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Near-field acoustical holography: Understanding sound generation from musical instruments to military aircraft

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Near-field acoustical holography (NAH), like its optical cousin, is a method by which measurements made along a two-dimensional surface are used to create a three-dimensional reconstruction. Its basic principles provide the physics student with a rich understanding of wave superposition and propagation, the Helmholtz equation, separable geometries, wavenumber spectra, and near-fields, i.e., evanescence. Implementing NAH requires an understanding of temporal and spatial Fourier transforms, signal-to-noise ratio, windows, filters, and other signal processing concepts. This paper introduces key concepts of NAH and explains its application to understanding sound radiation from the hammered dulcimer, the cajón drum, and a military jet aircraft.