

Report to CCAUV 2006 on Research and Development Progress in the Field of Vibration at NIM (China)

The past four years have witnessed the rapid improvements in vibration calibration technology and national vibration standards at NIM, China. So far, the scientific research work has involved three national standards (low, medium and high frequency), various laser interferometry technologies (homodyne and heterodyne) and two main categories of primary calibration methods (phase demodulation and frequency demodulation) for complex sensitivity of transducers.

1 Low frequency vibration standard from 0.1 Hz to 120 Hz

Sine-approximation method (homodyne version) has been successfully implemented with the dynamic phase unwrapping algorithm as a core, which has expanded the low frequency limit of the standard down to 0.1Hz for the accurate calibration of vibration transducer complex sensitivity. Even lower frequency will be possible with future super-low-frequency vibration exciter developed in three years (down to 0.01Hz). Various experiments performed have ensured a reasonable evaluation of system performance and measurement uncertainty.

2 Medium frequency vibration standard from 10 Hz to 800 Hz (version1) and from 10 Hz to 10 kHz (version2)

Besides the traditional fringe counting method, a modified homodyne time interval analysis method has been proposed and implemented for medium frequency vibration standard with the help of virtual instrument technology. Equipped with an ordinary Michelson interferometer and dual channel synchronous data acquisition card (5MS/s), the primary vibration calibration standard using the novel algorithm can perform measurements of complex sensitivity of accelerometers accurately, meeting the uncertainty requirements laid down in pertaining ISO standard. The main benefit from this simplified algorithm is the low requirement on data acquisition and processing hardware and high speed in software execution. For this version, the frequency range is from 10 Hz to 800 Hz.

Significant improvements have been made for conventional heterodyne time interval analysis (TIA) and sine approximation (SAM) methods, based on frequency and phase demodulation techniques respectively, by taking into account influences from disturbing motions stimulated at high frequency. This leads to an innovative integration of advanced TIA and SAM proposed by NIM. Equipped with a Mach-Zehnder interferometer and dual channel synchronous data acquisition card (5MS/s), the newly developed national primary medium

frequency vibration standard using two novel methods can perform measurements of complex sensitivity of accelerometers accurately up to 10 kHz (version2).

3 High frequency vibration standard from 2 kHz to 20 kHz

The newly developed national primary high frequency vibration standard using two novel heterodyne calibration methods mentioned above for version2 of medium frequency standard can perform measurements of complex sensitivity of accelerometers accurately from 2 kHz up to 20 kHz with the piezo-electrical vibration exciting system made by NIM.

All these improvements enable NIM to conduct a supplementary vibration comparison with PTB from 10 Hz to 10 kHz, using various methods. The comparison is now in the stage of draft B.

In addition to these technical improvements in calibration methods and national standards, a peer review on vibration and shock headed by Dr. Suh from KRISS was carried out successfully at NIM in March, 2005. The results concluded by the Korean experts about the CMCs in vibration & shock NIM claims are quite positive and have been submitted to secretariat of APMP.