EFFICIENT 3D TEMPERATURE PROPAGATION FOR LASER GLASS INTERACTION

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ABSTRACT

A new algorithm in the class of the AGE method is for developed to solve the heat equation in 3 space dimensions laser glass model problem. AGE method is one of the iterative, convergent, stable and second order accurate with respect to space and time. All the parallel strategies were developed on a CPUs. The distributed parallel computer system were run on the homogeneous cluster of 20 Intel Pentium IV PCs, each with a storage of 20GB and speed of 1.6Mhz. where data decomposition is run asynchronously and concurrently at every time level. The performance evaluations of the algorithm are increasing in terms of speed-up, efficiency and effectiveness.

INTRODUCTION

This research are to present the coordinate system cylinder parabolic equation with the laser glass interaction model problem and also to described its parallel implementation on the PVM platform is used.

OBJECTIVES

i. To derive the mathematical modelling of polar coordinate of parabolic equation.

ii. To discreatize of the laser glass using partial differential equation (PDE)

ii. To compare the numerical performance of the Alternative Group Explicit method (AGE) with DOUGLAS, GSRB and BRAIN.

METHODOLOGY

Using Alternative Group Explicit method (AGE), such as AGE-BRIAN, AGE-DR, and AGE-GSRB.

NUMERICAL METHODS

The mathematical simulation of the problem statements lead to solving partial differential equation of the parabolic type.In the special case of temperature propagation in an isotropic and homogeneous medium in the 3-dimensional space of cylindrical coordinate of parabolic type and descritize by Taylor, this equation is (Smith, 1978):

$$\frac{1}{a}\frac{\partial U}{\partial t} = \frac{\partial^2 U}{\partial r^2} + \frac{1}{r}\frac{\partial^2 U}{\partial r} + \frac{1}{r^2}\frac{\partial^2 U}{\partial \theta^2} + \frac{\partial^2 U}{\partial z^2} + \frac{q}{k'}$$

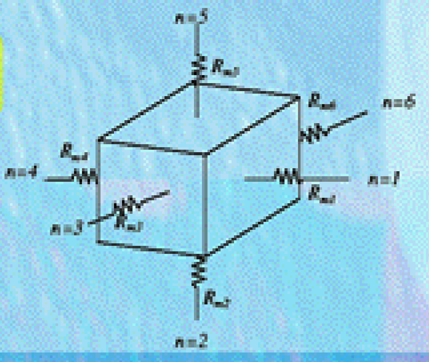
with the initial condition:

$$T(r,\theta,z,t)\,|\,r=0 = T_0$$

and boundary condition:

$$T(r,\theta,z,t)|_{s1=0} = T_1$$

$$T(r,\theta,z,t)|_{s2=0} = T_2$$



CONCLUSION

The stable and highly accurate AGEB algorithm is found to be well suited for parallel implementation where the data decomposition runs asynchronously and concurrently at every time level.

AGE_Brian scheme on system coordinate cylinder on laser glass interaction using heat equation proof that this scheme have a convergence value better than AGE_Douglas and GSRB. Comparison the result shows that when the size of dimension is increase, speed-up and efficient of AGE will decrease. The factors are communication cost between processors increase, time idle increase and the level equilibrium of data storage decrease. AGE_Brian proof as a theoretically and experimentally that is

VISUALIZATION OF LASER GLASS

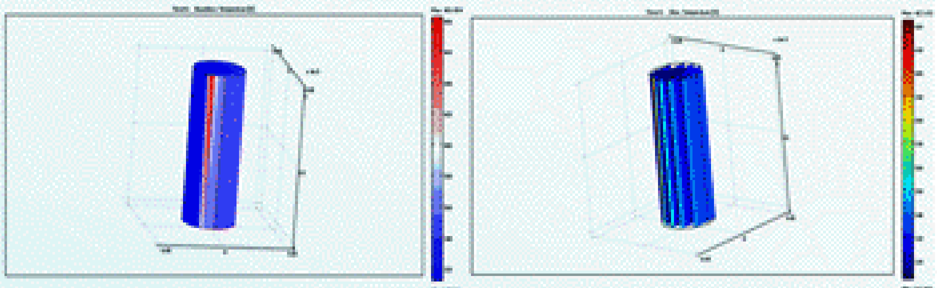


Figure1: Temperature distribution after 1s of laser heating on the piece of glass

