

# A high-quality microphone array for motion-tracked binaural (MTB) recording and reproducing of spatial sound

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In 2004 though, Algazi et al. [1] proposed a new binaural recording technique – motion tracked binaural sound (MTB) – which promises an efficient solution for the recording and rendering of dynamic binaural ambient scenes. The MTB recording device consists of a rigid sphere with the diameter of an average head. At the horizontal circumference of the sphere a number of microphones are mounted evenly distributed on the surface. By means of interpolation (i.e. cross-fading) algorithms, the multichannel signal recorded with the MTB array can be used to reconstruct two audio signals in a way as if they were recorded approximately at a listener's ear position. The rigid sphere of the MTB array acts as an obstacle for sound propagation introducing frequency dependent interaural level (ILD) and time (ITD) differences which are similar to those occurring in binaural hearing.

Lindau and Roos [2] tested various interpolation approaches for their perceptual suitability, and found a clearly superior algorithm: If there are no constraints regarding the processing power, the Two Band Spectral-Interpolation Restoration (TB-SI), proposed by Algazi et al. [1], should always be used for interpolation, especially as its performance is nearly independent from number of microphones (from 8 up to 32), and type of content.

We build in cooperation with Sennheiser electronic GmbH & Co. KG a 16-channel MTB array with a sphere's diameter of 176 millimeters. The shell of the MTB array was fabricated from a thermoplastic material in a rapid prototyping process (cf. Fig. 1). Flush with the surface 16 matched omnidirectional and diffuse field-equalized electret condenser microphones (Sennheiser KE14,  $\varnothing = 14$  mm) are mounted. Via a special converter circuit, placed in the sphere, standard phantom power sources from 12 V to 48 V can be employed as power supply. For that purpose we use two 8-channel digitally controlled microphone preamps with analogue (XLR) and digital (ADAT optical) interfaces. Using a 16 channel optical interface with USB connectivity, the MTB array can be connected to a standard laptop for recording.



In a first practical application our MTB array was used to record Beethoven - Symphony No 3, Orchester Wiener Akademie (Martin Hasselböck), performed in May 2016 at the Palais Lobkowitz, Vienna.

Fig. 1: Exploded view of CAD prototype at final design

- [1] Algazi, V. Ralph; Duda, Richard O.; Thompson, Dennis M. (2004): "Motion-Tracked Binaural Sound." In: *J. Audio Eng. Soc.*, Vol. 52, No. 11, pp. 1142-1156
- [2] Lindau, Alexander; Roos, Sebastian (2010): "Perceptual evaluation of discretization and interpolation for motion-tracked binaural (MTB) recordings." In: *Proc. of the 26<sup>th</sup> Tonmeistertagung*. Leipzig, pp. 680-701.