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Boundary Stabilization of a Plate in Contact with a Fluid

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Abstract: This paper presents a solution to the boundary stabilization of a vibrating plate under fluid loading. The fluid is considered to be compressible, barotropic and inviscid. A linear control law is constructed to suppress the plate vibration. The control forces and moments consist of feedbacks of the velocity and normal derivative of the velocity at the boundaries of the plate. The novel features of the proposed method are that (1) it asymptotically stabilizes vibrations of a plate in contact with fluid (the fluid has a free surface) via boundary control and without truncation of the model; and (2) the stabilization of both plate vibrations and fluid motions are simultaneously achieved by using only a linear feedback from the plate boundaries.

Keywords: *semigroups of operators; LaSalle invariant set theorem; asymptotic stabilization; Kirchhoff plate; compressible Newtonain barotropic fluid.*

Mathematics Subject Classification (2010): 35M12, 35Q30.

1 Introduction

The vibration of a plate in contact with fluids has been thoroughly analyzed by many authors [1–3]. Such problems appear frequently in practice, for example when studying the veins, pulmonary passages and urinary systems which can be modeled as shells conveying fluid, aero-elastic instabilities around flexible aircraft, container conveying the fluids and dams [1–5].

One of the most challenging practical difficulties which is present in many of the fluid-structure applications is the vibration of the structures. This may be due to relatively low rigidity and small structural damping and a little excitation may lead long vibration decay time. Vibration is the most destructing source for the flexible structures.

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