A Study on the Estimation of Radiation and Transmission Characteristics in Acoustical Systems

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As a fundamental study for the design of noise control systems, method of estimating sound radiation from multiple-degree-of-freedom systems under arbitrary vibration modes and configuration, and design method for the identification of the waveform transmission model suitable for adaptation to time variation, are established.

For the analysis of noise radiation from machine elements, it is effective to estimate the radiated energy from energy balance equations based on energy transmission model. An numerical method is derived to obtain radiation efficiency and radiation loss factor for arbitrary mode and configuration. As vibration input peculiar to machine elements, impact phenomenon is studied, and by estimating the radiated energy due to rigid body acceleration, the essence of the impact sound is described. Choosing a vibrating plate by periodic impacts as an example of vibrating machine element, property of noise radiation caused by modal vibration is investigated, and estimates of radiated sound power are compared with the experimental values.

For designing digital controller of active noise control systems, it is important to establish an adaptive identification systems for efficient modelling of the sound field. As an internal structure, effective orders of FIR model and pole/zero model representing the transfer functions of acoustic paths are studied. It is shown that, when modal density of the system is low, and frequency range is narrow, pole/zero modelling can greatly reduce the model order compared to FIR modelling, As an external structure of controller, the configuration of adaptive system tracking the time variation of transfer function is studied, and an effective configuration for simultaneous identification of multiple acoustic path is proposed.