swissaudec®

FAQ

What is novel about swissaudec's technology?

In the fifties Bell Laboratories started his research activity in the field of so called „pseudostereophonic" signals. Manfred R. Schroeder, a German physicist then suggested to generate a sum and a difference signal out of a single mono channel signal the way that their sum equals 1 (the original mono signal would then be rendered). Most prior art „pseudostereo" methods are more or less based on such a processing method, however, they fail to to render plural sound sources constantly on the sound stage as these sound sources would move in functional dependency on frequency.

The British mathematician Michael A. Gerzon, a professor at Oxford University who by his love for music and electroacoustics was to be the most eminent figure in theoretical electroacoustics (inventing together with Peter G. Craven a three-dimensional sound recording system named the „Soundfield" microphone), suggested a cascaded complex gain processing peudostereophonic method as well as a frequency-dependant rotation matrix in order to stabilize this undesired movement – which implies that plural recorded sound sources rendered by the same mono signal will be uniformly dispersed across the sound stage.

Pseudostereophonics methods therefore proved themselves inferior to classical stereo recording techniques so far and never enjoyed vast popularity among engineers and amateurs.

When starting our research activities in this field trying to develop a mathematical filtering method which then should render fully professional Stereo or multi-channel sound we were not driven by the agnostic approach scientists had already adopted when talking about pseudostereophony. All attempts had been arbitrary so far, and none of these pseudostereophonic methods ever had taken *the original recording situation* into consideration.

Our method is the first filtering method that will render plural sound sources varyingly distributed in space without their moving in functional dependency on frequency!

What are the scientific challenges behind a one-channel-based 3-D sound image?

A single channel *per se* may not reveal the spatial parameters which are necessary to create Stereo or Surround sound. This problem is called an „ill-posed inverse problem" as the dimension of the given data (in our case a single audio channel) does not correspond to the necessary dimension of the data to be derived (in our case e.g. plural loudspeaker signals). However, the approximative solution for an „ill-posed inverse problem" represents the smart answer. VoiCode® is such an approximative solution by creating an ideal virtual MS stereophony.

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As soon as the original Stereo or Surround signal is known, or the original recording situation has been adequately measured the spatial parameters are no longer unknown. In this case the approximation of such data by means of one single audio channel plus our VoiCode® filters represents a so-called „well-posed problem“ which may be easily solved.

How is this one-channel-based 3-D sound image being achieved?

MS recording techniques in many ways show similarities to Schroeder's initial attempts. They all use a mid microphone signal M and a side signal S which principally is a figure-eight pattern microphone turned 90 degrees to the left. A stereo representation then is calculated by the equations

(1) L = (M + S) * 1/sqrt (2)

(2) R = (M – S) * 1/sqrt (2)

which imply that the sum of the left and the right channel represent the mid microphone signal M – as would be with Schroeder's system.

Unlike Schroeder who arbitrarily distributed frequencies to the left and the right channel by means of complementary all-pass filters we focused on the question whether an S signal could be interpolated from the original recording situation and at the same would solve Gerzon's problem of plural uniformly dispersed sound sources.

Angular spread immediately turned out to be the major factor, and indeed, the angle-dependant simulation of plural omnidirectional microphones that would replace the initial figure-eight pattern microphone proved to be successful in reconstructing a spatial sound image.

What the system will calculate in detail are specific delays and amplitude corrections with respect to the angular spread of sound sources by which the entire spatial information can be recovered. Simple in its structure the core of this technology shows additional parameters for optimizing the sound stage.

Is the filtering method equal to existing stereo recording techniques with plural microphones?

The pratical results will show no difference in quality when being compared to first-rate professional MS recordings.

In this case the spatial distribution of sound sources will absolutely be respected by such a system!

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What are the additional technical features of swissaudec's three-dimensional filters?

These new filters can be adjusted the way that a specific degree of correlation may be obtained - literally varying from -1 to +1!

