Microphone Techniques for 2.0 and 5.1 Ambience Recording

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Abstract

Ambience is an important part of any mix. It is responsible for the listener's sense of involvement and envelopment, and the impression of the type of space in which events are occurring. This is true for nearly every type of recording, whether it be music, film sound, a sports presentation, etc. Ambience miking thus takes on a decisive role.

The three layers of ambience are explained along with their respective goals and suitable microphone setups. Finally, particular ambience microphone techniques for 2.0 and 5.1 are introduced, and their principles of operation are illustrated. An extensive investigation and collection of recordings, originally created for the VDT "Ambience Recording" seminar, is described and offered for free use.

1. Introduction

The functions of ambience in a recording are many-sided, making it an important topic for recording producers and engineers, and interesting for researchers as well. Ambience is supposed to draw the listener into the scene, create the experience of envelopment, provide an impression of a space and of the listener's orientation within that space, define the sonic character of the scene, and finally, contribute significantly to producing the mood of a scene. It is thus an essential component of dramatic portrayal.

Ambient elements are part of nearly every kind of sound mix, their goals being none other than those of the recording as a whole. Thus to seek the art of ambience recording amounts to no less than seeking the art of good sound recording itself. Any discussion of the means for producing a convincing ambience pickup will include all the elements of which a good recording or sound mix consists. Or more concretely: Whoever can make a good ambience recording is well on the way to making a good recording or sound mix in general.

2. Real or Fake?

When we listen to audio, we never hear what we think we are hearing. Every recording or sound mix contains some proportion of pseudo- or hyper-reality. The question of making a 1:1 recording of the occurrences at the recording location has, to that extent, become obsolete; instead, the question is now, "What expectations of the listeners must I fulfill, and what perceptions must I provide for them, when I record at this location?"

A primary reason for this is that the totality of perception in the playback environment is severely restricted. Many features are missing that a person present in the recording locale would draw upon, consciously or unconsciously, to help grasp the mood of the setting: visual (3D) information, foreknowledge of the spatial arrangement and of the acoustic sources, as well as a feel for the general "atmosphere" of the occasion.

For film sound recordists, all this is completely obvious. They know how to produce particular perceptions, whether based in reality or not. Music and other sound materials are deliberately employed for a partly subconscious effect, *e.g.* chirping crickets or howling dogs. Even in documentary films, various means are employed to "help perception along," although any effects that would be obvious as such are avoided.

Do the same restrictions apply to ambience pickup in the concert hall? In this case it is equally impossible to convey the entire scenario. And of course one is obliged to convey, generally far more than in film sound, only sounds that actually occur in the hall—a considerable limitation[1]. This leads to the question of which approach to live recording is best at fulfilling the operative expectations. Usually there is no direct relationship to any visible scene, so one is relatively free with respect to the reproduction of directional location, distance, and room sound. This widens the range of miking choices and leaves room to optimize certain practical issues. As an example, the orientation of the cardioids in a Theile Trapezoid (see section 7.5) optimizes the suppression of front-arriving sound rather than the creation of a proper 360° directional image.

3. Layers of ambience

Ambience consists of several layers, each having its own function. This is described in [2]. Since these functions are also achieved by different means, it is important to know what ambience is composed of, and how to choose microphone setups that are appropriate for each component.

Figure 1 shows the three layers.

Layer 1 contains diffuse, non-localized elements. Hall reverb belongs to this layer, as well as diffuse environmental sounds such as rustling leaves, traffic noise, background music, etc. "Diffuse" means here that the signals do not originate from any one fixed direction, and thus cannot be localized. This layer is responsible for giving the listener the impression of the space in terms of its overall arrangement and size, and to envelop the listener so as to draw him in to the virtual space. For this to be achieved convincingly, it is absolutely necessary that the signal be diffuse on the playback side as well. This is difficult to fulfill, however, and it separates the wheat from the chaff among microphone techniques. To produce a diffuse sound field, the loudspeaker channels must reproduce uncorrelated layer-1 signals throughout the entire frequency spectrum. The loudspeaker signals as a whole don't need to be fully uncorrelated, though, since of course they are also made up of components from layers 2 and 3 as well as non-ambient components. Techniques for producing broadband, uncorrelated layer-1 components are considered in further detail in section 5.1.

1 This limitation doesn't necessarily apply in all cases. Artificial enhancement via the use of archival material sometimes occurs even in the live "reality" formats of sport and music, *e.g.* archived applause or skiing sounds in cross-country.

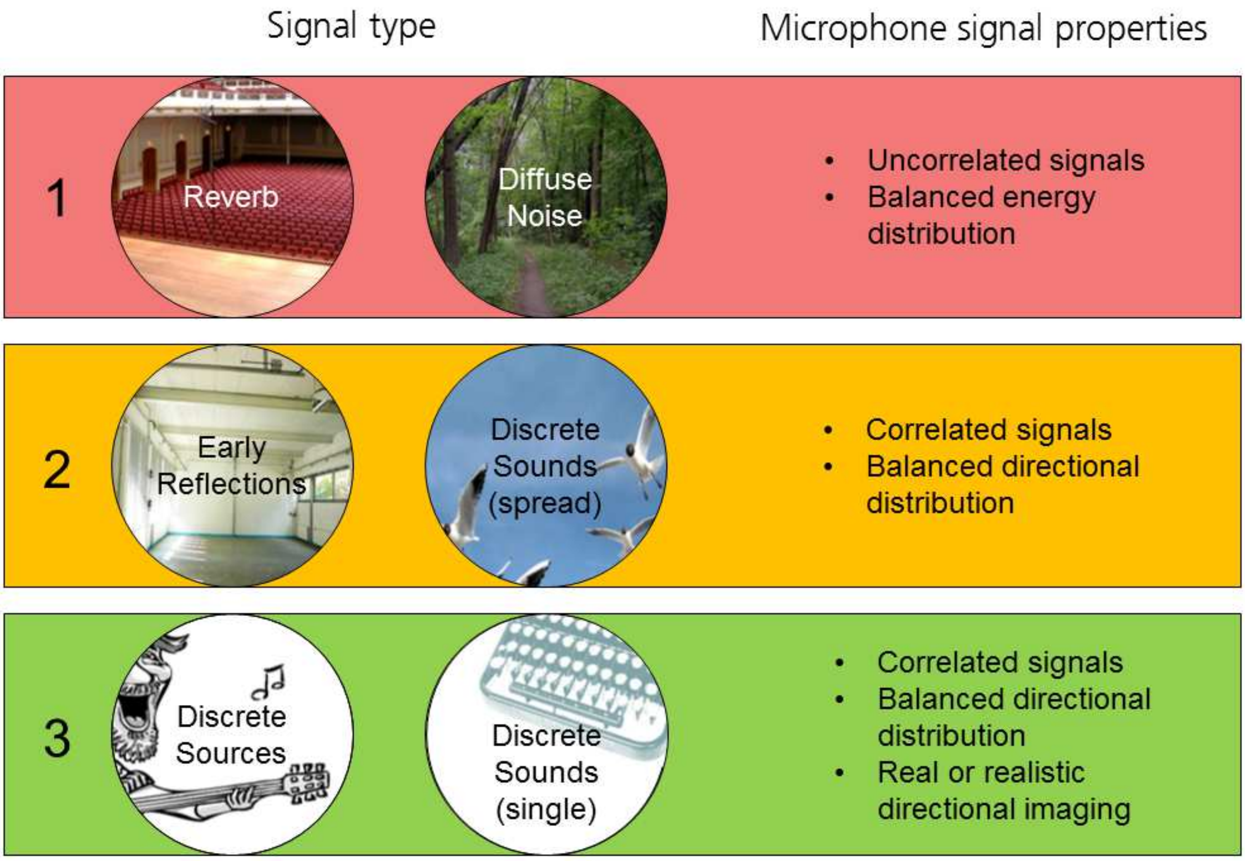


Figure 1: The three levels of ambience and their distinguishing characteristics

Layer 2 contains components that are discrete in that they arrive from particular directions, but their directions of origin don't have to be represented in 1:1 fashion. The birds shown in Figure 1 are an example of this; it doesn't matter which bird is perceived to be where; rather, what matters is that bird sounds arrive from all directions equally. The function of these sounds is to convey the size and the mood or "tuning" of the space, thus supporting the dramatic composition.

The all-important early reflections should also be reproduced in a discrete, well-distributed manner. But the actual direction of origin in the recording space for these reflections doesn't matter. The function of early reflections is for the perception of depth and distance.

Layer-2 signals should be reproduced discretely, *i.e.* as phantom sound sources between at most two loudspeakers. Only then can they be localized as their function requires. Thus the recording techniques for this type of signal, described in section 5.3, are essentially the same as those for ordinary stereophonic recording. But only an approximate correspondence in localization is called for, not a linear localization curve[1]; more about this in section 5.2.

Layer 3 contains the discrete sound components whose perceived direction is relevant. In an ambience recording this would include a car driving by, for example, or any sound sources that are intrinsic to a particular place, such as from a coffee machine or the closing of a door. Layer-3

1 A *localization curve* indicates the phantom sound source location in the playback space as a function of the angle of sound incidence in the recording space. Localization curves for various microphone arrangements are given in sections 6 and 7.

signals should be reproduced discretely as phantom sound sources between at most two loudspeakers. In this case, unlike layer 2, the exact localization curve provided by the microphone arrangement is very important. The correspondence doesn't usually have to be 1:1, but a correspondence that allows for optimal reproduction must be assigned. In the case of an automobile driving by, for example, a recording angle of 90° might be appropriate, and the sound could be reproduced between L and LS; more on this in section 5.3.

