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Cosine beamforming

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In various application areas, e.g., seismology, astronomy and geodesy, arrays of sensors are used to characterize incoming wavefields due to distant sources. Beamforming is a general term for phased-adjusted summations over the different array elements, for untangling the directionality and elevation angle of the incoming waves. For characterizing noise sources, beamforming is conventionally applied with a temporal Fourier and a 2D spatial Fourier transform, possibly with additional weights. These transforms become aliased for higher frequencies and sparser array-element distributions. As a partial remedy, we derive a kernel for beamforming crosscorrelated data and call it cosine beamforming (CBF). By applying beamforming not directly to the data, but to crosscorrelated data, the sampling is effectively increased. We show that CBF, due to this better sampling, suffers less from aliasing and yields higher resolution than conventional beamforming. As a flip-side of the coin, the CBF output shows more smearing for spherical waves than conventional beamforming.