# C. 1) Microphone practical *(JCD)*

The aim of this practical is to introduce you to microphone measurements and calibration. The microphones used are electret microphones that you have been introduced to in the microphone lecture. Electret microphones have a large polarization voltage applied to the membrane. Any deformation of the membrane changes the capacitance of the membrane and produces an electrical signal that subsequently is amplified and conditioned by a preamplifier.

The first rule of microphones: Get (or have access to) one really good microphone that you can use as a reference. In this laboratory, we use B&K microphones that are reliable and well-documented, but of course other brands can also be used. Once you have such a reference microphone, your other microphones (for examples the ones you use for field recordings) can be calibrated by comparison. The reference microphone is calibrated by an electrostatic actuator and a sound calibrator.

The exercise use a DSP-based sound generation system (Tucker-Davis, system 3) controlled by a software program. In this program, sweeps of different durations and frequency content can be emitted from a DA converter and the microphone signals recorded by an AD converter. The default sweeps range from 200 to 17 kHz with flat frequency spectra. The program averages a number of sweeps (10-100) and calculates spectra. One input can be taken as reference and differences between a test input and the reference calculated (the analyze menu) Spectra can be saved on disk. The figures can also be saved on the clipboard and exported to PowerPoint (recommended).

1. The ½" microphone can be calibrated using an electrostatic actuator, a metal grid that can be connected to a voltage source. Here, the membrane is driven directly by a (large) AC voltage of different frequencies. Actuator calibration need only be performed very infrequently, but it is a simple way to check your microphone if you suspect that it is not working correctly.
2. The ½" microphone that we are using as a reference is calibrated with a sound calibrator that emits 1 pa (RMS) at 1 kHz. Read and note the amplitude of the calibration signal and use it to scale subsequent measurements.
3. Place the ½" microphone in the setup in the holder, choose the 'reference' button, set the number of sweeps and start a measurement (run).
4. The ½ microphone you use is a pressure microphone. This kind, in contrast to free-field microphones, has maximal response when the membrane is pointing at the sound source (pressure build-up in front of the membrane). Free-field microphones, in contrast, are 'vented', so they do not show pressure build-up. Try to point the ½ at the source and compare the response to a position where it is perpendicular to the direction to the source.
5. Now connect other kinds of microphones (probe, ¼ ", Beyer), select the test button and compare them to the reference
6. Try to insert a baffle on the reference microphone and compare recordings before and after. **Microphones are sensitive to their immediate surroundings** (such as, e.g. a person holding the microphone) – any obstacles diffract or reflect sound and changes the sound measured by the microphone. This is more important the higher frequencies you record.
7. The reference microphone can also be used to calibrate the speakers. The speaker output is measured in response to a flat FM sweep. The spectrum of the response divided by the spectrum of the sweep is the transfer function of the speaker. If subsequent signals are **divided** by the transfer function before emitting the signals through the speaker, the output will be flat. Try to calibrate one of the speakers using the 'calibrate' menu. Check the quality of your calibration.