4. Purpose-oriented recording techniques

No one ambience recording technique can have the perfect characteristics for all situations, since the functions of the three ambience layers contradict one another to some extent. Each recording technique is ideal for only one particular combination of these layers. Such a combination comes about when ambience signals from more than one layer occur simultaneously, as they do in most recording situations. The choice of recording technique depends significantly on the combination of ambience layers at hand. The table below shows some examples for combinations of layers and possible miking solutions.

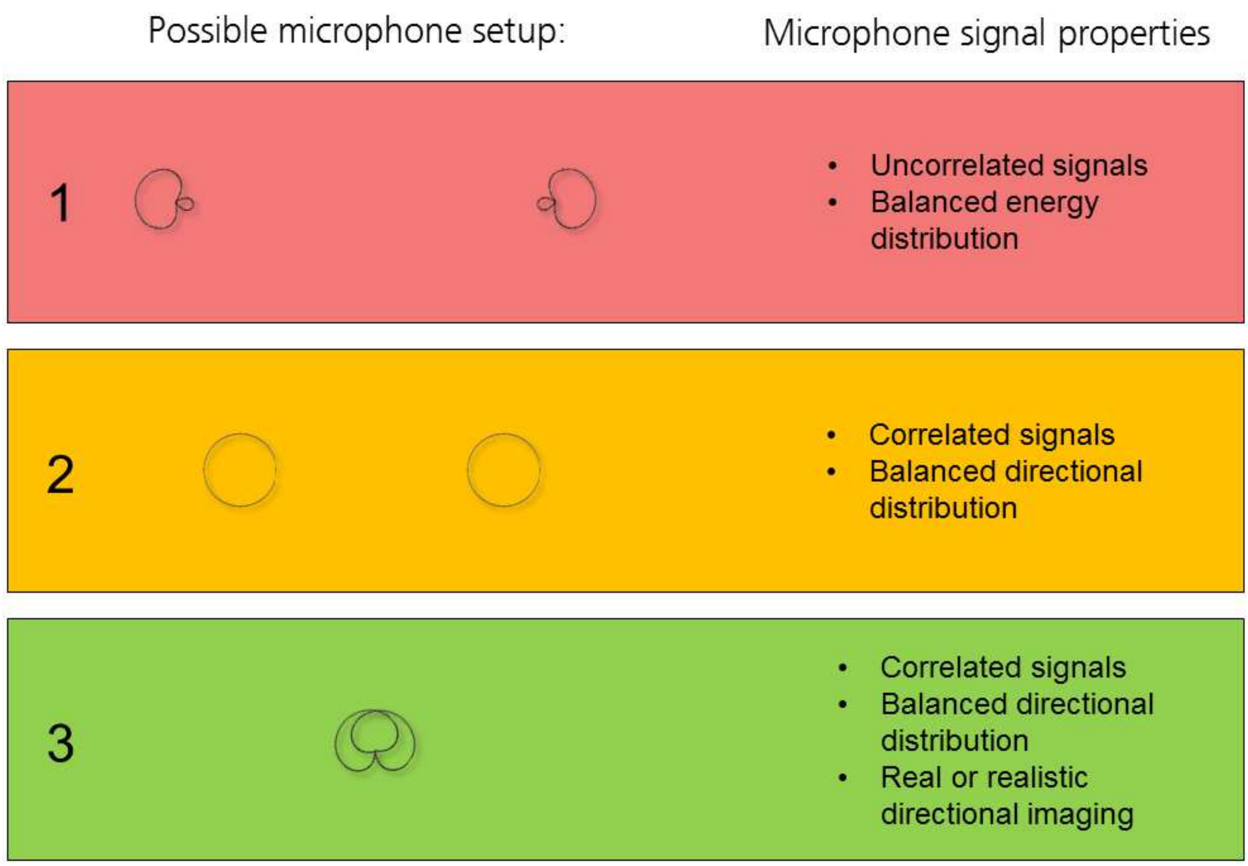
Each cell in the right-hand column shows just one example of a suitable microphone arrangement. The actual choice will depend significantly on the priorities which the producer sets for the recording, and the compromises that can most readily be accepted. One producer might like to work with omnidirectional microphones for sonic reasons, while another might place more emphasis on natural spatial imaging.

Combination of layers			Example	Possible microphone setup for 5.1 (see sections 6 and 7)
1	**2**	**3**		
X	**X**		Film ambience without discrete sounds	5 omnis
X	**X**		Room microphones in a concert hall	Hamasaki Square
X	**X**	**X (no center)**	Stadium ambience for sports events	ORTF Surround
X	**X**	**X (with center)**	Documentary film ambience with discrete sounds	5 wide cardioids
X	**X**	**X (front only)**	Orchestra in a concert hall	OCT Surround, OCT + Hamasaki
	X	**X**	Dry outdoor ambience	Double M/S, ORTF Surround
		X	Dry recording of a radio play in a studio	Double M/S

Practical considerations also play a significant role in the selection of a microphone setup. A gigantic arrangement of omnidirectional microphones, for example, would be out of the question for most applications even if one might think of it as ideal.

Practical considerations that affect the choice of a microphone setup:	Sonic considerations that affect the choice of a microphone setup:
• Size of the setup • Simplicity, robustness • Wind protection • Downmix compatibility • Cost • Flexibility in post-production • Number of recorded tracks • etc.	• Sound color • Quality of the spatial image • Envelopment • Natural rendering of the space • Directional imaging • Directional characteristics of the setup • etc.

Specially configured setups that offer complete "solutions" including suspension, wind protection, multicore cables, means for attaching the microphones and even for keeping them warm, can help to avoid errors while providing for rapid, reliable assembly. Whether sonic compromises result from this approach is a matter for the recording producer and engineer to decide. Many offerings on the market do represent large compromises. In the following sections, this paper will show that one cannot have everything all at once, because physics and psychoacoustics set the rules.



5. Recording techniques for the three layers of ambience

As described in section 3, different purposes must be kept in mind when choosing a microphone arrangement for the three layers of ambience. Figure 2 provides another overview, this time with focus on the microphone arrangements.

Clearly it is difficult to find a microphone setup that delivers optimal results for all three layers. But the requirements are not as different or as incapable of being brought together as it seems. To this end, please consider the following analysis of the requirements of each ambience layer.

5.1. Microphone arrangements for ambience layer 1: Diffuse signals

It is indispensable for the diffuse sound field in the recording space to appear diffuse in the playback environment as well. If, for example, the reverberation is reproduced as a mono signal, it will be falsely localizable from one direction. It will also lose its enveloping quality and the intuitive information as to the size and makeup of the recording space. This will have a markedly negative effect on the sound quality of the reverberation. Figure illustrates this effect in the case of reproducing the diffuse sound field in a wooded area.

Figure 3: Diffuse ambience (wooded area with rustling leaves), showing the original and its reproduction via loudspeakers.
Left: The ambience is localized; it seems narrow, with an unnatural coloration
Right: The ambience is reproduced in an optimally diffuse manner

To produce a diffuse signal in the playback environment, the loudspeaker signals must be uncorrelated, *i.e.* the degree of correlation or coherence between each pair of loudspeakers must be small. In the following discussion, we assume that the microphone signals are routed discretely to the individual loudspeakers[1,2].

The requirement for low correlation is particularly difficult with multi-channel setups, but it is nonetheless essential. Three simple rules apply when miking diffuse sound (see Figure).

Thus there are three general measures to produce uncorrelated signals when placing microphones: the distances between the microphones, their directivity, and the angles among their main axes. These three can also be combined, of course.

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1 Analogous investigations can also be made with a (double) M/S setup, if one considers the virtual X/Y microphone signals that result from the M/S decoding.

2 For the sake of completeness: In theory there are other methods for producing uncorrelated signals besides an uncorrelated pickup in the recording space, *e.g.* artificial decorrelation by means of suitable algorithms.

