Accepted Manuscript

A numerical model of two-phase flow at the micro-scale using the volume-of-fluid method

Mosayeb Shams, Ali Q. Raeini, Martin J. Blunt, Branko Bijeljic

 PII:
 S0021-9991(17)30921-X

 DOI:
 https://doi.org/10.1016/j.jcp.2017.12.027

 Reference:
 YJCPH 7766

To appear in: Journal of Computational Physics

<page-header><image><image>

Received date:3 May 2017Revised date:17 December 2017Accepted date:19 December 2017

Please cite this article in press as: M. Shams et al., A numerical model of two-phase flow at the micro-scale using the volume-of-fluid method, *J. Comput. Phys.* (2017), https://doi.org/10.1016/j.jcp.2017.12.027

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.

ACCEPTED MANUSCRIPT

A numerical model of two-phase flow at the micro-scale using the volume-of-fluid method

Mosayeb Shams^{*}, Ali Q. Raeini, Martin J. Blunt, Branko Bijeljic

Department of Earth Science and Engineering, Imperial College, Prince Consort Road, London SW7 2BP, UK

Abstract

This study presents a simple and robust numerical scheme to model two-phase flows at small scales in which capillary forces dominate over viscous effects. The volume-of-fluid method is employed to capture the interface whose dynamics is explicitly described based on a finite volume discretization of the Navier-Stokes equations. Interfacial forces are calculated directly on reconstructed interface elements such that the total interface curvature is preserved. The computed interfacial forces are explicitly added to the Navier-Stokes equations using a sharp formulation which effectively eliminates spurious currents. The stability and accuracy of the implemented scheme is validated on several two- and three-dimensional test cases, which indicate the capability of the method to model two-phase flow processes at the micro-scale. In particular we show how the co-current flow of two viscous fluids leads to greatly enhanced flow conductance for the wetting phase in corners of the pore space, compared to a case where the non-wetting phase is an inviscid gas.

Keywords: two-phase flow, micro-scale modelling, volume-of-fluid method, spurious currents.

¹ 1. Introduction

Understanding multiphase flow through porous media is of great importance in a variety 2 of environmental, industrial and engineering applications such as contaminant cleanup [35], 3 fluid separation in fuel cells [48], enhanced oil recovery [29] and carbon dioxide storage 4 in geological porous media [32]. However, accurate modelling and quantification of such 5 flows at the pore level is challenging when the interfacial tension effects become dominant. 6 Inaccurate numerical modelling of the interfacial force may upset the balance of forces in the 7 momentum conservation equation and lead to instabilities and unphysical results [54, 16, 17]. 8 Popular approaches to simulate multiphase pore-scale processes in porous media in-9 clude pore-networks models [13, 7, 6, 53], lattice Boltzmann models [47, 40, 2], mesh-free 10

Preprint submitted to Journal of Computational Physics

^{*}Corresponding author.

Email address: m.shams14@imperial.ac.uk (Mosayeb Shams)

Download English Version:

https://daneshyari.com/en/article/6929124

Download Persian Version:

https://daneshyari.com/article/6929124

Daneshyari.com