

Accepted Manuscript

Numerical analysis of the nonlinear plane Couette-flow problem of a rarefied gas for hard-sphere molecules

Oleg Rogozin

PII: S0997-7546(15)30282-X

DOI: <http://dx.doi.org/10.1016/j.euromechflu.2016.06.011>

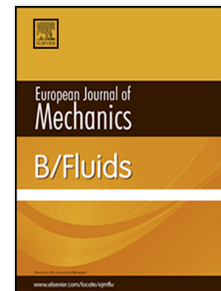
Reference: EJMFLU 3032

To appear in: *European Journal of Mechanics B/Fluids*

Received date: 16 October 2015

Revised date: 6 April 2016

Accepted date: 22 June 2016



Please cite this article as: O. Rogozin, Numerical analysis of the nonlinear plane Couette-flow problem of a rarefied gas for hard-sphere molecules, *European Journal of Mechanics B/Fluids* (2016), <http://dx.doi.org/10.1016/j.euromechflu.2016.06.011>

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.

Numerical analysis of the nonlinear plane Couette-flow problem of a rarefied gas for hard-sphere molecules

Oleg Rogozin

Moscow Institute of Physics and Technology, 9 Institutskiy pereulok, Dolgoprudny, Moskovskaya obl., Russian Federation

Abstract

The plane Couette flow of a rarefied gas is investigated on the basis of the Boltzmann equation over the wide range of Knudsen and Mach numbers. The velocity distribution function and its first thirteen moments are obtained from the accurate numerical solution based on the projection discrete-velocity method extended for nonuniform rectangular velocity grids. The DSMC simulation is used to reinforce the obtained results. The nonlinear Hilbert-type asymptotic solution for a slightly rarefied gas is constructed and also included in the comparison. For this purpose, some additional transport coefficients for hard-sphere molecules are evaluated.

Keywords: Couette flow, rarefied gas dynamics, Boltzmann equation, asymptotic analysis, projection method, OpenFOAM, DSMC

Contents

1	Introduction	2
2	Formulation of the problem	3
2.1	Kinetic description	3
2.2	Linearization of the problem	4
3	Outline of the methods for the linear problem	5
4	Outline of the methods for the nonlinear problem	7
4.1	Free molecular limit	7
4.2	Navier–Stokes equations	7
4.3	Asymptotic analysis for small Knudsen numbers	8
4.4	Statistical simulation	9

Email address: oleg.rogozin@phystech.edu (Oleg Rogozin)

Download English Version:

<https://daneshyari.com/en/article/7051146>

Download Persian Version:

<https://daneshyari.com/article/7051146>

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