UNIVERSITI PUTRA MALAYSIA

SOLVING THIRD-ORDER BOUNDARY VALUE PROBLEM BY DIRECT METHODS

AHMAD SHAH ABDULLAH BIN AHMAD ZULKIFLI

IPM 2014 2

SOLVING THIRD-ORDER BOUNDARY VALUE PROBLEM BY DIRECT METHODS

By

AHMAD SHAH ABDULLAH BIN AHMAD ZULKIFLI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Master of Science

February 2014

© COPYRIGHT UPM

All material contained within the thesis, including without limitation text, logos, icons, photographs and all other artwork, is copyright material of Universiti Putra Malaysia unless otherwise stated. Use may be made of any material contained within the thesis for non-commercial purposes from the copyright holder. Commercial use of material may only be made with the express, prior, written permission of Universiti Putra Malaysia.

Copyright © Universiti Putra Malaysia

© COPYRIGHT UPM

DEDICATION

TO

MY FAMILY,

ALL MY TEACHERS

AND

ALL MY FRIENDS

© COPYRIGHT UPM

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

SOLVING THIRD-ORDER BOUNDARY VALUE PROBLEM BY DIRECT METHODS

By

AHMAD SHAH ABDULLAH BIN AHMAD ZULKIFLI
February 2014

Chairman: Associate Professor Zanariah Abdul Majid, PhD

Faculty: Institute for Mathematical Research

In this research, the direct method of multistep method is developed for the numerical solution of nonlinear boundary value problems (BVPs) of Type 1 and Type 2 directly. Most of the existing research involving BVPs will reduce the problem to a system of first order Ordinary Differential Equations (ODEs). However, the proposed method will solve the third-order BVPs directly without reducing to first-order ODEs with constant step size using the shooting technique. On- point and two-point direct block method of Adam Moulton have been derived. These methods consists the predictor and corrector method where the predictor is one order less than the corrector. In the numerical results, one-point direct methods have advantages in accuracy and for two-point direct block methods have advantages in timing calculation. The results clearly show that the proposed method is suitable for solving third-order nonlinear BVPs.

© COPYRIGHT UPM

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENYELESAIAN MASALAH NILAI SEMPADAN PERINGKAT KETIGA MENGGUNAKAN KAEDAH LANGSUNG

Oleh

AHMAD SHAH ABDULLAH BIN AHMAD ZULKIFLI
Februari 2014

Pengerusi: **Professor Madya Zanariah Abdul Majid, PhD**

Fakulti: **Institut Penyelidikan Matematik**

Dalam kajian ini, kaedah langsung bagi kaedah multilangkah dibangunkan untuk penyelesaian berangka bagi masalah nilai sempadan (MNS) tak linear dari Jenis 1 and Jenis 2 secara langsung. Kebanyakkan penyelidikan yang sedia ada melibatkan MNS akan menurunkan masalah kepada sistem Persamaan Pembezaan Biasa (PPB) peringkat pertama. Walau bagaimanapun, kaedah yang dicadang akan menyelesaikan MNS peringkat ketiga secara langsung tanpa menurunkan masalah ke sistem PPB peringkat pertama dengan saiz langkah malar menggunakan teknik menembak. Kaedah blok langsung Adam Moulton satu titik dan dua titik telah diterbitkan. Kaedah ini terdiri kaedah peramal dan pembetul yang mana peramal adalah kurang satu peringkat daripada pembetul. Dalam keputusan berangka, kaedah langsung satu titik mempunyai kelebihan dari segi ketepatan dan kaedah blok langsung dua titik mempunyai kelebihan dalam pengiraan masa. Keputusan jelas menunjukkan kaedah yang dicadangkan adalah sesuai bagi penyelesaian MNS tak linear peringkat ketiga.

© COPYRIGHT UPM

ACKNOWLEDGEMENTS

I would like to express my gratitude to my supervisor Associate Professor Dr. Zanariah Abdul Majid, my co-supervisor Dr. Norazak Senu, and my senior Phang Pei See for the useful comments, remarks and engagement through the learning process of this master thesis. Besides, I would also like to thank my parents for their endless love and support. Furthermore I would like to gratefully acknowledge the financial support of Graduate Research Fund (GRF) from Universiti Putra Malaysia and MyMaster from the Ministry of Higher Education.

© COPYRIGHT UPM

© COPYRIGHT UPM

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science**.** The members of the Supervisory Committee were as follows:

Zanariah Abdul Majid, PhD
Associate Professor
Institute for Mathematical Research
Universiti Putra Malaysia
(Chairman)

Norazak Senu, PhD
Senior Lecturer
Faculty of Sciences
Universiti Putra Malaysia
(Member)

© COPYRIGHT UPM

_____

BUJANG BIN KIM HUAT, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

DECLARATION

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any other institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and Innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software.

Signature: _____ Date: _____

Name and Matric No.: _____

© COPYRIGHT UPM

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature: _____	Signature: _____
Name of Chairman of Supervisory Committee: _____	Name of Chairman of Supervisory Committee: _____
Signature: _____	Signature: _____
Name of Chairman of Supervisory Committee: _____	Name of Chairman of Supervisory Committee: _____

© COPYRIGHT UPM

TABLE OF CONTENTS

© COPYRIGHT UPM

© COPYRIGHT UPM