UTM UNIVERSITI TEKNOLOGI MALAYSIA
Innovation and Commercialisation Centre (ICC)

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1. Contributor

Reference No : IP/CR/00999
Title of Innovation : Matlab Source Code for One-Dimensional Unsteady Advection-Diffusion Equation Using Finite Difference Method with Explicit Time Stepping

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Department	: RESOURCE SUSTAINABILITY		
Capacity Involved	: Co-Inventor / Co-Originator (UTM Staff)		

2. Funding

No.	Funding Source	Funding Body	FUNDING TYPE	UNIVERSITY REFERENCE NO.	PROJECT LEADER

3. External Collaboration

Has any of this work been carried out elsewhere ? : No

4. Benefit of Copyright

Benefit to society / community

Description of benefit to society / community	:
Relevant community for the copyright to be implemented	:

Benefit to Industry

Description of benefit to industry	: The copyright involves the solution of the advection and diffusion problem which highly relevant to any field that requires the prediction of advection-diffusion processes such as heat and pollutant transport.
Relevant industry(s) for the copyright to be commercialized	: Any industry that involves the prediction of transport processes such as in civil engineering, mechanical engineering and chemical engineering.

5. Copyright

Application Title

Matlab Source Code for One-Dimensional Unsteady Advection-Diffusion Equation Using Finite Difference Method with Explicit Time Stepping

Copyright Details

Date Invented	: 31-08-2020
Place Invented	: Universiti Teknologi Malaysia, Skudai, Johor
Country of origin	: MALAYSIA

Problem Statement

Problem	: The full description of the scalar transport process can become increasingly complex when the problem is unsteady, involving arbitrary geometry and boundary conditions. In such cases, the solution cannot be obtained analytically. The solution of the scalar transport problem, governed by the unsteady advection-diffusion, can be obtained by solving the partial differential equation using the numerical method. One method that can be used to solve the equation is the Finite Difference Method (FDM). Using the FDM method, the equation is discretized using a Taylor Series expansion. The discretization process creates a set of simultaneous equations which can be solved using a computer. The solution of the unsteady advection-diffusion is readily available, however, the source code is not widely available.
Solution	: The 1D unsteady advection-diffusion equation was discretized using FDM. The source code to solve the discretized equation was written in Matlab programming language.
Copyright Category	: Source Code

Brief description of the invention

The copyright is a Matlab source code for the 1D unsteady advection-diffusion equation. The equation is discretized using the Finite Difference Method (FDM). The spatial term is discretized using a central difference method for the diffusion term and an upwind scheme for the advection term. The temporal term is discretized using Euler Forward (explicit method). The explicit method is conditionally stable and requires the satisfaction of stability criteria.

6. Statutory Declaration

Date of project started	: 01 Ogos 2020
Date of work completed	: 30 Ogos 2020

STATUTORY DECLARATION FOR COPYRIGHT

COPYRIGHT ACT 1987

IN THE MATTER of Section 42 of the Copyright Act 1987 (Act 332)

And

In THE MATTER of the copyright in the Work (as hereinafter defined and attached hereto marked as "Exhibit 2", in the name of Universiti Teknologi Malaysia

STATUTORY DECLARATION

I, **ASSOC. PROF. Ts DR. NOOR AZURATI BINTI AHMAD @ SALLEH** (NRIC No. **790325-01-5032**) of full age and a Malaysian citizen with an address at Innovation and Commercialisation Centre, Industry Centre, Technovation Park, Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia, do hereby solemnly and sincerely declare that the following contents of this notice are true :

1. I am the Director of Innovation and Commercialization Centre, Universiti Teknologi Malaysia (hereinafter referred to as "the University"), a Public University in Malaysia with its address at Innovation and Commercialization Centre, Industry Centre, Technovation Park, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia.

2. In my aforesaid capacity, I have been duly authorized by the University to make this Statutory Declaration on their behalf. The faces herein contained are, unless to the country is stated from any personal knowledge or taken from the record of the University to which I have free and unrestricted access. The facts deposed to herein are true to the best of my knowledge, information and belief.

