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Generation of Inhomogeneous Acoustic Waves Using an Array of Loudspeakers

Samuel E. Wonfor, Trevor A. Kyle, J. Stuart Bolton, and Jeffrey F. Rhoads
School of Mechanical Engineering, Purdue University
Ray W. Herrick Laboratories, Purdue University

ABSTRACT

In previous studies it has been shown that pressure fields created by inhomogeneous sound waves (waves which decay in a direction perpendicular to their propagation direction) are able to transmit energy into objects more effectively than ones created by conventional sound waves. This behavior may be useful in the detection of hidden explosive threats. To explore this, a device capable of constructing inhomogeneous waves is being developed. The proposed device is an acoustic array consisting of several high-frequency speakers. The speakers are independently driven to construct a desired inhomogeneous pressure field on a target surface. Inhomogeneous pressure fields were reconstructed across a span of decay parameters and standoff distances. Results show low root-mean-square errors at realistic levels of power consumption. These results imply that the device can recreate desired inhomogeneous pressure fields with high enough accuracy and low enough power consumption to test the energy transmission properties of inhomogeneous waves on mock explosives, which may be useful in applications related to improvised explosive device detection and defeat.

KEYWORDS

Inhomogeneous waves, least-squares reconstruction, energetic materials