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Notes on Rendering Focused Directional Virtual Sound Sources in Wave Field Synthesis

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Wave field synthesis (WFS) is an approach to the physical (re-)synthesis of a desired virtual wave field. It is based on the Kirchhoff-Helmholtz integral formulated for interior problems. This implies that WFS is per se only capable of recreating the wave field generated by virtual acoustic sources outside the listening area. However, it has been shown that the exploitation of the time-reversal principle provides an approach to the reproduction of sources inside the listening area when some drawbacks are accepted. These virtual sources are known as focused sources. So far only point source models have been considered in the derivation of the appropriate loudspeaker driving functions. In this paper, we introduce an approach to the rendering of focused sources with arbitrary directivity. For this purpose we briefly introduce an approach to the rendering of non-focused virtual sources with arbitrary directivity which has been previously published in detail. The approach relies on the expansion of the source's directivity (i.e. its spatial transfer function) into orthogonal basis functions. We will then extend this approach to focused virtual sources and point out the particularities that have to be taken into account compared to the traditional focusing of virtual point sources.