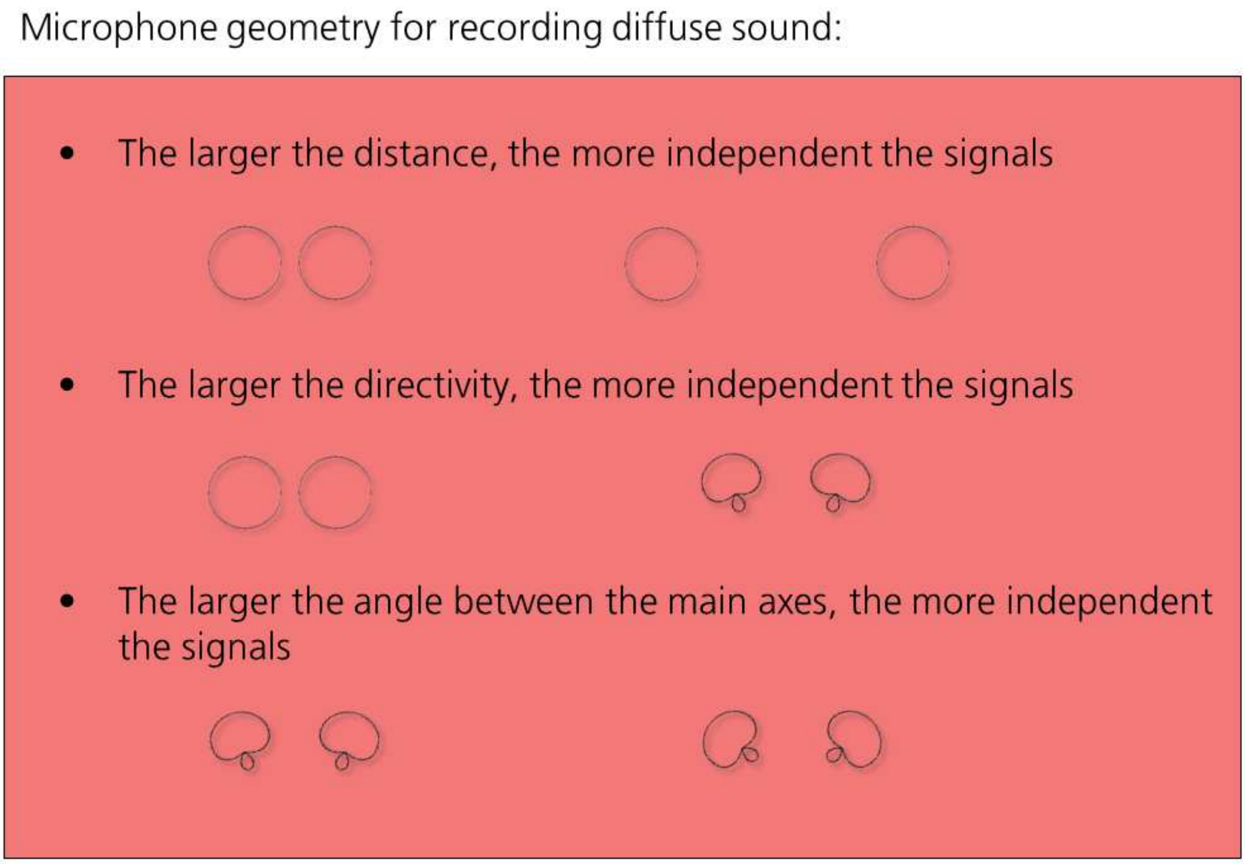


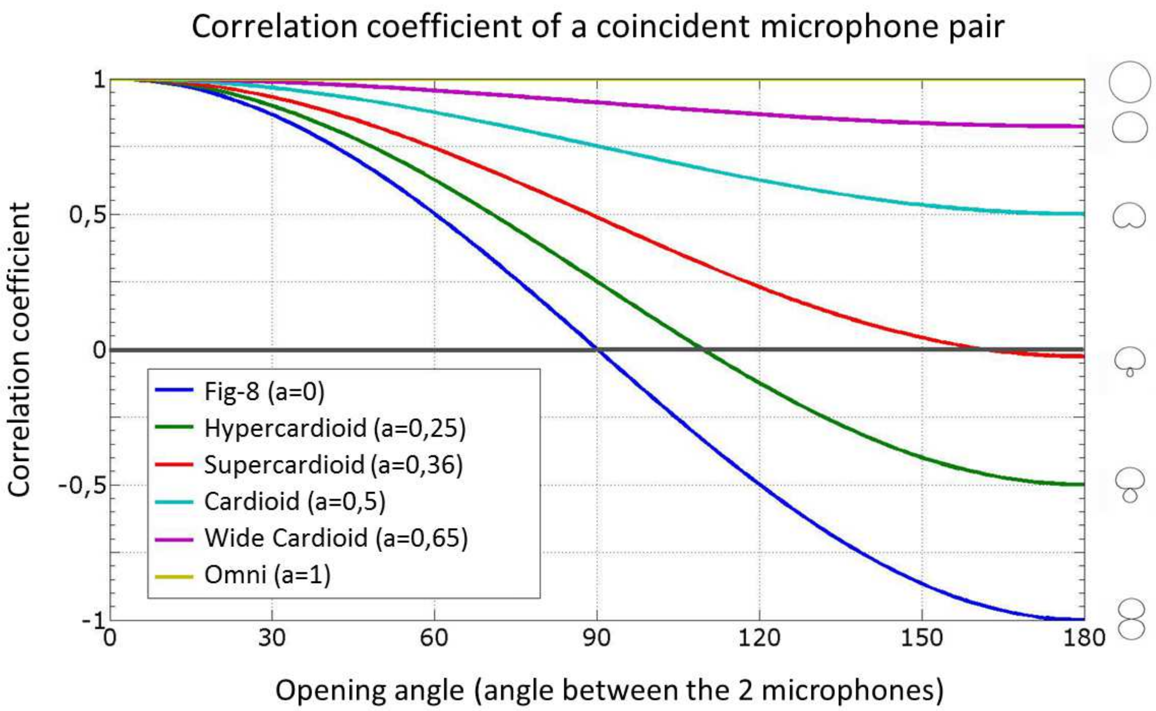
Figure 4: Simple guiding principles for uncorrelated recording of diffuse sound

Coincident Microphones

Given that the distance in this case is zero, Figure illustrates how the factors of microphone directivity and the angle between 0º axes affect the interchannel correlation of a coincident microphone arrangement. The assumption has been made that diffuse sound is predominant in the recording environment. The resulting correlation is called “diffuse-field correlation” (DFC).

It can be seen from this graphic that with a coincident microphone arrangement, a low diffuse-field correlation is possibly only for supercardioid (angle ≥ 120°), hypercardioid (angle ≥ 90°) or figure-8 microphones (angle ≥ 75°). From experience, a good value of DFC is taken to be one that is lower than 0.5. The frequently-encountered arrangement of X/Y-cardioids at 90° thereby falls out of consideration with its high DFC value of 0.75. This explains the well-known inferiority of this arrangement with regard to spatial reproduction.

Thus a four-channel (let alone five-channel) coincident arrangement that meets this condition is hardly possible, at least with first-order microphone patterns. The minimum diffuse-field correlation for a usable four-channel arrangement is 0.5, assuming four supercardioids are set up with 360°/4 = 90° between each. Double M/S and first-order Ambisonic microphone arrangements (*e.g.* SoundField) share this disadvantage as far as spatial reproduction is concerned.



Mixed methods; methods based on arrival-time differences

Figure 5: Interchannel correlation as a function of the angle between the 0° axes of two coincident microphones of various patterns, translation from [Wittek et al., *2006]*

It is significantly easier to reduce the diffuse-field correlation by choosing microphone arrangements with distances > 0. However, this then makes the correlation dependent on frequency, since the effective distance approaches 0 for large wavelengths (low frequencies). The coherence curves show the correlation as a function of frequency. The first null occurs when the distance between the microphones equals a half wavelength: $d = \lambda/2$. Coincident microphone arrangements have the same value of coherence function at all frequencies, which corresponds to the correlation coefficient.

With spaced-microphone arrangements there is no one reliable value for the correlation coefficient[1], since this value should be integrated across basically the entire frequency range. Spaced-microphone arrangements behave at low frequencies like coincident microphone arrangements, while at higher frequencies (wavelengths > $\lambda/2$) the function value approaches 0. Figure indicates the coherence function for various setups.

1 The "correlation meter" is a problematic instrument for investigating diffuse-field correlation, since in practice a pure, diffuse layer-1 signal almost never occurs. The overlay of discrete signals leads to false result values. Furthermore, with spaced microphone arrangements, the meter incorrectly responds to discrete signals as if they were diffuse, if the arrival-time differences exceed the integration time of the meter. *See also* [Dickreiter, 2008, Vol. 2, p. 1139].

Interpreting diffuse-field correlation

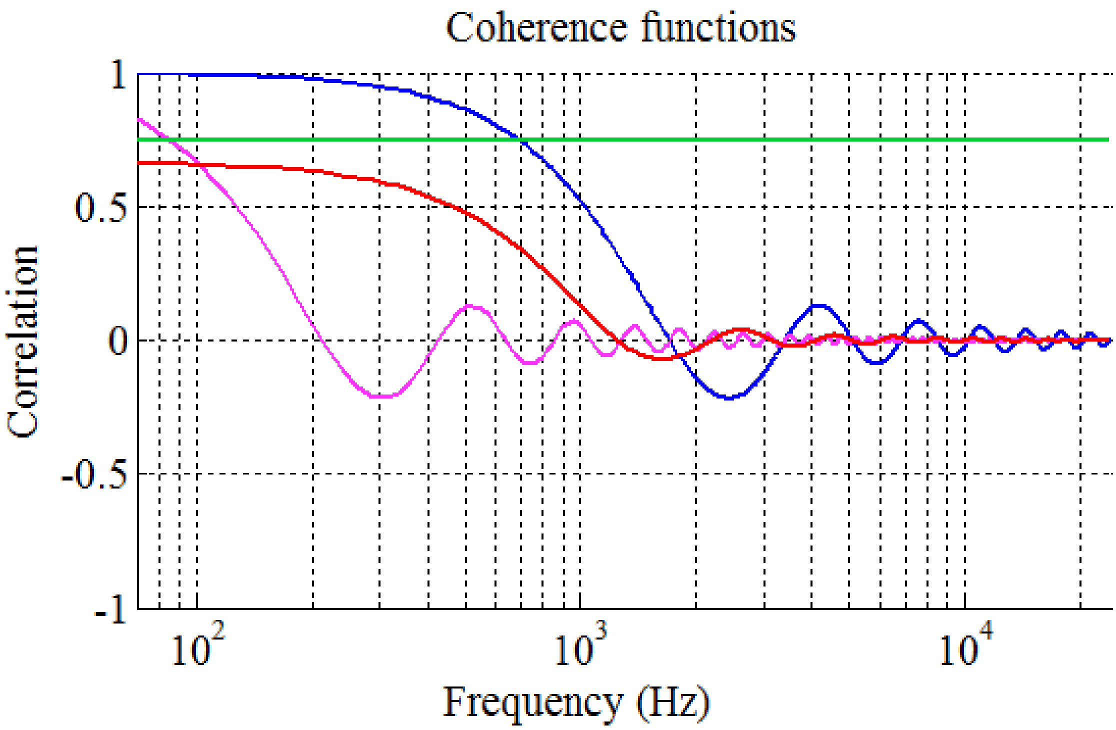
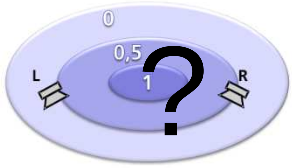


Figure 6: Coherence functions (diffuse-field correlation) of various microphone arrangements: green: X/Y cardioids at 90°; blue: A/B omnidirectional microphones with d = 10 cm; violet: A/B omnidirectional microphones with d = 80 cm; red: ORTF, cardioids, 17 cm, 110°

These mathematical analyses are of little use by themselves unless they can be translated to the level of perception. The issues are therefore:

- At what value of diffuse-field correlation does the perception of spaciousness begin to suffer?
- In a spaced microphone arrangement, at what frequency should the correlation function have its first null value?



