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3D sound field rendering under non-idealized loudspeaker arrangements

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The approach to realise periphonic sound field reproduction based on spherical harmonics (multi-pole theory) has already been well-known as Ambisonics and Higher Order Ambisonics, respectively. By the aid of an N-dimensional orthogonal set of vectors any arbitrary source free sound field can be described. Reproduction is realized by projection of the encoded sound field on a regular loudspeaker distribution over a spherical surface. The used set of vectors exhibits a defined hierarchic with interesting symmetries. In the original scheme sound sources represented by plane waves (sources in far distance) can be encoded independent of the decoding process on the regular loudspeaker layout. Usually, in practice - in contrast to theory, 3D loudspeaker layouts are requested for the upper hemisphere. This restriction is caused by the physical configuration. First of all that demand bounds the reproduction of sound sources to the upper area. Furthermore caused by these facts idealized regular layouts considering the 3 dimensions are impossible. Within this contribution we will show how the symmetries of the spherical harmonics can be used to obtain optimized decoding rules and to overcome insufficient irregular loudspeaker arrangements.