

From AutoPilot to SoundFlow

CORE (Communication Optimized Real-audio Engine) sets new standards

The correction of hearing loss through use of a hearing system remains, as always, a task where audiologists and developers push the limits of technical possibilities. The greatest challenge is to improve hearing, a biological system, through use of an electronic device. This requires close collaboration of people from different disciplines. Phonak, as a top manufacturer of hearing systems, is the leader in this area. Through worldwide networking with important research institutes, it is guaranteed that the newest audiological research findings are applied in further development. In this way, Phonak brought bionic expertise for the first time to hearing systems a few years ago. The key was the development of the Palio platform, a universal chip set that revolutionized hearing technology at that time. The introduction of the multi-base approach made the application of various, individually configured programs for different hearing situations possible. While other available systems worked with only one base program (single-base approach) and, depending upon the situation, activated parameters such as noise reduction or directional microphone, multi-base made possible the creation of

completely different hearing programs which can be optimized to an individual's hearing objectives. With the newly developed CORE platform, Phonak introduces a digital audio processor which has performance and options well beyond anything in the market today. The new platform is first implemented in the new Phonak product families, Exélia and Naida, and offers the user as well as the hearing care professional completely new tools and resources to address the problems of hearing loss. Along with many functionalities never before seen in hearing systems, the CORE platform with SoundFlow makes the unique multi-base technology from Phonak even more efficient. Improved understanding and more natural sound quality is now possible in many hearing situations.

Different hearing situations and a winner

The acoustic environment is made up of countless, often very different situations. A perfect hearing system should be able to adjust itself automatically and seamlessly to the different situations in order to provide the user with optimal speech understanding and comfort. This is the reason that modern hearing systems feature different hearing programs. Characteristics for a specific program include a set of special parameters which configure the optimal combination of factors such as frequency range, gain model, compression, attack and release times, directional microphone technology, noise reduction, feedback reduction, wind noise reduction, echo reduction, suppression of reverberation, etc. These factors harmonize like musicians in a symphony orchestra to achieve the goal of having the best speech understanding and most comfortable hearing in all sound environments. This harmonic meshing of the various parameters in a hearing program explains the advantages of the multi-base technology over single-base systems. It is well known that the numerous acoustic environments can be classified so that four main categories; Quiet, Speech in Noise, Noise and Music can be accommodated with appropriate programs. This knowledge was used to develop the AutoPilot function. The acoustic environment is continually monitored, classified in categories, and the dominant base program is activated. The classic situation is that a "winner" dominates over the other programs.

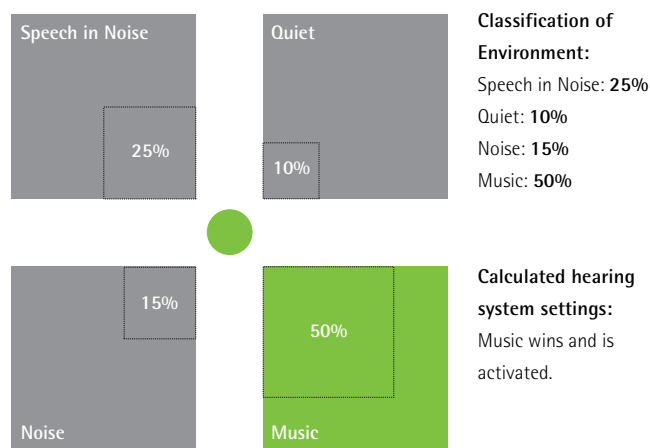


Figure 1: AutoPilot functionality. The results of environment classification lead to activation of a base program, in this case Music.

This system functions quite well but pushes its limits when unclear situations occur or when there should be a transition from one environmental category to another.

Does it work without a winner?

To further improve the detection and adaptation of this system in various hearing environments we need to look deeper into the challenges of environment recognition. The world of hearing is made up of numerous acoustic environments which although classifiable, seldom fall 100% into a "winner" classification. More often, a mix of

various environments occurs which contain a certain percentage of all categories.