Listening experiments designed to answer these questions were conducted in [Riekehof *et al.*, 2010]. Recordings of diffuse reverberation were made with a large variety of coincident, spaced-microphone and mixed arrangements. Listeners were then asked to rate whether the reverberant sound was perceived as being broad or narrow, with an X/Y cardioid arrangement serving as reference. The results are shown in Figure .

We may presume that it is optimal for sustained reverberant sound to be perceived as broad. Some microphone arrangements achieve this. But the problem is that no one value can be given for the DFC of a spaced microphone arrangement, since it depends on frequency. One assumes nonetheless that it is good for the sense of spaciousness if the area beneath the curve of the coherence function—its integral, in other words—is small, particularly at low frequencies (*see also* [Griesinger, 1998]). For this reason [Riekehof et al., 2010] attempted to determine a figure of merit for the diffuse-field correlation that represents, in practice, an integration of the squared

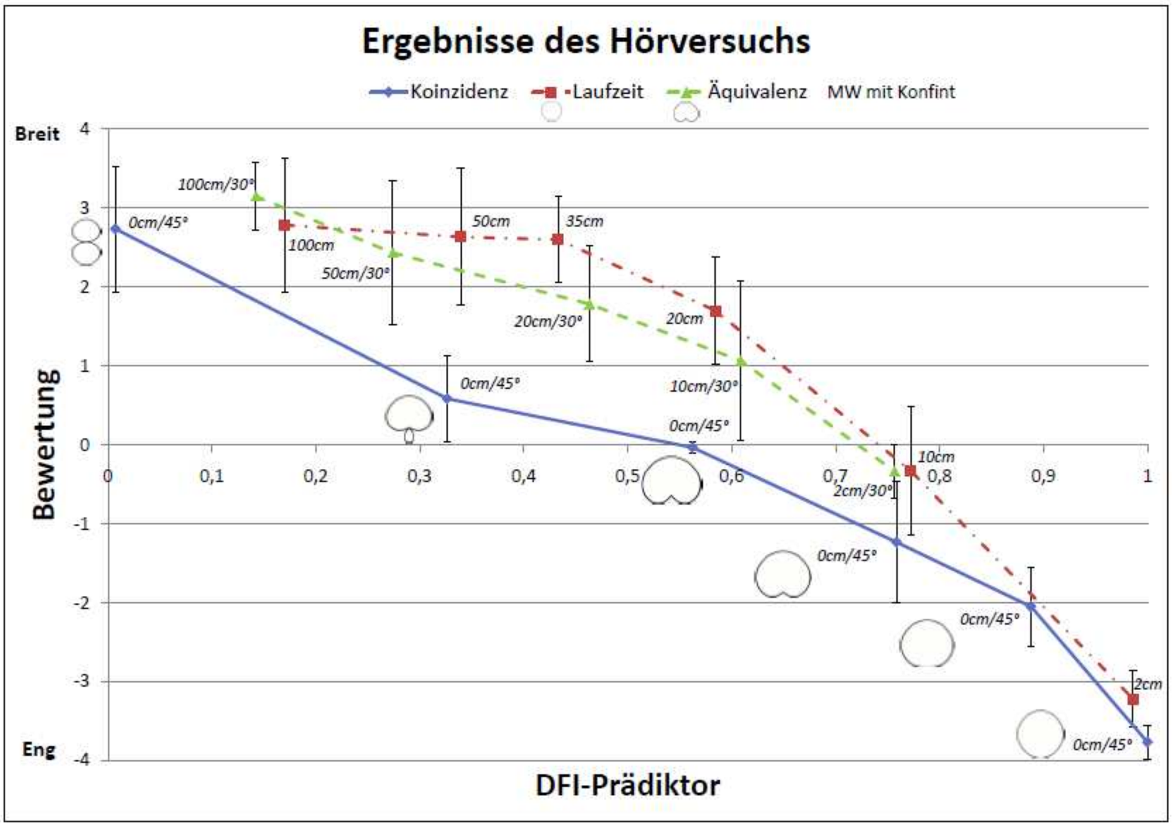


Figure 7: Perceived width (y-axis) of diffuse reverberation vs. the DFI Predictor (a measure of coherence) of various microphone arrangements; from [Riekehof et al.*, 2010]*

coherence function after weighting (with low frequencies being more important). In this way a value is obtained with which different arrangements can be compared and their width predicted: the "Diffuse-Field Image Predictor."

If a minimum value of +2 is set for the width evaluation, the following can be concluded:

- The Blumlein arrangement is the only coincident arrangement that came out well in the listening test. Its DFC is 0. In figure 5 one can find which other arrangements allow a DFC value less than 0.5 to be achieved[1].
- For mixed and pure arrival-time-difference arrangements the DFI Predictor value must be less than 0.5. This can be achieved *e.g.* with a microphone spacing ≥ 35 cm. For mixed arrangements the distance can be less, depending on the directional pattern and angle between the main axes of the microphones.
- An optimal, extended perceived width of diffuse sound can be achieved with coincident microphones as well as with spaced-microphone methods.

1 The DFI Predictor gives the same result for coincident arrangements as the square of the diffuse-field correlation.

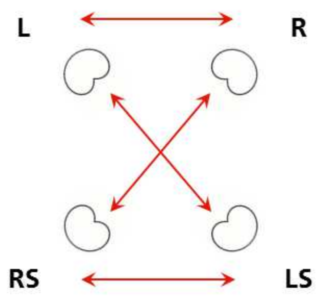
- Since an arrangement based purely on arrival-time differences can have optimal perceived width only when the distance between microphones ≥ 35 cm, those multi-channel setups which are based on a relatively small solid body between the microphones (sphere, plate, etc.) deserve a negative ranking, because at low frequencies the separation makes hardly any difference.

In summary it can be said that the diffuse sound field plays an enormously important role in the perception of spaciousness as well as sound color. For this reason it must be ensured that the diffuse sound field is reproduced with low correlation. Many good or bad properties of any stereophonic miking arrangement have nothing to do with its localization characteristics, but only with its ability to reproduce a beautiful, open spaciousness. An X/Y cardioid arrangement is a good example: Good with regard to localization, but bad with regard to spaciousness. In the future, much more notice should be paid to diffuse-field correlation. The stereophonic recording angle is often used by itself to determine a choice of microphone arrangement—but the diffuse-field correlation is at least equally important.

Some further concrete examples will be provided in sections 6 and 7.

5.2. Miking for ambience layer 2: Discrete, location-agnostic signals

Signals of layer-2 ambience are discrete signals, they are reproduced as phantom sources according to the known laws of directional imaging (see Section 5.3). However, It doesn't matter *where* they are perceived; in other words, the localization curve doesn't need to be linear. In those cases in which no layer-1 signals need to be picked up, microphone arrangements with highly irregular localization curves may be used.



One example is a type of IRT Cross with rotated rear channels; the rotation reduces the diffuse-field correlation in the side-facing loudspeaker pairs L/Ls and R/Rs, which leads to a more open sound. Additionally, this improves the down-mix compatibility.

As is well known, microphone arrangements based on arrival-time differences do not produce stable imaging; thus for certain applications they are not suitable. For layer-2 ambience signals, however, this is not a concern. An example is the Hamasaki Square (see section 7.6). With such microphone arrangements some reflections will in any case be localized between the side loudspeakers, regardless of where the listener is sitting within the playback environment. With layer-2 ambience, the perceived direction of origin for certain early reflections is unimportant.

5.3. Miking for ambience layer 3: Discrete, location-relevant signals

Layer-3 ambience signals are discrete, and are reproduced as phantom sound sources according to the known laws of directional imaging (see for example [Williams, 1987] and [Theile, 2001]). Figure shows the level and/or arrival-time differences that are necessary for this.

Since a combination of level and arrival-time differences can be used, it is complicated to calculate the distribution of the resulting phantom sound sources. One useful aid is the online

"Image Assistant" [Wittek, 2012], which can compute the localization curve and recording angle of a given stereo microphone arrangement (see Figure).

The demands on the directional imaging of ambience layer 3 signals vary depending on the application. Often the directional image is not the most important attribute, so that the design of the microphone arrangement can rather be optimized for ambience layers 1 and 2. However, ambience layer-2 signals also require some care with regard to directional imaging, as their energy distribution throughout the reproduction area should be even, without a predominance of any one direction. A *linear* localization curve is only required when ambience layer-3 signals actually necessitate it, e.g. when the movement of a passing car should be reproduced evenly.

