

# Neuroprothetik Exercise 7

## CI filter banks

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### 1 A simplified cochlear implant model

Cochlear implants (CIs) consist of an array of equidistant electrodes which address different frequency bands of an incoming sound signal. In the following two exercises, we will compare CIs with different electrode numbers.

#### 1.1 Electrode corner frequencies

The band-pass filters in CIs range from about 200 Hz for the most apical electrode to 8 kHz for the most basal electrode. Use `logspace` to calculate the corner frequencies of the filters in CIs with 3, 6, 12 and 22 electrodes. Plot the result for the 22-electrode CI. (solution for 3 electrodes: [200, 680, 2340, 8000])

#### 1.2 Implement a filter bank

Implement an eighth-order band-pass filter bank with the corner frequencies from 1.1 for all given CI types using the Matlab function `own_filter(...)` given in moodle.

Record an acoustically interesting word with a microphone and filter it with the filter banks.

Plot the frequency response of the filter bank on a double-logarithmic scale for 3 and 22 electrodes (don't forget the units).

Plot and listen to the output (time signal) of each filter channel of a 12-electrode CI.

In moodle, you also find an example how to use the functions. If you use python, you can implement a simple butterworth filter and use it in a similar way as in the example.

#### 1.3 Join the channels

Sum the channel outputs and listen to the result. Plot the spectra (`loglog`) and spectrograms (`spectrogram`) of joint signal for all given CI types. Use a time window of 10 ms with an overlap of 5 ms for the spectrograms.