SoundFlow – the unique solution to a digital problem

Where there was formerly a clear, distinct winner in classification of a current hearing environment and a disregard of the other underlying sound classes, Exélia and Naida, with the new CORE platform, achieve a balance between the two. There are no more "losers". Just like the visual world, the acoustic world is not just black and white but also grey or colored with many subtle nuances. Now, similarities in hearing situations are identified but do not serve to determine a classification. Instead, they become a foundation for the system to use. In other words, the effective hearing program establishes itself as an elaborate mix of individual programs where each of the base programs blend their characteristics. SoundFlow creates an exquisite composition of a program exactly customized to the hearing environment, built on the base programs working harmoniously together.

If, for example, the environment analysis shows the presence of speech, quiet, noise and music, a program is created that addresses these specific conditions. As the environment changes, the programs will continually readjust and the blended program changes from one area to another. This happens automatically as the environment requires.

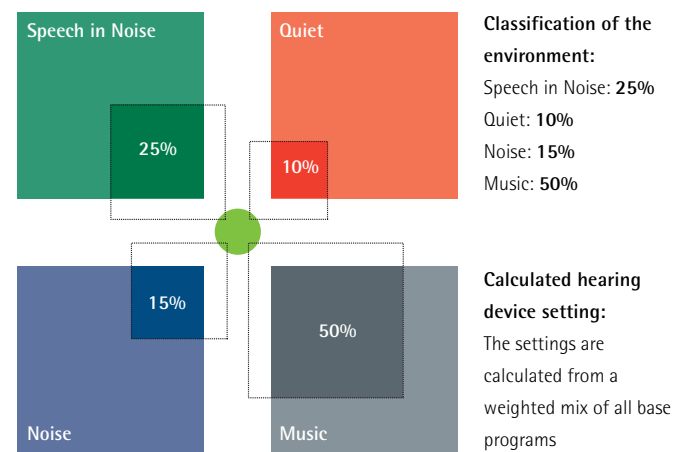


Figure 2:
Schematic illustration of SoundFlow

High resolution environmental analysis

Now that not only one winner is considered in the environmental analysis but rather all environmental situations are brought into the hearing program, an exact analysis of the environment is critical. The combination of acoustics, position of the sound source, noise and signal characteristics make every hearing environment unique. The composition of an optimal hearing program from the various base programs has, indeed, brought a clear improvement in sound processing quality. But the engineers were not yet satisfied. SoundFlow also allows specific functionalities to work individually, as needed, in particular hearing environments. SoundFlow utilizes various complex statistical measures to analyze the current hearing

environment. For example, an echo in a stairwell or wind noise in an open convertible are not just identified as speech in noise or noise but automatically activate the EchoBlock or WindBlock management systems.

In this manner, subclasses such as fading speech, wind noise, etc. can be differentiated and thereby more effectively processed achieving an even more optimal result.