A multichannel microphone arrangement is often implemented as combination of a "layer 3" microphone for the front hemisphere (L-C-R) and a "layer 1+2" microphone for the rear hemisphere and the room (L-R-Ls-Rs). This makes it easier to optimize each microphone arrangement. Moreover, ambience layer 3 signals often exist only in the front. In [Zielinksi, 2004] this is called an "F-B Scene" (front: Foreground, rear: Background). An orchestra recording in a concert hall is a typical "F-B Scene", as the orchestra is only in the front. In such cases, "OCT Surround" or "OCT + Hamasaki Square" (see section 7.4) are suitable microphone arrangements.

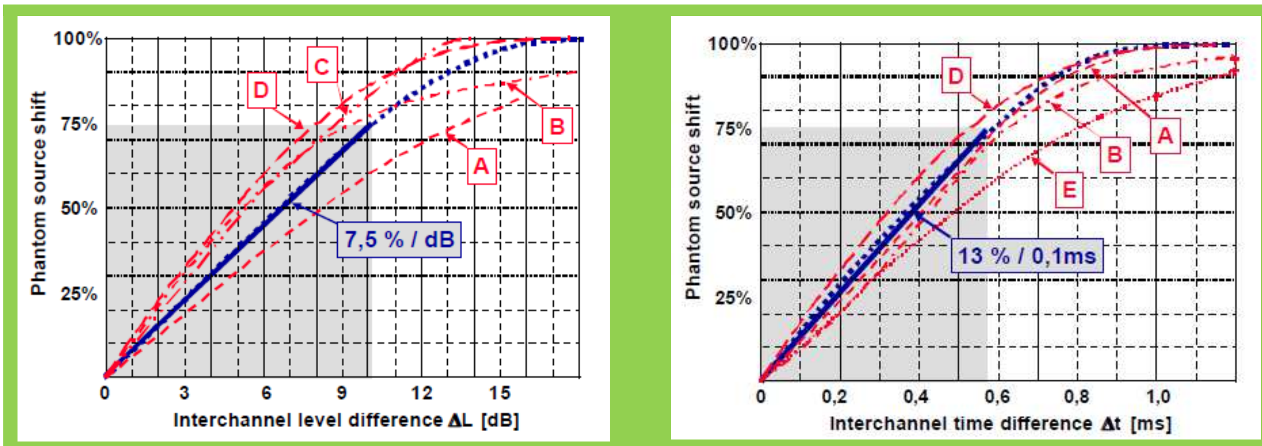


Figure 8: Shift of the phantom sound source as the result of level differences (left) and arrival-time differences (right), various authors, from [Wittek and Theile, 2002]

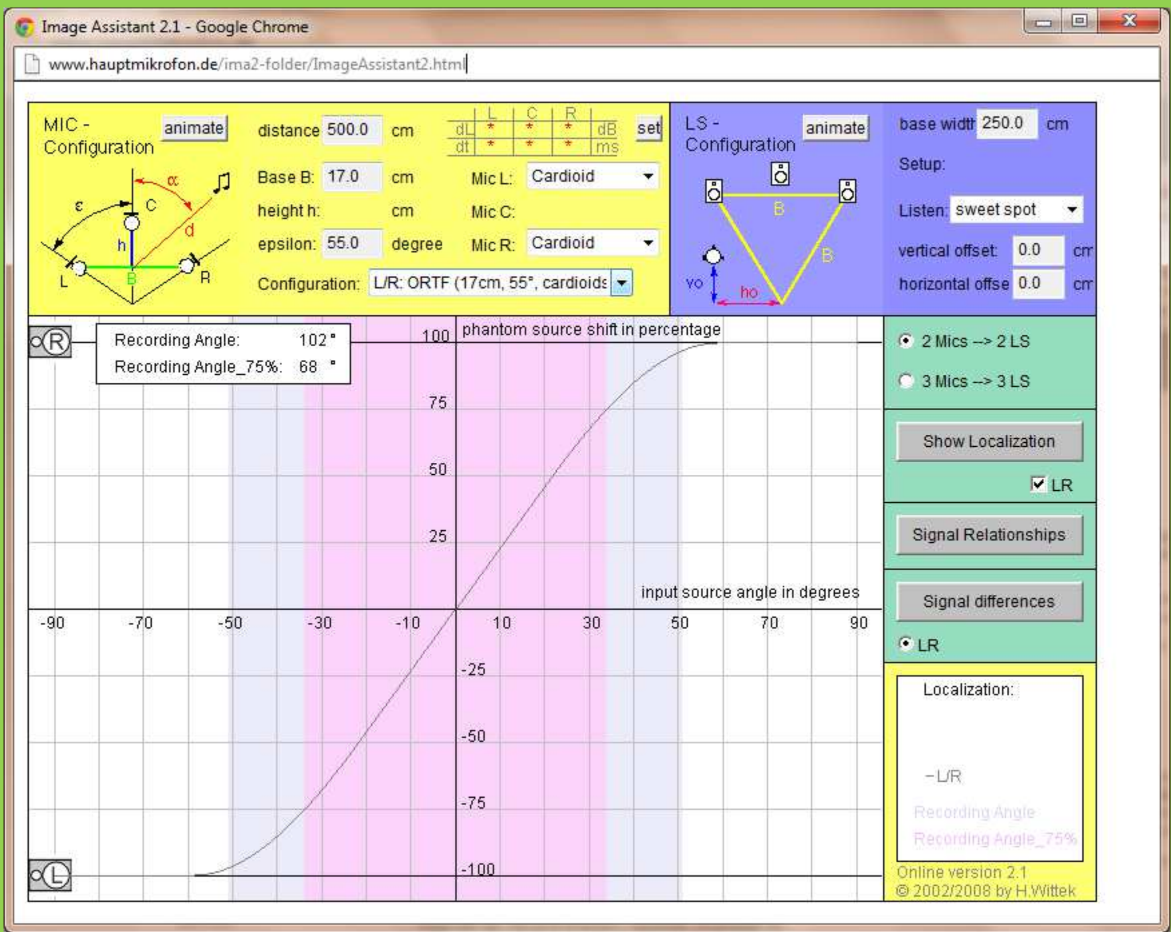


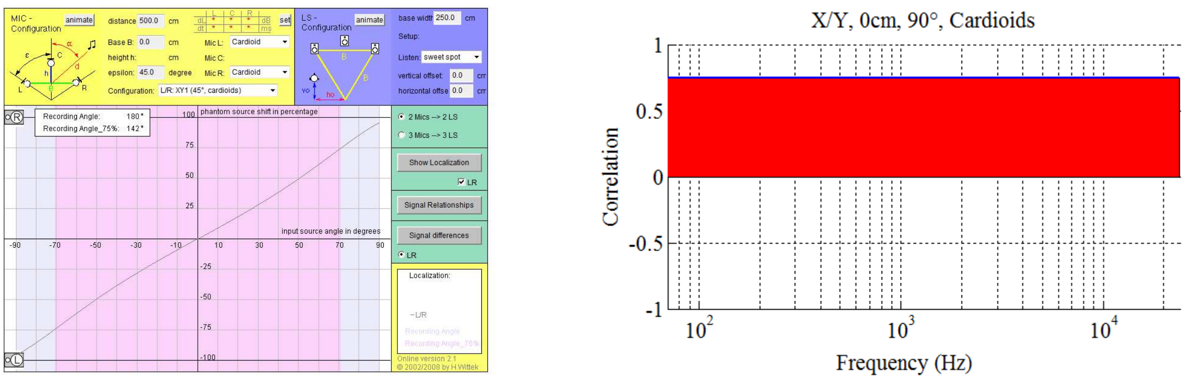
Figure 9: The "Image Assistant", a Java applet on www.hauptmikrofon.de for plotting the localization curve of any given 2- or 3-channel microphone arrangement (shown here: ORTF) [Wittek, 2012]

6. Microphone arrangements for ambience (two-channel)

In the following two sections, various microphone arrangements will be described and their properties sketched. In addition, where possible the localization curve (computed by the "Image Assistant" [Wittek, 2012] and the coherence function in the diffuse field (DFC) are also given. The area beneath the coherence function is filled in in red and a rough generalization can be made: The smaller the red area, the more spacious the result will be.

6.1. X/Y with cardioids

- 2 cardioids, coincident, 90° between their main axes
- Highly compact
- Large recording angle (180°) and high DFC (0.75)
  → often a boring-sounding pickup of the room
- Better results can be achieved with supercardioids



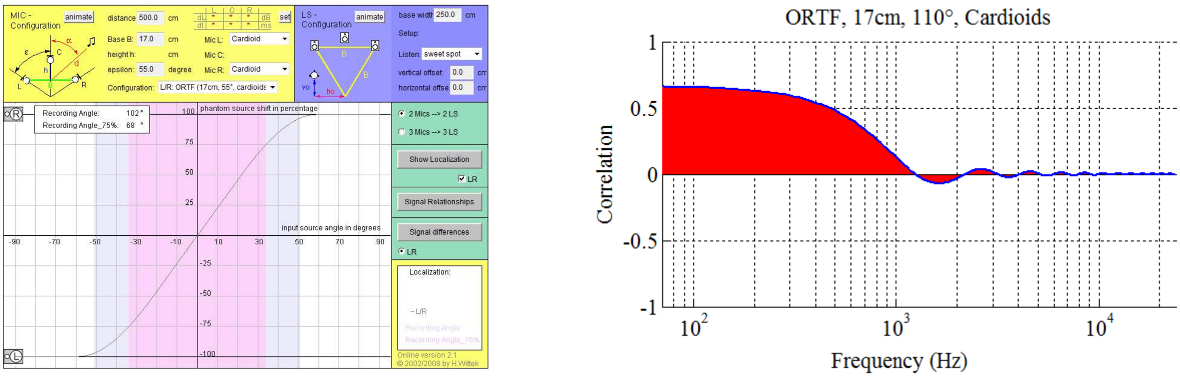
X/Y cardioids: 2 cardioids, 90°; localization curve and coherence function

