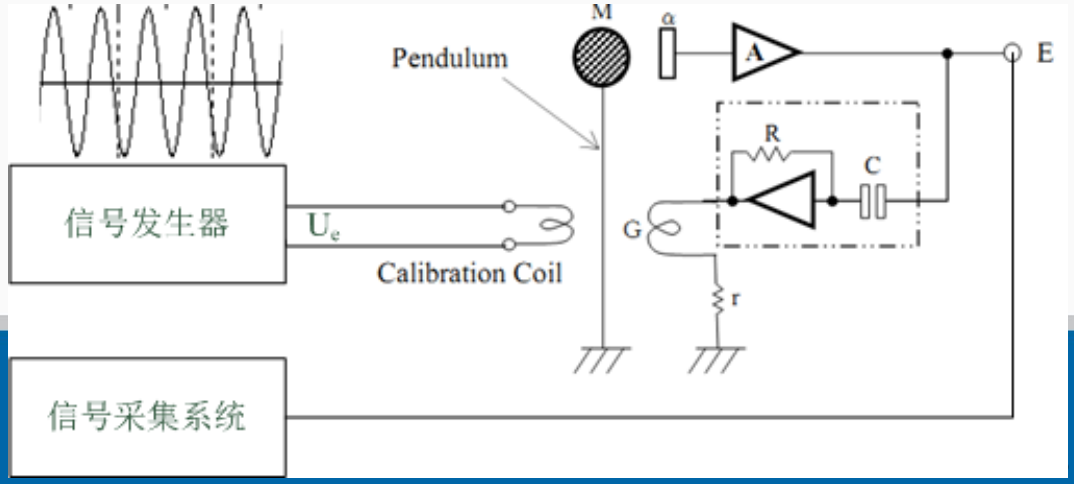




For on-site calibration, a low stroke portable low frequency calibration system is developed.




For in-situ calibration, a new standard ISO 16063-45 "Calibration of vibration transducers with built-in calibration coils“ is prepared.



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Thank you for your attention!

9th meeting of CCAUV, BIPM
29 to 31 Oct, 2013