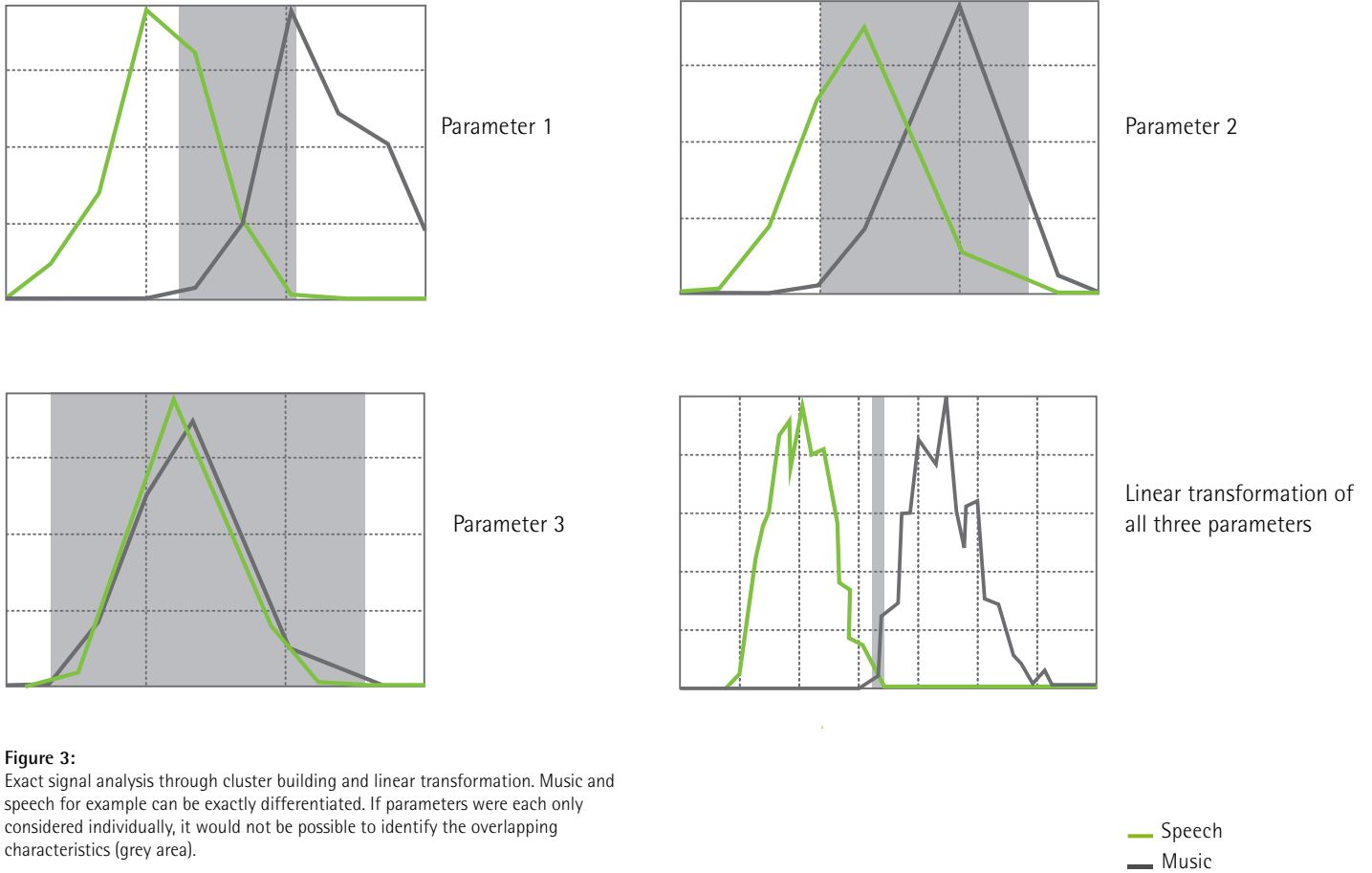


Figure 3:
Exact signal analysis through cluster building and linear transformation. Music and speech for example can be exactly differentiated. If parameters were each only considered individually, it would not be possible to identify the overlapping characteristics (grey area).

Everyone hears differently

That every person has different preferences is well known. According to the previous explanation, it seems as if SoundFlow might consider all people the same without considering their personal likes and dislikes. Not true. In order to achieve the most personalized configuration for every individual, SoundFlow features functionalities to account for personal preferences. The fitter can select if a specific program should have a higher or lower level of importance. If, for

example, the end user places high priority on good understanding in noise, he can give the Speech in Noise program a higher preferential weighting. The other programs will be reduced proportionally in their level of importance compared to the Speech in Noise program.

Better hearing for profound hearing losses

Until now, people with profound hearing loss had significant problems, particularly in fast changing hearing situations and have not liked automatic program switching systems. Automatic activation of, for example, a noise cancellation function could result in a loss of audibility and/or clarity, a particularly annoying problem

for someone with a profound hearing loss. With SoundFlow, end users can finally be offered an automatic system that can be configured exactly to their individual preferences and which adjusts smoothly and without disruption.

Better and more comfortable hearing in all situations

The new SoundFlow brings significant improvement in the recognition and processing of different hearing environments.

For the user this means:

- Hearing systems with CORE operate more naturally than ever before
- The blend of different hearing programs results in a significantly better fitting in varying hearing environments
- The hearing system reacts optimally in every situation
- A more exact classification of different hearing situations is possible
- The hearing system reacts significantly faster and more precisely to changes in the hearing environment
- Better speech understanding and comfort, for example in the car
- Transitions are no longer audible
- Even better sound quality
- Customer satisfaction is increased

Conclusion

The CORE platform from Phonak sets a new benchmark in automatic adaptivity. Numerous innovations made possible with the introduction of SoundFlow means the active hearing program adapts more specifically to the sound environment and also takes individual preferences into consideration. Thanks to SoundFlow, it is also finally possible to offer people with severe to profound hearing loss a device that automatically adjusts to sound environments and still meets their special power needs.