6.2. M/S

- Coincident combination of mid microphone and figure-8 microphone
- Requires M/S decoding
- Very compact and flexible
- with suitable decoding good spatial and directional characteristics can be achieved, DFC can be optimally low
- Can be used on a boom with M = supercardioid or shotgun
- If M = omni or wide cardioid, a "full" sound for music recording can be obtained

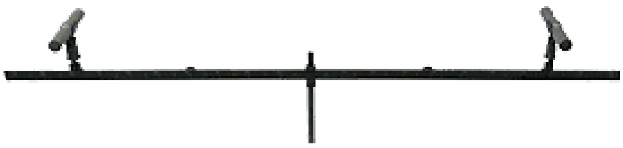
6.3. ORTF

- Classic setup: 2 cardioids, distance of 17 cm, 110° between the main axes
- Relatively compact
- Open, good-sounding room sound
- Recording angle of 100°

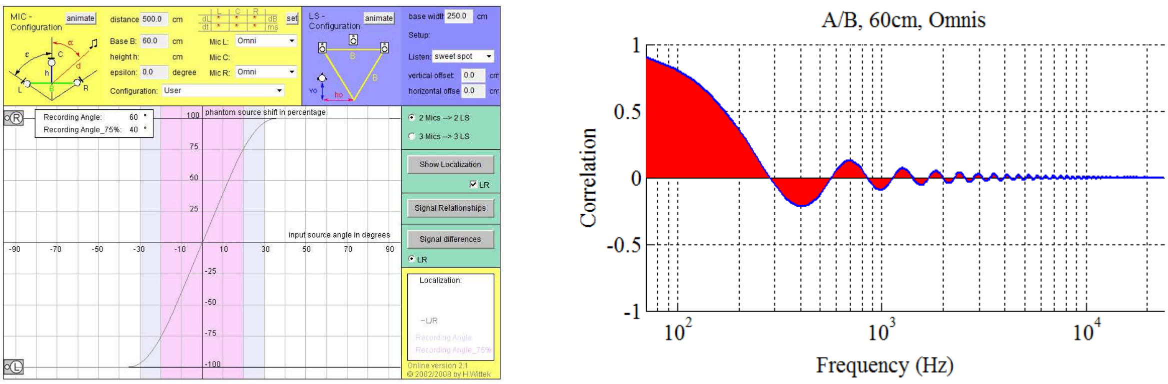


ORTF: 2 cardioids, 17 cm, 110°; localization curve and coherence function

6.4. A/B



- Not compact, d ≥ 40 cm
- Sound color is often preferred
- Open, very nice spatial image
- Poor directional characteristics
- The wind sensitivity of omnis is low

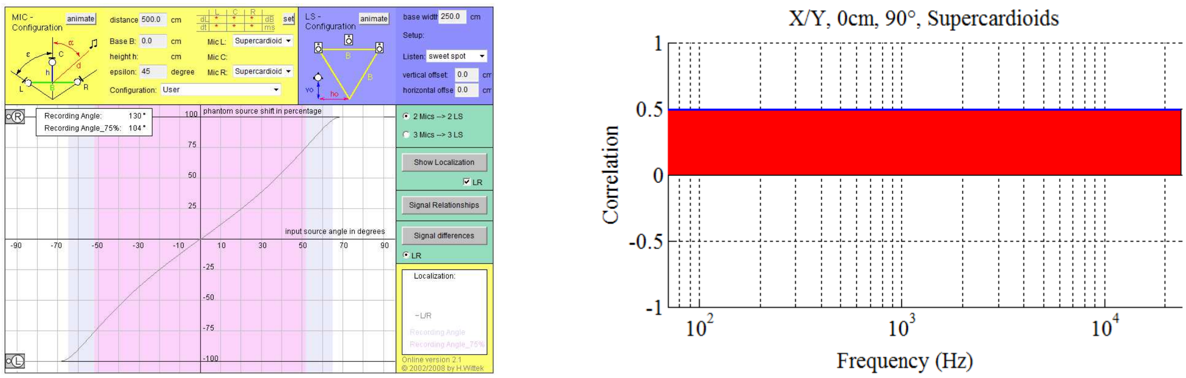


A/B omnidirectional: 2 omnis, 60 cm; localization curve and coherence function

7. Microphone arrangements for ambience (multi-channel)

7.1. Coincident (=Double M/S or first-order Ambisonics)

- See also [Wittek *et al.*, 2006]
- Compact
- Flexible and practical; requires decoding
- Only 3 channels needed for surround: front-facing cardioid, figure-8, rear-facing cardioid
- Decoding:
  - o Double M/S: with normal M/S matrixes, hardware de-coder, or plug-in
  - o Ambisonics: with specialized hardware or plug-in
- High DFC if more than 3 output channels; 4 is the most that makes sense
- Sufficient spatial characteristics if the decoding is good
- (Only with good decoding) good sound color; good directional characteristics



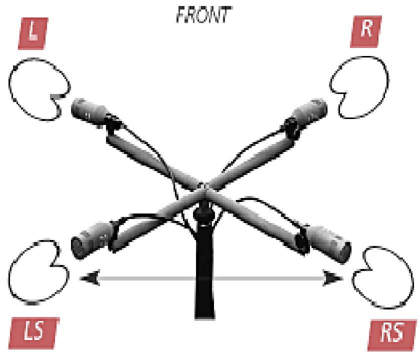
Coincident surround arrangement: Graphs shown for the X/Y pair L/R, based on a decoding to four virtual supercardioids at 45°, 135°, 225°, 315°; localization curve and coherence function

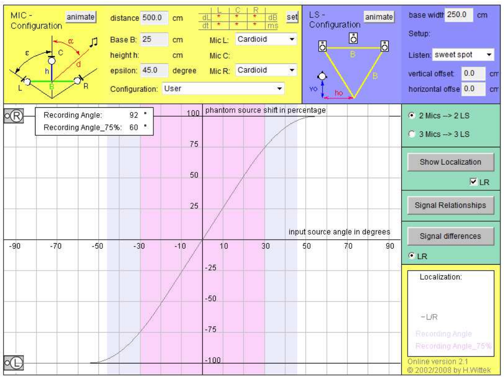
7.2. Double M/S with shotgun

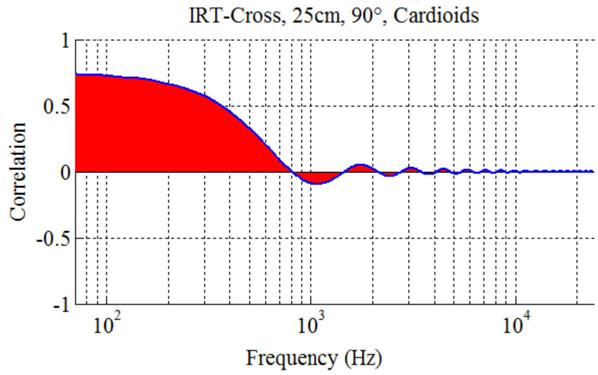
- With shotgun microphone for the center: ideal setup for documentary film-making
- Compact: A surround setup with windscreen does not need to be any larger on the boom than a mono arrangement
- Flexible and practical
- Fair spatial characteristics, depending on the decoding
- Only three channels needed for surround: Shotgun, figure-8, cardioid
- Simple decoding with two normal M/S matrixes

7.3. IRT Cross

- See also [Theile, 2001]
- Open spatial image, very good 360°-directional imaging
- Basis length:
  - o with 4 cardioids: 25 cm each
  - o with 4 supercardioids: 18 cm each
  - o with 4 wide cardioids: 31 cm each



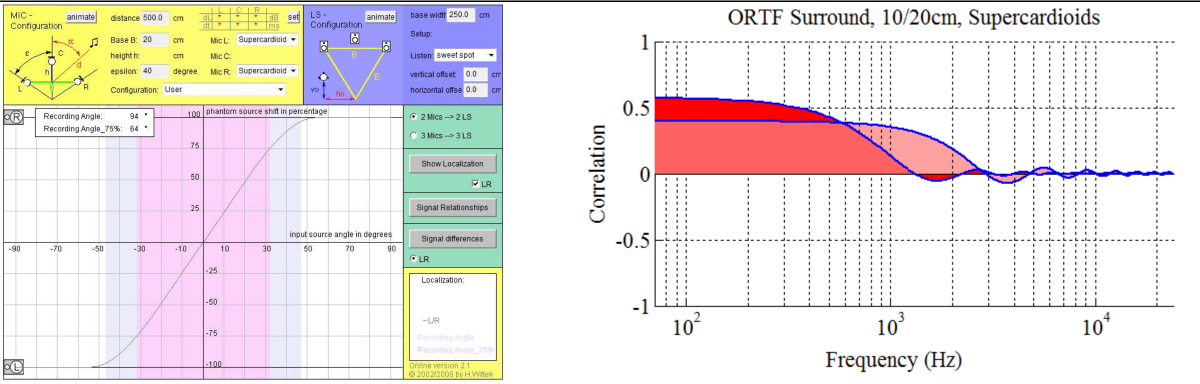




IRT Cross with cardioids, distance 25 cm: Graphs shown for the pair L/R: localization curve and coherence function

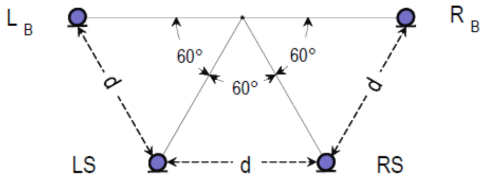
7.4. ORTF Surround

- 4 supercardioids, 10 cm/100° + 20 cm/80°
- Compact and practical
- Open spatial image (like IRT Cross)
- *Plug & Play*: Special windscreen, Microphone holder, Multi-core cable with multi-pin plug

