STEREO
From Live to Recorded and Reproduced
What does it take?
Binaural recording & playback
- From ear drum to ear drum
- Very low spatial distortion
- The Auditory Scene does not follow head movement cues

Conventional recording & playback
- From microphones to loudspeakers & room
- Generally very high spatial distortion
- The Auditory Scene is formed using head movement cues

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What do I hear?
What do the microphones hear?

- Direct sound streams
- Multitudes of reflected sound streams
Sound sampling from an audience perspective

Pick up of sound streams from the Orchestra and of reflected streams from the Hall

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Physically, the microphone signals are reproduced by left and right loudspeakers.

Perceptually, the microphone signals are mapped as phantom sources to the space between the two loudspeakers and as mono signals into each loudspeaker.
Level and arrival time difference between the two microphones determine the position of the phantom source.

The perceptual mapping procedure

Image Assistant 2.1 (Theile & Wittig)
www.hauptmikrofon.de

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Potential problems with recording from an audience perspective

Loss of clarity
Too much reverberation
Too distant sounding

• We de-reverberate the hall sound in a live situation
• We have difficulty to de-reverberate the recorded hall sound upon playback

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Potential problems with not recording from an audience perspective

Ever greater Spatial Distortion of the Acoustic Scene

• Outputs from multiple microphones close to the performers and in their own sub-spaces are down-mixed to 2 tracks
• Phantom sources are placed between L & R loudspeakers
  • Artificial reverberation is added to the mix
Recording - What does it take?

The microphones must capture a believable spatial perspective
or
A believable spatial perspective must be obtained
in the mixing process

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What happens to the recorded microphone signals when they are reproduced over two loudspeaker in a room?

- We hear **real** and **phantom** sound streams
- The direct sound streams are governed by the loudspeakers’ on-axis response in Frequency & Time & Amplitude
  - L&R streams interfere at the listener’s ears
- Room reflections depend upon the loudspeakers’ polar response and the absorptive/diffusive properties of the room surfaces
Reproduction - What does it take?

1. Normally live room acoustics
2. Symmetrical loudspeaker & listener setup
3. Reflections >6 ms delayed
4. Neutral spectrum of reflections
Loudspeakers - What does it take?

1. Controlled directivity
2. Sufficient volume displacement
3. Low stored energy
4. Low non-linear distortion
1 – Controlled directivity

We auditorially process the room via its reflections.
1 – Controlled directivity

Omni and waveguide

What is the optimum radiation pattern for a believable Auditory Scene?
2 – Sufficient volume displacement

Sealed Box

[Diagram showing frequency response and dimensions for sealed boxes with varying sizes and distances.]
2 – Sufficient volume displacement

Open Baffle

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3 – Low stored energy

- Cabinet panel resonance modes
- Air cavity resonances inside the box
- Driver membrane break-up modes
- Driver frame + magnet resonance
- Vented system roll-off response

Stimulus:
4-cycle burst, Blackman windowed
4 – Low nonlinear distortion

- Harmonic & intermodulation distortion
- Thermal gain compression

1.5kHz, 30Vpp, 10W, 100ms

15x 10-cycle burst

Waveform distortion

Envelope compression

Harmonics & intermodulation

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What does it take?

A system design approach at every stage
A - Microphone setup & mix
B - Room & loudspeaker setup
C – Loudspeakers having
1. Controlled directivity
2. Volume displacement
3. Low stored energy
4. Low nonlinear distortion

The reduction of Spatial Distortion in the Auditory Scene is the final frontier

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STEREO

We know what it takes, but do not pay sufficient attention to the reduction of Spatial Distortion in the Auditory Scene i.e.

Microphone setup & Mix
Polar response of Loudspeakers

Thank You

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Accurate Reproduction and Recording of Auditory Scenes