New Trends on Frequency Compression

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Summary

Frequency lowering serves people with hearing impairment who do not get sufficient or appropriate audibility restoration from conventional amplification. This may be true because of the degree of hearing loss or because of the low level of the interesting signals. Frequency compression has been Phonak's solution for frequency lowering (SoundRecover). The effect of amplification alone is limited with regard to the processing quality which the impaired human ear provides in the high frequency region (loudness recruitment, frequency resolution, dead regions) and with regard to technical limitations of hearing aids (feedback stability, saturation effects). With frequency compression the said restrictions can be mitigated considerably.

SoundRecover acts as a static instantaneous frequency compressor. Below the cutoff frequency linear frequency processing is applied, above it output frequencies are compressed with a particular compression ratio. This principle works nicely for a large range of hearing losses but has its limitation with profound hearing losses when cutoff frequencies below 1.5 kHz would be needed.

Cutoff frequencies below 1.5 kHz would – in case of harmonic sounds as to vowels or musical tones – distort the harmonic relation of overtones above the cutoff frequency too strongly and lead to a unnatural sound quality. SoundRecover2 has been developed to overcome this limitation. It replaces static frequency compression by an adaptive compression scheme. The input output function for frequencies has three segments. The first segment below the cutoff frequency 1 is linear. The lowest possible cutoff frequency 1 is 800 Hz. Between cutoff frequency 1 and cutoff frequency 2 the compression scheme is adaptive. This means the compressor behaves either linearly if the levels of the lower frequencies are dominant relative to the levels of the higher frequencies or compressively if the levels of the higher frequencies are dominant. This adaptive principle makes sure that the harmonic relations of the overtones of harmonic sounds like vowels or musical tones are maintained up to a higher frequency as being possible with the original SoundRecover, while fricative and other high frequency sounds are effectively compressed making them more audible. The third segment of the input output function is static compression as known from the original SoundRecover.

The adaptive compression principle offered to lower frequencies in SoundRecover2 – provides increased audibility for hearing impaired people, including profound hearing losses. The adaptive part of the compression scheme provides more natural sound quality and effective increase of high frequency sounds.

The hearing care professional is provided with two parameters for adjusting SoundRecover 2 to the individual needs of the hearing impaired user. With fitting parameter "A", he or she selects the balance between two factors related to auditory clarity: Audibility increase versus discrimination of audible sounds. With fitting parameter "B", the hearing care professional can adjust the balance between increased clarity and naturalness of hearing. With the Phoneme Perception Test the hearing care professional can easily check if SoundRecover2 is set appropriately for a hearing impaired individual.

In terms of clinical evaluation it comes to a limitation of test material which is currently available on the market and in addition is sensitive for this kind of new technology. Especially for German speaking countries. The clinical evaluation of SoundRecover2 was mainly done with the Phoneme Perception Test (Schmitt et al. 2016).