3. The University is the owner of the copyright of "**Matlab Source Code for One-Dimensional Unsteady Advection-Diffusion Equation Using Finite Difference Method with Explicit Time Stepping**" (hereinafter referred to as "the works"). Please refer to Exhibit 2.

4. The contributor(s) who is/are the author(s) of the Work is/are as follows:-
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    2. Name : **AIN NAADIA BINTI MAZLAN**
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    3. Name : **DAYANG ZULAIKA BINTI ABANG HASBOLLAH**
       NRIC No. : **880503135010**

    4. Name : **MUHAMMAD NAQIUDDIN BIN MOHD WARID**
       NRIC No. : **861202436465**

    5. Name : **MOHD RIDZA BIN MOHD HANIFFAH**
       NRIC No. : **840515125059**

    6. Name : **AHMAD RAZIN BIN ZAINAL ABIDIN @ MD. TAIB**
       NRIC No. : **820512145443**

    7. Name : **MUSHAIRRY BIN MUSTAFFAR**
       NRIC No. : **620811065391**

    8. Name : **RADZUAN BIN SA'ARI**
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    9. Name : **MUHAMMAD AZRIL BIN HEZMI**
       NRIC No. : **790912055223**

    10. Name : **CHE ROS BIN ISMAIL**
        NRIC No. : **640809025225**

    11. Name : **MUHAMMAD NASSIR BIN HANAPI**
        NRIC No. : **640929085935**

    Main contributor of the Work must be the employee of the University (hereinafter referred to "the Main Author")
    The personal details of the contributor(s) (hereinafter referred to as "the Author(s)") and information of the Work is attached herewith and marks as "Exhibit 1".

5. The Author(s) involved in the development of the Work is as listed in the document annexed as "Exhibit 1", herein and have been involved in the development of the Works for a period commencing from **01 Ogos 2020**.

The Works comprises of One (1) document entitled as follows :

i. "Exhibit 2"

I hereby declare the following:

ii. on **30 Ogos 2020**, copyright subsisted in the Works and continues to subsist:

iii. the Author(s) has/have expended sufficient to make the Work original in character:

iv. the Work has been reduced to a material form;

and pursuant to Section 7 of the Copyright Act, 1987, the Work is eligible for copyright protection.

6. I have further been advised and verify believe that as:

   i. The Main Author was at all material times the employee of the University and had developed the Work in the course of his employment with the University; and

   ii. The University is the qualified person within the meaning of Section 10 of the Copyright Act 1987 the copyright in the Work belongs to the University.

7. Therefore I, on behalf of the University, do hereby assert the ownership of the copyright in the Work.

8. The Work was first published on Malaysia on . And I make this solemn declaration conscientiously believing the same to be true and by virtue of Section 42 of the Copyright Act 1987 and the Statutory Declaration Act 1980.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of Section 42 of the Copyright Act 1987 and the Statutory Declaration Act 1980.

SUBSCRIBED and SOLEMNLY DECLARED }

By Name : **ASSOC. PROF. Ts DR. NOOR AZURATI BINTI AHMAD @ SALLEH** }

NRIC No. : **790325-01-5032** }

at Johor Bahru }

On this day of, }

Before me,

Commissioner of Oaths

Affixed Seal and Date

7. Applicant Declaration

The information which is provided on this form will be user by the University to access the ownership of the intellectual property rights, potential third party claims to those rights and obligations to external sponsors. Incorrect or incomplete detail could lead, the reduction or loss of commercialization revenues, or the invalidation of patent applications.

I declare that the information which I have provided in this form is, to the best of my knowledge and belief, correct and complete and that the contributors named are all the original creators of this invention/design. I also agree to cooperate in seeking or other legal protection in the name of Universiti/Institution and in the commercialization of this invention/design. I also confirm that I have notified the University/Institution of any conflict of interest which may exist in relation to the invention.

eSubmit status	:-- **agree for submission --**
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Acceptance Date	: **17-09-2020**

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Approximate % Contribution	: **5 %**
Acceptance Date	: **18-09-2020**

eSubmit status	:-- **agree for submission --**
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