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GABRIEL N. GATICA

PREPRINT 2026-31

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GABRIEL N. GATICA[†]

Abstract

In this paper we establish the existence of solenoidal liftings that are arbitrarily small in suitable Lebesgue norms for all Dirichlet boundary data satisfying the zero-flux condition. This result is needed to derive, by means of a translated velocity unknown, existence of solutions to mixed variational formulations of the Navier–Stokes equations without imposing any smallness assumption on the Dirichlet boundary data for the velocity. Our approach relies first on a density property of the divergence-free vector test functions, whose proof makes use, among other tools, of the classical Hahn–Banach theorem and the distributional de Rham lemma, and then on the vector-valued version of the trace theorem and a standard right inverse of the divergence operator. Finally, the necessity of the zero-flux condition is also shown.

Key words: solenoidal lifting, Hahn-Banach, de Rham, zero-flux condition, Navier-Stokes

Mathematics subject classifications (2000): 76D05, 46E35, 46F10

*This research was supported by ANID-Chile through the project CENTRO DE MODELAMIENTO MATEMÁTICO (FB210005); and by Centro de Investigación en Ingeniería Matemática (CI²MA), Universidad de Concepción.

[†]CI²MA and Departamento de Ingeniería Matemática, Universidad de Concepción, Casilla 160-C, Concepción, Chile, email: ggatica@udec.cl.

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