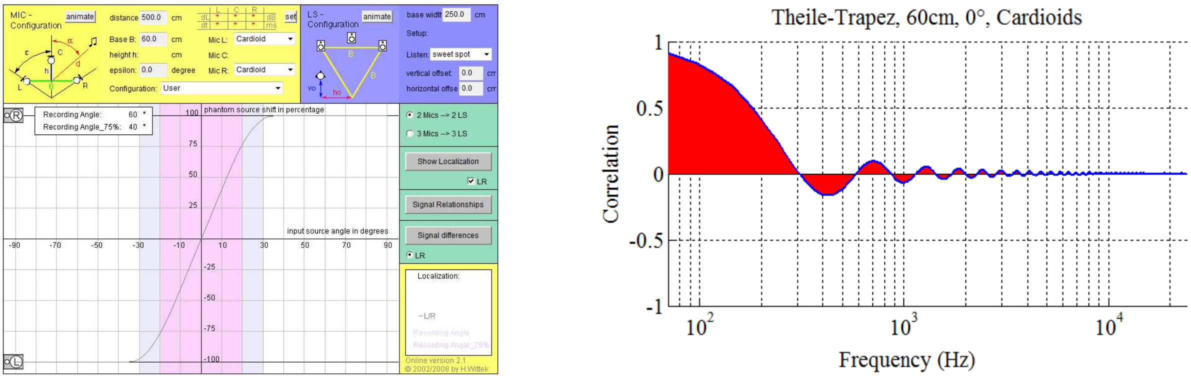


ORTF Surround; localization curve and coherence functions

7.5. Theile Trapezoid



- Room microphone arrangement for a “F-B-Szene” (direct sound from the front); unsuitable for layer-3 signals; ideal for layers 1 and 2
- 4 cardioids aimed toward the back; d = 60 cm
- Optimal suppression of direct sound from 0°

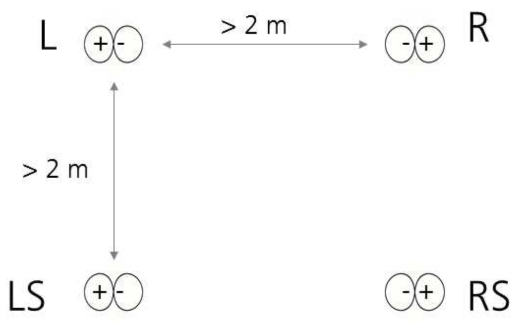


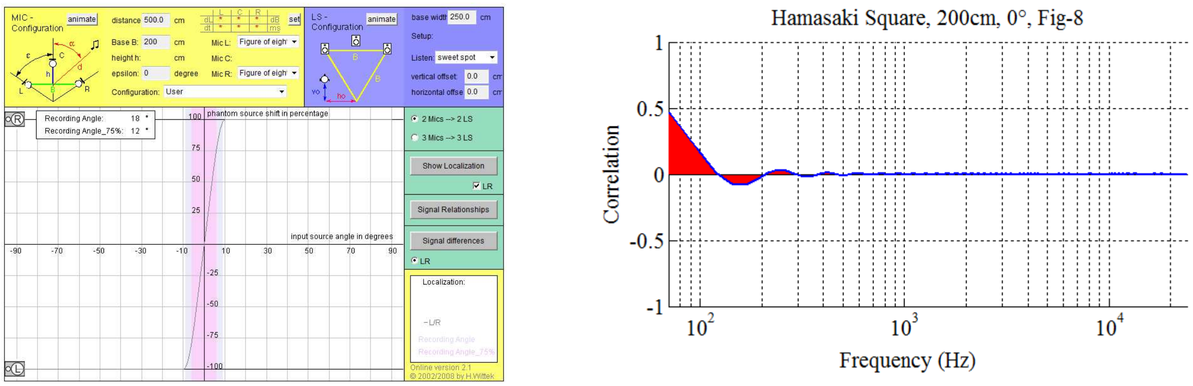
Theile Trapezoid: Graphs shown for the pair Ls/Rs; localization curve and coherence function

Theile Trapezoid with L/R=100 cm, LS/RS=60 cm:

7.6. Hamasaki Square

- See also [Theile, 2001]
- Room microphone arrangement; unsuitable for layer-3 signals; ideal for layers 1 and 2
- 4 figure-8s, d ≥ 200 cm
- Extremely large distances; not a “handy” arrangement
- Open spatial image, extremely low DFC
- Optimal suppression of direct signals from 0°
- Optimal reproduction of lateral reflections

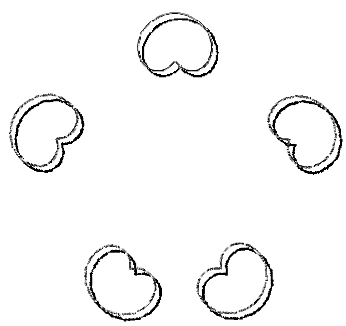


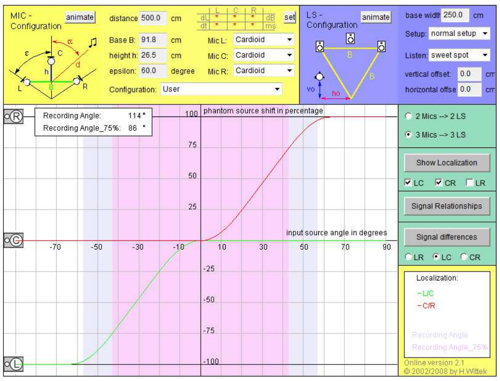


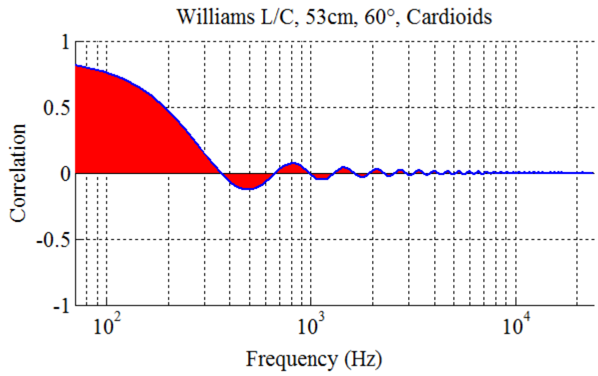
Hamasaki Square: Graphs shown for the pair L/Ls; d=200 cm; localization curve and coherence function

7.7. 5ch setup after Williams/Theile/Wittek

- with center channel, but resembles IRT Cross otherwise
- Geometry can be computed with Williams MMAD [Williams MMAD] or “Image Assistant” [Wittek]
- With cardioids, open cardioids or wide cardioids
- Not compact; requires large distances and therefore separate windscreens
- Very good sound color
- Very good both spatial and directional characteristics







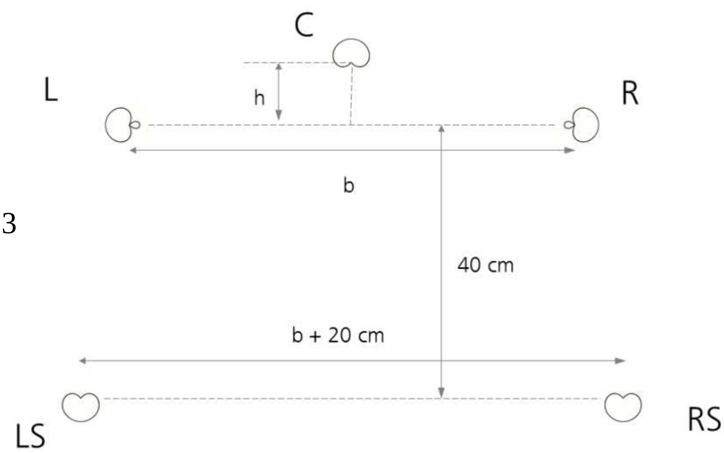
5ch setup after Williams/Theile/Wittek: Graphs shown for L/C and C/R, d=92 cm, h=26.5 cm, Angle between main axes (L/C) = 60°, 2 cardioids; localization curve and coherence function

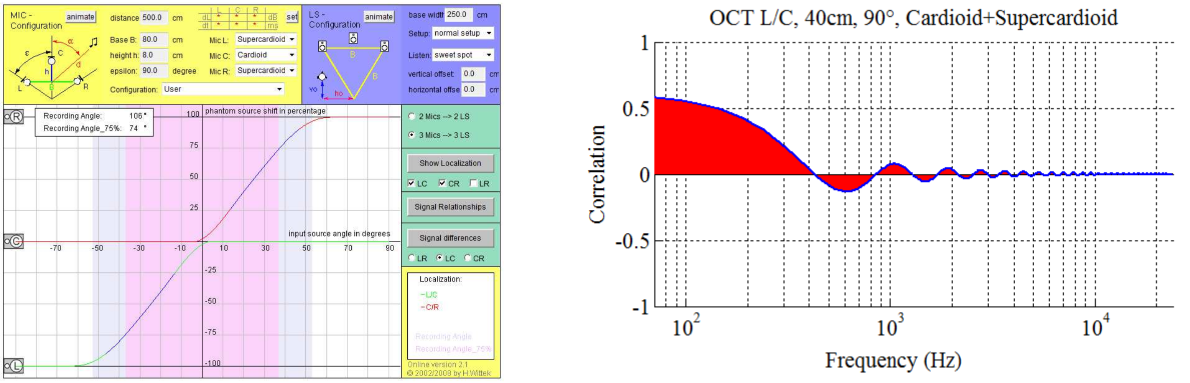
5ch setup applications:

