UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

THE NUMERICAL SOLUTIONS FOR INVISCID BURGERS EQUATION USING LAX METHOD AND METHOD OF LINES

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IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL

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ABSTRACT

There are many equations in mathematics which are used in our daily life. Burgers equation is one of them which is a simplification of Navier-Stokes equation where the external force is neglected. This equation is used to analyze traffic congestion and acoustics. Due to the complexity of the analytical solution, numerical method is needed to solve this equation. In this report, 1D nonlinear Inviscid Burgers equation has been solved numerically. Numerically, it is solved using Finite Difference using *Lax Method* and *Method of Lines*. Numerical method is implemented with computer programming to get the numerical solution of 1D nonlinear Inviscid Burgers equation.

1 INTRODUCTION

1.1 Research Backgroud

Throughout this era, Partial Differential Equation (PDEs) was famously nominated in the study of science stream and it is avidly being used to construct models of the most basic theory underlying Physics and engineering stream. First and foremost, the system of PDEs is well-known as Maxwell's equations which can be derived from the entire theory of electricity and magnetism, including light (Moore, 2003). However, PDEs can be also found in Biology, Chemistry, Computer Science and even in Economics field.

PDEs generally can be categorized into three branches of equation. They are parabolic equation (heat equation), hyperbolic equation (wave equation) and elliptic equation (poison equation) respectively. These individual branches of the subject are going to be concerned with the special types of PDE's which are vital for model diffusion, wave motion, and myriad equilibrium of membranes (Moore, 2003). Heck, PDEs also significant for the solution of the physical problems involving three general classifications which are equilibrium problems (heat diffusion), propagation problems and Eigen problems.

In the interim, Burger's equation is a nonlinear and its own phenomena can be described as simultaneously to a turbulence. By the simplification of Navier-Stokes equation, in 1D without any sort of pressure, it have been used to study diverse non equilibrium, nonlinear phenomena in turbulence, cosmology and interface dynamics (Beatus et al., 2009). Furthermore, this equation is mainly used to describe the wave processes in acoustics and hydrodynamics. The left side of the equation can be labeled as a convection term which is nonlinear while the right side can be labeled as diffusive term that represented viscosity respectively. Burger's equation can be illustrated as,

$$\frac{\partial}{\partial t}U(x,t)+U(x,t)\frac{\partial}{\partial x}U(x,t)=v\frac{\partial^2}{\partial x^2}U(x,t)+F(x,t)$$