Danish Primary Laboratory of Acoustics

Short Report on Activities, August 2004

Organization

The Danish Primary Laboratory of Acoustics (DPLA) was established by the Department of Trade and Industry (EFS) in 1989 as a cooperation between the manufacturer Brüel & Kjær and the Acoustic Laboratory (now Oersted Institute, Acoustic Technology) at the Technical University of Denmark (DTU).
DPLA is an ordinary member of DANIAMET, which is an umbrella organization covering all primary and reference laboratories in Denmark. The Danish Institute of Fundamental Metrology (DFM) holds the Secretariat of DANIAMET.
There are ongoing negotiations regarding a future transfer to DFM of the present DPLA activities at DTU.
The activities of DPLA are supervised by a small board consisting of:
Knud Rasmussen, Technical Manager;
Erling Frederiksen, Acoustics in air and
Torben R. Licht, Acoustics in solids.

Responsibilities

It is the responsibility of DPLA to maintain and disseminate the basic units in the field of Acoustics in gasses and solids and through research in the area to develop and improve methods for primary as well as secondary calibrations in this field. This responsibility is undertaken by the services offered on primary calibration of microphones by the reciprocity calibration technique and accelerometers by laser interferometry. DPLA holds an accreditation by DANAK for these services. Secondary calibrations by comparison methods, performance testing and verification of acoustical measuring instruments are all performed by other accredited calibration laboratories in Denmark and not by DPLA.

Calibration activities

The annual number of certificates issued to costumers over the last three years on primary pressure reciprocity calibration of microphones is about 75 and about 170 on laser-calibration of accelerometers. In addition to the calibrations for customers a large number of internal microphone calibrations are performed to maintain the unit of sound pressure and for research and development activities. For this purpose DPLA holds about 22 B&K Type 4160 and 28 B&K Type 4180 microphones, which generally are calibrated twice a year. DPLA further holds four sets of reference accelerometers, including the associated preamplifiers, which are maintained and used as transfer standards. The four sets are calibrated every month.

Research activities

The major activities are related to calibration of microphones by improving the calibration methods, extending the frequency range and the dynamic range of calibrations, through improved modelling of microphones to predict their behaviour etc.
Examples on some recent activities are:
A computer guided free-field reciprocity calibration system is now in operation. Calibrations are performed automatically at four distances. Deviations in the resulting

free-field sensitivity from the average value over the four distances are within ± 0,02 dB up to 25 kHz for LS1 microphones and 40 kHz for LS2 microphones.
The instrumentation used is capable of performing measurements up to 150 - 200 kHz and thus free-field calibration of WS3 and similar microphones are to be investigated.
Also an automatic free-field comparison technique for WS-microphones will be investigated based on the same equipment and technique.

A technique has been developed for measuring level linearity and harmonic distortion of microphones over the range from 94 dB (rms) to 171 dB (peak). The measurement is done at 500 Hz with a very pure sine signal, whose level is increased in pre-selected steps. The maximum distortion and level deviation of the system itself occur at 174 dB and is 0.3 % and 0.04 dB respectively. The reference level of linearity is 124 dB.

New couplers have been developed for phase comparison calibration of quarter-inch and half-inch microphone sets applied with intensity measurements. The sound distribution system of the couplers gives a uniform pressure and make them suited for calibrations from 20 Hz up to at least 8 kHz and 12.5 kHz for half and quarter-inch microphones respectively.

Low-frequency (1Hz – 20 Hz) calibration of LS-microphones by reciprocity calibration in closed couplers, by electrostatic actuators and by calculations. This includes an investigation of the heat conduction theory in couplers.
Calibration methods for artificial mastoids and impedance transducers.
Low frequency calibration laser calibration (0,5 – 30 Hz)
Double beam laser calibration

International cooperation
DPLA is an active player in the regional cooperation within EUROMET and some of the above-mentioned research activities make parts of EUROMET projects. Staff members of DPLA are active members of IEC TC29 and ISO 108/SC3 acting as specialists and project leaders for specific standards.
K. Rasmussen is the Chairman of IEC TC 29 and Torben R. Licht is chairman of ISO 108/SC3.
DPLA acted as technical pilot laboratory in CCAUV.A-K3 and EUROMET 674 on primary pressure reciprocity calibration of LS2 microphones in the frequency range 30 Hz – 25000 Hz in 2003-2004.