

	RESEARCH & INNOVATION HANNOVER	Page 1 of 1 pages	Date	April 25, 2013
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SOUND FIELD TRANSMISSION USING HIGHER ORDER AMBISONICS

During the TC-25CSS SG Immersive Audio Systems: B-Chain and Distribution Meeting on 13th Feb. 2013 a few questions were raised to get a better feeling for sound field transmission using Higher Order Ambisonics. This is a summary on our experience made during the last 6 years working with the format.

Number and positions of loudspeakers

Sound fields encoded in Higher Order Ambisonics (HOA) can be played back on all existing and new planned loudspeaker setups in cinemas. In the past classical Ambisonics required regular speaker setups with equal loudspeaker spacing, but modern HOA processing can handle arbitrary speaker setups. Special speaker position agnostic renderers can be designed that use beam forming technology to optimally radiate spatial sound for a sweet spot or a sweet line approach. Our suggestion would be to use 12 to 20 speakers for small sites and up to 60 or 80 speakers for large sites.

Expected order of HOA

A physically exact sound field description is given by an infinite series of HOA coefficients. Due to a limited number of speakers for replay this series can be truncated and the maximal order coefficient is dubbed the HOA order 'N'. This order depends on the minimal angular spacing of loudspeakers seen from a sweet spot (or sweet line). As examples the NHK 22.2 speaker setup requires HOA orders of 4 to 5.

Commercially available HOA microphones, like the Eigenmike™ allow to capture live spatial sound with 32 microphones for an HOA order of 4.

Expected Bandwidths

The number of the total HOA coefficient channels is given by $(N + 1)^2$. A coefficient channel is a time domain sampled signal representation. An uncompressed HOA representation of an Eigenmike recording at 48 kHz sampling rate, 24 bits precision and an order $N=4$ would require $48k * 24 * 25 \text{ bit/s} = 28.8 \text{ Mbit/s}$. Due to the characteristics of HOA signals lossless average compression factors of ~ 3 are common. Lossy compression technology allows transparent transmission of a 4-th order HOA signal at about 1.2-1.5 Mbit/s.