

Accepted Manuscript

Error analysis of the immersed interface method for Stokes equations with an interface

Rui Hu, Zhilin Li

PII: S0893-9659(18)30113-7
DOI: <https://doi.org/10.1016/j.aml.2018.03.034>
Reference: AML 5486

To appear in: *Applied Mathematics Letters*

Received date: 28 December 2017
Revised date: 3 March 2018
Accepted date: 4 March 2018

Please cite this article as: R. Hu, Z. Li, Error analysis of the immersed interface method for Stokes equations with an interface, *Appl. Math. Lett.* (2018), <https://doi.org/10.1016/j.aml.2018.03.034>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Error Analysis of the Immersed Interface Method for Stokes Equations with an Interface

Rui Hu and Zhilin Li^a

^a*Department of Mathematics, North Carolina State University, Raleigh, NC 27695*

Abstract

The immersed interface method using the three Poisson equation approach has been successfully developed to solve incompressible Stokes equations with interfaces [6, 8]. While the numerical results show second order convergence for both velocity and pressure, rigorous error analysis is still missing. Based on recent theoretical development, particularly the error analysis by Beale & Layton [1], second order convergence has been shown in this paper for both pressure and velocity under some assumptions.

Keywords:

Stokes equations, error analysis, finite difference method, immersed interface method, divergence-free

2010 MSC: 65N06, 65N15, 76D07

1. Introduction

Consider the incompressible Stokes equations in two dimensional spaces,

$$\nabla p = \mu \Delta \mathbf{u} + F + \mathbf{g}, \quad \nabla \cdot \mathbf{u} = 0, \quad \mathbf{x} \in \Omega, \quad \mathbf{u}|_{\partial\Omega} = \mathbf{0}, \quad (1)$$

where \mathbf{u} is velocity, p is pressure, μ is coefficient of viscosity, \mathbf{g} is a body force, F is a source distribution along a closed smooth interface $\Gamma \in \Omega$ as in Peskin's immersed boundary (IB) model [9], $F(\mathbf{x}) = \int_{\Gamma} f(s) \delta_2(\mathbf{x} - \mathbf{X}(s)) ds$, where δ_2 is the 2D Dirac delta function and $\mathbf{x} = (x, y) \in \Omega^+ \cup \Omega^-$. The interface Γ is assumed to be closed in C^2 and has the parametric form $\mathbf{X}(s) = (x(s), y(s))$, where s is a parameter such as the arc-length and divides the domain into two disjoint sub-regions Ω^+ and Ω^- . The pressure, its normal derivative, and the normal derivative of the velocity are discontinuous across the interface. We will assume μ is constant, which can be written as $\mu = 1$ after scaling.

Download English Version:

<https://daneshyari.com/en/article/8053632>

Download Persian Version:

<https://daneshyari.com/article/8053632>

[Daneshyari.com](https://daneshyari.com)