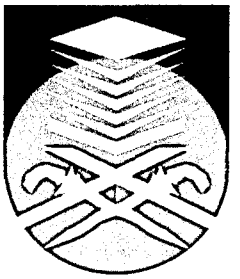
COMPARATIVE STUDY BETWEEN FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR GAS-KINETIC BGK SCHEME



INSTITUTE OF RESEARCH, DEVELOPMENT AND COMMERCIALISATION
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM, SELANGOR
MALAYSIA

BY:

ONG JIUNN CHIT
LIM JIUNN HSUH
MUHAMAD OTHMAN

JUNE 2006

UNIVERSITI TEKNOLOGI MARA
Institut Penyelidikan, Pembangunan dan Pengkomersilan (IRDC)
Institute of Research, Development and Commercialisation (IRDC)
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Tarikh : 5 November 2004

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13500 Permatang Pauh
Pulau Pinang

Tuan/ Puan

PERLANTIKAN BAGI MENJALANKAN PENYELIDIKAN

Merujuk kepada perkara di atas, bersama-sama ini dimajukan salinan surat kelulusan menjalankan penyelidikan serta ringkasan kos perbelanjaan bagi penyelidikan yang dijalankan oleh pensyarah dari UiTM Cawangan Pulau Pinang ;

Tajuk Projek	: Comparative Study Between Finite Difference and Finite Volume Methods for Gas-Kinetic BGK Scheme'
Ketua Projek	: Ong Jiunn Chit
Kos Yang diluluskan	: RM 16,760.00
Jenis Geran	: Geran Dalaman

Sekian, terima kasih.

Yang benar

PROF DR AZNI ZAIN AHMED
Penolong Naib Canselor (Penyelidikan)

s.k: 1. Prof Madya Peridah Bahari
Koordinator URDC
UiTM Cawangan Pulau Pinang

2. Ong Jiunn Chit
Ketua Projek
UiTM Cawangan Pulau Pinang

3. Encik Mohd Halil Marsuki
Penolong Akauntan
Unit Kewangan Zon 17
(Sila hantarkan geran penyelidikan bagi projek ini ke Kampus Cawangan)

Date : 9 Jun 2006

No. Fail Projek : 600-IRDC/ST 5/3/887

The Director

Institute of Research, Development and Commercialisation

Universiti Teknologi MARA

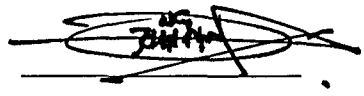
40450 Shah Alam

SUBMISSION OF FINAL RESEARCH REPORT "COMPARATIVE STUDY BETWEEN FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR GAS KINETIC BGK SCHEME"

The above matter is referred. Herewith, three copies of final research report entitled "Comparative Study between Finite Difference and Finite Volume Methods for Gas-Kinetic BGK Scheme" are submitted to the IRDC.

Thank you.

Yours Sincerely,



ONG JIUNN CHIT

Project Research Leader

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ABSTRACT

Many numerical schemes have been developed in the field of computational fluid dynamics to simulate inviscid, compressible flows. Among those most notable and successful are the Godunov-type schemes and flux vector splitting schemes. Besides these numerical schemes, schemes based on the gas kinetic theory haven been developed in the past few years. Stemming from this approach, the gas kinetic Bhatnagar-Gross-Krook (BGK) scheme is realized. In this research, the BGK scheme based on the BGK model of the approximate Boltzmann equation has been fully analyzed and developed accordingly. The BGK scheme is formulated based on a semi-discrete finite volume framework. Higher-order spatial accuracy of the scheme is achieved through the reconstruction of the flow variables via the Monotone Upstream-Centered Schemes for Conservation Laws (MUSCL) approach. For time integration method, the classical Runge-Kutta multi-stage method is employed. In order to fully understand the computational characteristics of the BGK scheme, three test cases are selected to assess the numerical scheme. Then, the semi-discrete finite volume BGK scheme's results are compared against the second-order central difference scheme with Total Variation Diminishing (TVD) using a finite difference approach. In comparison, the BGK scheme exhibits the most accurate shock resolution capabilities, least diffusiveness, least oscillatory and great robustness.