

ANALYSIS OF A LINEAR FLUID-STRUCTURE INTERACTION PROBLEM

Q. DU

Department of Mathematics
Penn State University, State College, PA 16802, USA

M.D. GUNZBURGER

School of Computational Science and Information Technology
Florida State University; Tallahassee FL 32306, USA

L.S. HOU

Department of Mathematics
Iowa State University; Ames, IA 50011, USA

J. LEE

Department of Mathematics
Carnegie Mellon University, Pittsburgh, PA 15213, USA

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Abstract. A time-dependent system modeling the interaction between a Stokes fluid and an elastic structure is studied. A divergence-free weak formulation is introduced which does not involve the fluid pressure field. The existence and uniqueness of a weak solution is proved. Strong energy estimates are derived under additional assumptions on the data. The existence of an L^2 integrable pressure field is established after the verification of an inf-sup condition.

1. Introduction. Fluid-structure interaction problems have been extensively studied in the past and continue to be the focus of much attention today. We classify a number of different types of mathematical models for fluid-structure interactions into the following three categories.

Elementary fluid. The fluid motion is governed by equations for a potential function, e.g., the Laplace equation or the wave equation. In [25], a coupled system of a potential equation and a wave equation was considered. Elementary fluids interacting with a rigid cavity or a moving wall were studied in [15] and with an elastic solid in [3].

Inviscid fluid. The fluid motion is governed by inviscid fluid models, e.g., the Euler equations. Interactions between linearized inviscid fluids and elastic solids were analyzed in [1, 27]. An algorithm applicable to an inviscid nonlinear fluid coupled with rigid walls was given in [2].

Viscous fluid. The fluid motion is governed by viscous, incompressible or compressible fluid models, e.g., the Stokes or Navier-Stokes equations. There is an extensive literature on linearized viscous fluids coupled with solids. Solids modeled

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