

Accepted Manuscript

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PII: S0022-460X(18)30488-7

DOI: [10.1016/j.jsv.2018.07.044](https://doi.org/10.1016/j.jsv.2018.07.044)

Reference: YJSVI 14286

To appear in: *Journal of Sound and Vibration*

Received Date: 22 February 2018

Revised Date: 26 June 2018

Accepted Date: 27 July 2018

Please cite this article as: S. Kaneko, G. Hong, N. Mitsume, T. Yamada, S. Yoshimura, Numerical study of active control by piezoelectric materials for fluid–structure interaction problems, *Journal of Sound and Vibration* (2018), doi: [10.1016/j.jsv.2018.07.044](https://doi.org/10.1016/j.jsv.2018.07.044).

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Numerical Study of Active Control by Piezoelectric Materials for Fluid–Structure Interaction Problems

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Abstract

Fluid–structure interaction (FSI) is a phenomenon caused by mutual interference between structures and the surrounding flow. Controlling FSI is important because FSI causes undesired vibration and it often affects the safety and lifetime of structures. Piezoelectric materials have excellent electromechanical properties to suppress vibration. As such, piezoelectric sensors and actuators are often used for reducing not only mechanical vibration but also FSI induced vibration. A number of studies have examined active control of FSI using piezoelectric materials. In the study of the control of FSI, numerical simulations are effective because they are proper for parametric studies and reduce the need for experiments. Although a number of numerical studies examined the control of FSI using piezoelectric materials, in these studies, detailed fluid analyses were not performed and the fluid force was modeled as a simple function. As such, the existing method cannot treat complicated FSI problems. Therefore, we herein propose a general-purpose system that conducts detailed electrostatic, structural, and fluid analyses and considers an active control algorithm. We design a structure–fluid–electrostatic interaction analysis system considering active control by inserting electrostatic analysis into FSI analysis solved by the partitioned iterative method and integrating the active control algorithm. In the present

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