Williams “Umbrella” 5-channel mount (left) and F. Camerer with Ambient A-Ray using 5* CINELA Zephyx (right)

7.8. OCT Surround

- *See also* [Theile, 2001]
- Recording angle depends on the distance b (50 cm ≤ b ≤ 100 cm)
- For “F_B-scenes” (ambience-layer 3 signals only from the front)
- Not compact
- Good sound color
- Optimal avoidance of crosstalk, resulting in high stability of the directional image
- Very good both spatial and directional characteristics

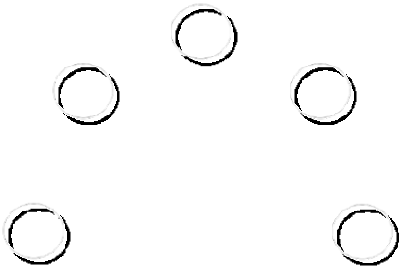


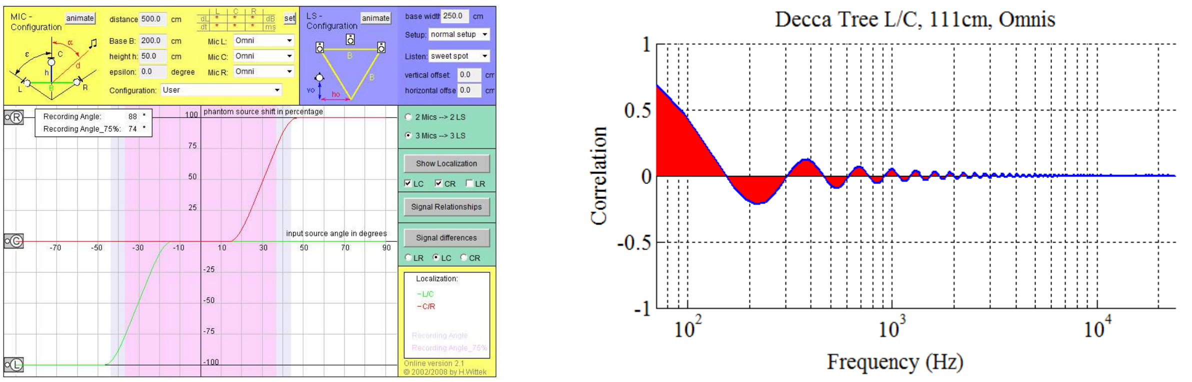


OCT Surround: Graphs shown for the pairs L/C and C/R; b=80 cm; localization curve and coherence function

7.9. Omni setup (Decca Tree, Polyhymnia or similar)

- Very large
- Uses omnis → often preferred sound color
- Very good spatial characteristics
- Stable, but poor directional characteristics





Decca Tree: Graphs shown für L/C und C/R; L/R=200cm, h=50cm, Omnis; localization curve and coherence function

8. A practical comparison of ambience microphone arrangements

In addition to the theoretical analysis, an extensive practical investigation was carried out. At five different locations, simultaneous recordings were made with six different ambience miking arrangements. The descriptions and further information are available, and all the recordings can be downloaded, at www.ambience.hauptmikrofon.de [Wittek, 2012].

The recordings were made on the occasion of the Berlin VDT “Ambience recording” seminar that took place in July, 2012.

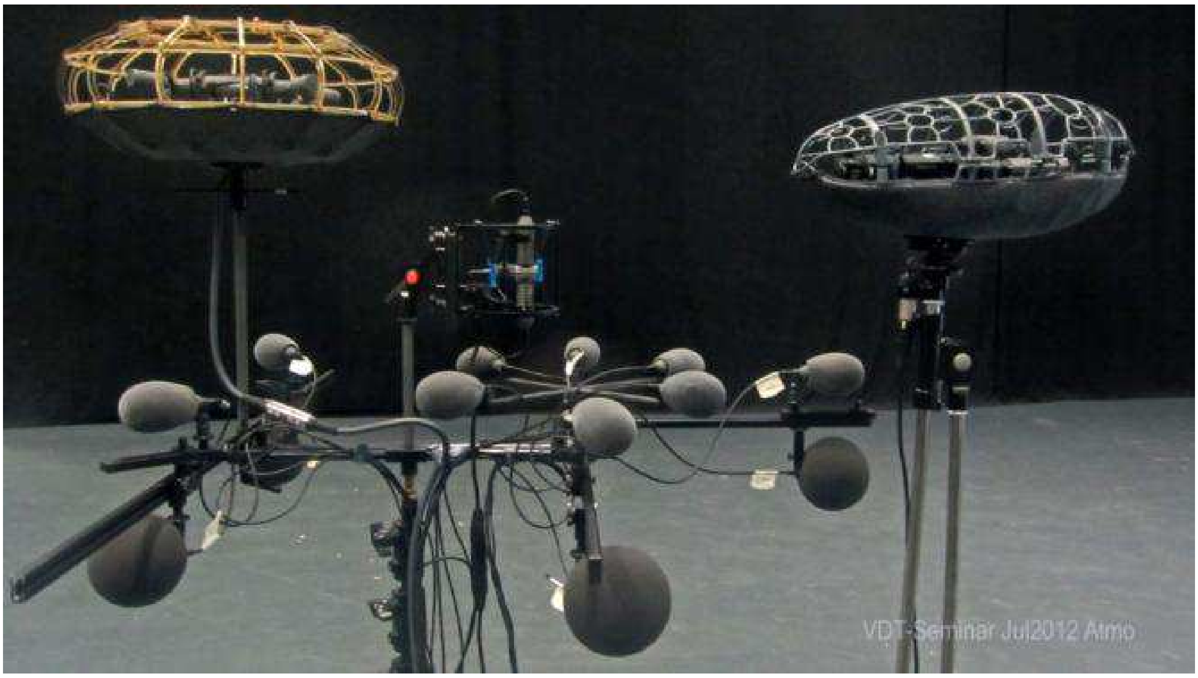
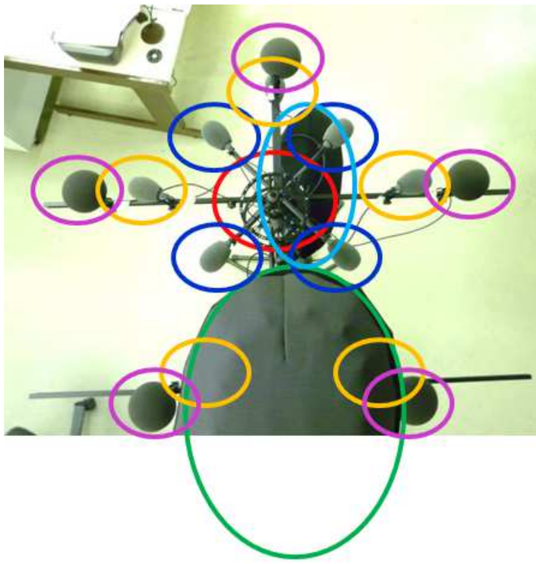


Figure 2: Microphone setup for simultaneous recording. Photo: Theile

The following six ambience miking arrangements were available for practical comparison:

- 5 omnis in a regular pentagon with side length of 51 cm (violet)
- 5 wide in a regular pentagon with side length of 49 cm (orange)
- IRT Cross (dark blue)
- ORTF Surround (green)
- Double M/S with 4-channel decoding to the equivalent of 4 supercardioids (red)
- Double M/S with a shotgun microphone, decoded (light blue)



The following five recording locations were available (see Figure 3):

- Street ambience, with streetcar
- A supermarket
- A workshop with machinery
- Applause in a room
- The speech of many people in a room

Figure 3: Recording locations for the ambience miking comparisons on www.ambience.hauptmikrofon.de [Wittek, 2012]

The recordings have all been put online in order to receive as much feedback as possible about the subjective impressions. There has not yet been any objective comparison experiment, thus for the sake of prejudice-free assessments, no prior judgment is made here. The above-mentioned Web site offers a survey form ready for use.

However, a few general observations can be summarized already:

- 5 of the 6 setups sound surprisingly similar.
- The arrangements with a center channel offer distinctly greater stability in the front.
- No bad ambience setups were used (they were excluded in advance from the practical experiments), although many exist in practice. This lack of a negative reference point is perhaps regrettable.
- The various types of microphone, from figure-8 to omnidirectional, sound (after filtering to mitigate the low-frequency rolloff of the pressure gradient types) surprisingly similar. In part this may be because all the microphones came from the same manufacturer (SCHOEPS).

9. Summary

This practical comparison of various ambient miking arrangements, as well as the theoretical analysis, were carried out to sketch for users the best solutions for ambience recording. It is not simple to find a good mixture of practicality and high-quality sound; often, one virtue comes at the expense of the other. Bad compromises in this regard can occur all too often, sadly also in products that are available on the market.

The great importance of the diffuse sound component has been an important and interesting aspect of this investigation. It is sometimes undervalued in discussions of main microphone arrangements (including my own). In reality it is a more important aspect than localization, certainly in ambience recording. However, for reliable prediction of the spatial quality of a microphone arrangement, the effect of the diffuse-field correlation on perception has to be understood better.

With this study the author attempts to explain why a particular kind of miking might work well for ambience recording. With this knowledge, it becomes much simpler to find a suitable microphone arrangement for a new recording situation. For better or for worse, not everything can be predicted yet; listening remains the most important factor in the search for the best recording technique.

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