Finite-element analysis of a static fluid–solid interaction problem

RODOLFO ARAYA
CI²MA, Departamento de Ingeniería Matemática, Universidad de Concepción,
Casilla 160-C, Concepción, Chile
raraya@ing-mat.udec.cl

GABRIEL R. BARRENECHEA*
Department of Mathematics and Statistics, University of Strathclyde, 26 Richmond Street,
Glasgow G1 1XH, UK
*Corresponding author: gabriel.barrenechea@strath.ac.uk

FABRI CE JAILLET
Université de Lyon, CNRS UMR 5205, LIRIS—SAARA team, F-69622 Villeurbanne cedex,
France
fjaillet@liris.cnrs.fr

AND

RODOLFO RODRÍGUEZ
CI²MA, Departamento de Ingeniería Matemática, Universidad de Concepción,
Casilla 160-C, Concepción, Chile
rodolfo@ing-mat.udec.cl

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This paper deals with a fluid–solid interaction problem inspired by a biomechanical brain model. The problem consists of determining the response to prescribed static forces of an elastic solid containing a barotropic and inviscid fluid at rest. The solid is described by means of displacement variables, whereas displacement potential and pressure are used for the fluid. This approach leads to a well-posed symmetric mixed problem, which is discretized by standard Lagrangian finite elements of arbitrary order for all the variables. Optimal-order error estimates in the $H^1$- and $L^2$-norms are proved for this method. A residual $a$ posteriori error estimator is also proposed, for which efficiency and reliability estimates are proved. Finally, some numerical tests are reported to assess the performance of the method and that of an adaptive scheme based on the error estimator.

Keywords: fluid–solid interaction; biomechanical brain model; finite elements; $a$ priori and $a$ posteriori error estimates; adaptive scheme.

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