MECHANICAL ENGINEERING STUDENT SEMINAR

Thursday, November 2 2022 at 13:30, D. Dan and Betty Kahn Building, Auditorium 1.

Sound Source Localization, Using Acoustic Intensity Measurement Techniques

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Sound waves are compressional oscillatory disturbances that propagate in a fluid. Moving fluid elements represent kinetic energy, and changes in pressure represent potential energy. Thus, the propagation of sound waves involves a flow of energy. Sound intensity is a vector quantity that describes the flow of acoustic energy in a sound field. The sound intensity vector is traditionally expressed as a complex vector where the real part is termed the 'active component' and is related to the potential energy. The imaginary part is termed the 'reactive component' and is associated with the kinetic energy. Sound intensity vector applications extend to measuring energy transmission and propagation paths, determination of acoustic impedance, analyzing pressure fields, and, more notably, noise source identification.

Measurement of sound intensity involves utilizing a minimum of two transducers to facilitate sampling of both the particle velocity and the pressure level. Various methods were developed through the years using different sets of transducers, including pressure and particle velocity transducers (p-u method) or two pressure transducers (p-p method). In addition, the array can be modified for applications in the 3D space by adding additional transducers in specific configurations.

This study conducted a series of tests in an anechoic chamber with different combinations of sound sources. The performances of several techniques for constructing the sound intensity vector from the sampled data were compared in sound source localization accuracy and sound source differentiation in a multi-source environment. These techniques ranged from the traditional methods (based on the most simplified mathematical expression for the intensity) and more advanced techniques such as the finite-difference (FD) and phase and amplitude gradient estimator (PAGE) methods. In addition, the effects of other parameters on the performance were also explored, such as distance from the source, source frequency, and differences between the 'active' and 'reactive' components of the vector.

It was observed that while the different techniques performed similarly, the more advanced methods (PAGE specifically) could accurately identify the direction of arrival with a complex source or in a multi-source environment. Also, it was apparent from the results that the 'active' component energy is better at identifying the direction of sound arrival than the 'reactive' component.

Note: the seminar will be given in Hebrew

Seminars Coordinator: Assoc. Prof. Matthew Suss.