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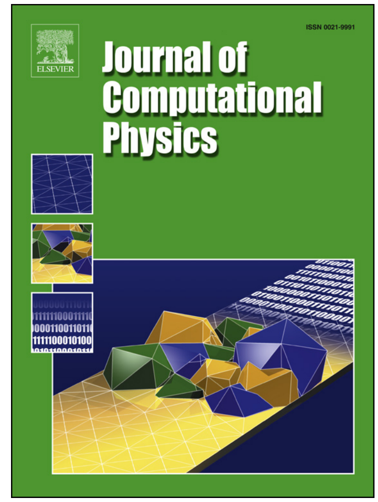

Gradient recovery for elliptic interface problem: II. Immersed finite element methods

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Gradient recovery for elliptic interface problem: II. immersed finite element methods

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Abstract

This is the second paper on the study of gradient recovery for elliptic interface problem. In our previous work [H. Guo and X. Yang, 2016, arXiv:1607.05898], we developed a novel gradient recovery technique for finite element method based on body-fitted mesh. In this paper, we propose new gradient recovery methods for two immersed interface finite element methods: symmetric and consistent immersed finite method [H. Ji, J. Chen and Z. Li, *J. Sci. Comput.*, 61 (2014), 533–557] and Petrov-Galerkin immersed finite element method [T.Y. Hou, X. H. Wu and Y. Zhang, *Commun. Math. Sci.*, 2 (2004), 185–205, and S. Hou and X. D. Liu, *J. Comput. Phys.*, 202 (2005), 411–445]. Compared to body-fitted mesh based gradient recover methods, immersed finite element methods provide a uniform way of recovering gradient on regular meshes. Numerical examples are presented to confirm the superconvergence of both gradient recovery methods. Moreover, they provide asymptotically exact *a posteriori* error estimators for both immersed finite element methods.

Keywords: elliptic interface problem, immersed finite element method, gradient recovery, superconvergence, *a posteriori* error estimator

2010 MSC: 35R05, 65N30, 65N15

1. Introduction

We are interested in developing gradient recovery methods for the following elliptic interface problem

$$-\nabla \cdot (\beta(z)\nabla u(z)) = f(z), \quad z \text{ in } \Omega \setminus \Gamma, \tag{1.1}$$

$$u = 0, \qquad z \text{ on } \partial\Omega, \tag{1.2}$$

where Ω is a bounded polygonal domain with Lipschitz boundary $\partial\Omega$ in $\mathbb{R}^2$, and Γ is the interface which splits Ω into two disjoint subdomains Ω^- and Ω^+. Note that the interface Γ can be given by a zero level of level set function [33, 38].

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