MS recording techniques, as are interpolated with the present filters, show vast editing possibilities. For instance the sound stage can be varied by changing the amplitude of the figure-eight S signal. The same variation, on a different mathematical basis, is also possible with the present filters. By employing stochastic methods (which recently have been patented on a worldwide scale) we have made these filters „intelligent" - which now will reconstruct the missing angular information for a genuine MS representation by calculating the best case.

Where can these revolutionary audio filters be applied?

This feature is of particular importance for deficient MPEG satellite signals that run a mid channel (L + R)/2 and a side channel (L – R)/2 - which are similar in their structure to MS signals (see above). Such deficient satellite signals may occur with so-called „rain fade" - meteorologically induced incoherent signal transmission. When applying our filters in this field the primary focus is to reconstruct the mid channel signal and to gather as much information about the side channel as possible – before processing the final signal as outlined above. The result is a fully professional stereo or Surround signal despite „rain fade"!

The same is valid for hybrid Internet radio, DAB, FM and PC streaming chips. FM radio broadcasts to a very large degree - for instance, in the United States and abroad - are still mono broadcasts – which by means of our system may be easily converted to genuine stereo or Surround!

Electronics are reigned by the principle of perpetual miniaturization, and transducers are fully in line with this fact. Only a few years ago MEMS (Micro-Electro-Mechanical Systems) started to enjoy wide popularity among electronic device manufacturers; and the first MEMS microphones were built into consumer electronics due to their indifference to electromagnetic fields. 1.7 billion of these miniature microphones - which are directly mounted on a tiny chip - have globally been sold so far. They generally show an omnidirectional polar pattern and therefore can only be used with highly instable prior art A-B stereophony.

Their frequency response, however, is excellent, and together with the present filters (for which we have chosen the portmanteau VoiCode®) can be turned into fully professional Stereo or Surround microphones that will, for instance, fit into an ordinary computer, handycam, mobile phone or iPod. A fully professional recording studio always at the user's fingertip might be the consequence (as our VoiCode® filter layouts only consume about 1% of the surface of an average consumer electronics microcontroller, they may likewise be directly integrated on the MEMS microphone's chip and may further revolutionize miniature consumer electronics!).

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The spatialization of sound is a very important feature with handsfree sets - particularly in the automotive industry. As the car's noise suppresses important formant frequencies, and consonants like „b", „p", „g", „k", „d", „t" or „f", „s" cannot be discerned any more, the driver (in his attempt to catch the important information) is distracted. He will furthermore focus on the localization of his interlocutors in one single spot somewhere between the car's loudspeakers...

The smart answer to this dilemma is to create a stereo or Surround sound image out of the original phone signal by means of VoiCode®. This new feature could be in line with further VoiCode® filtering of deficient car FM radio signals which is based on the same technological background as the reconstruction of satellite broadcasting signals in case of „rain fade".

Conventional car FM stereo signals furthermore suffer from the fact of continuously changing receiving conditions. As soon as the sub-channel L – R is poor the radio receiver automatically switches to the main channel L + R - leading to an incoherent sound image which may be described as „stereo pumping" - which with VoiCode® never will occur!

The present method to calculate an MS stereophony on the basis of an angle-dependant simulation of plural omnidirectional microphones has also successfully been tested in industrial measurement techniques: by means of VoiCode® filtering we then could localize sound sources or reflexions with one single mono microphone - in our case mechanical loudspeaker defects which had been recorded by one single omnidirectional test microphone. These mechanical defects indeed could be made visible with a goniometer (as their localization is frequency-invariant)!

The same methodology may likewise have a strong impact in related fields – stabilizing, for instance, medical Live 3D ultrasound (which currently is based on an about-turn of the scanning plane) and hand-carried ultrasound – as angular sound reflexions may now be localized by our VoiCode® filters.

What is the overall potenial of the present technology?

In the long run this technology might be the sound alternative for creating and decoding stereo or Surround - just a handful filter parameters of a few bit then would be *lingua universalis* in modern electroacoustics - replacing the current bulky multi-channel formats!

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