Measurements of acoustic velocity and pressure vectors in source localization using acoustic intensity sensor

Literature Survey Presentation

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INTRODUCTION

- Estimation of DOA (direction of arrival) of a single source using vector natured Acoustic intensity measurements
- MSAE (Mean Square Angular Error)
- Free Space and Reflecting boundary case
- Single source Acoustic Vector sensor

Key Paper #1

Statistical Distributions of Fundamental Acoustic Quantities (Pressure/Particle velocity/Intensity)

- Statistical Distributions of acoustic quantities are independent of the shape of the room boundaries and arrangements

  [Budhianto & Hixson,1996]

- Traditional Acoustic intensity measurements using scalar sensors is ineffective in terms of source localization

Single-Source Single Vector sensor measurements for DOA estimation in Free Space

- 4-D (pressure + 3-D particle velocity) Intensity Based Algorithm [Nehorai & Paldi, 1994]
  - Key Assumptions: Plane wave at the sensor, Band limited Signal Spectrum
  - MSAE = $1+\rho/\rho_v \rho_p$ where $\rho_v = \sigma_s^2/\sigma^2_v$ and $\rho_p = \sigma_s^2/\sigma^2_p$
  - MSAE is nearly optimal

- 3-D Velocity-Covariance-Based Algorithm
  - Use Covariance matrix to estimate $\underline{u}$
  - MSAE = = $\rho^{-1} + \rho^{-2}$ where $\rho = \rho_v$ [Nehorai & Paldi, 1993]
  - MSAE is optimal in Gaussian noise case

Measurements for DOA estimation using Intensity based Algorithm in Reflecting boundary case

- Key assumptions: Single bandlimited acoustic source radiating bandlimited spherical waves (different from free space case)
- The image Source is obtained by reflecting the original source in boundary (which adds Reflection Coefficient in the calculations)
- MSAE is calculated under the assumption that both signal and noise has Gaussian distributions
- MSAE is a function of SNR ρ and the elevation angle ψ

[Hawkes & Nehorai, 2003]