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Shigeki Kaneko, Giwon Hong, Naoto Mitsume, Tomonori Yamada, Shinobu Yoshimura

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

Shigeki Kaneko[a,*], Giwon Hong[a], Naoto Mitsume[a], Tomonori Yamada[a], Shinobu Yoshimura[a]

[a] *The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan*

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

*Corresponding author

Email addresses: s_kaneko@save.sys.t.u-tokyo.ac.jp (Shigeki Kaneko), g_hong@save.sys.t.u-tokyo.ac.jp (Giwon Hong), mitsume@sys.t.u-tokyo.ac.jp (Naoto Mitsume), tyamada@sys.sys.t.u-tokyo.ac.jp (Tomonori Yamada), yoshi@sys.t.u-tokyo.ac.jp (Shinobu Yoshimura)