Example of Laser Glass Products

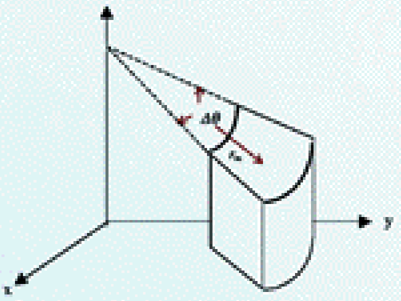


Figure 2: Cylinder with prescribed angle and radius

EXPERIMENTAL RESULTS

m	70X70X70			100X100X100		
AGE	BRIAN	DOUGLAS	GSRB	BRIAN	DOUGLAS	GSRB
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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p	1	1	1	1	1	1
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Table 1: Performance measurements of the sequential BRIAN and DOUGLAS schemes

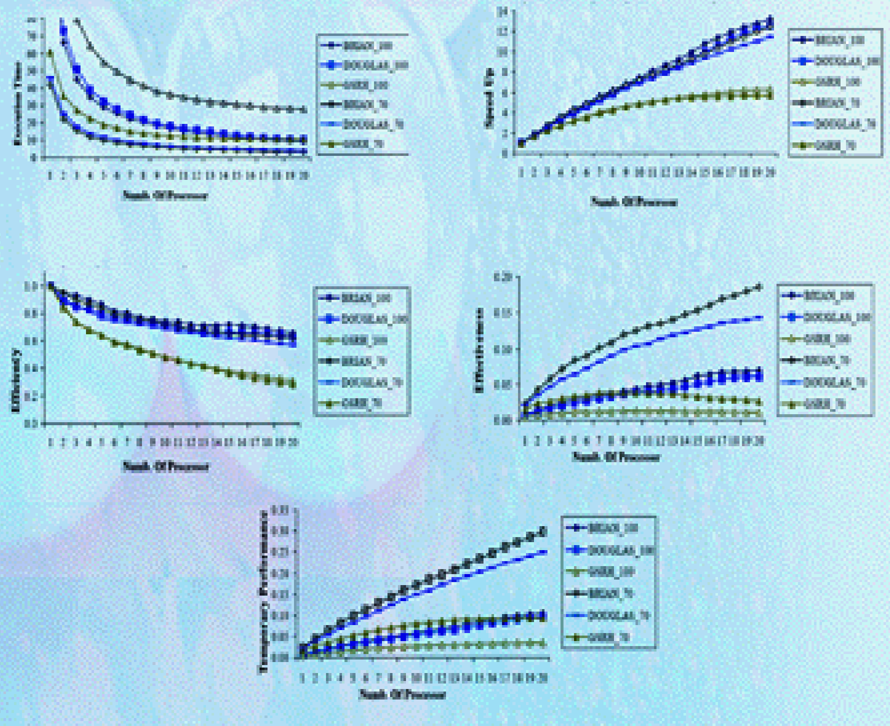
m scheme	Multiplications	Additions
Coefficients	7	10
Level time	$\frac{30m^2-30m^2}{p}$	$\frac{15m^2-20m^2}{p}$
BRIAN	$\frac{8(m-1)^2+4m^2}{p}$	$\frac{13(m-1)^2+10m^2}{p}$
DOUGLAS	$\frac{12(m-1)^2+8m^2}{p}$	$\frac{13(m-1)^2+10m^2}{p}$
GSRB	$\frac{15(m-1)^2+14m^2}{p}$	$\frac{13(m-1)^2+12m^2}{p}$

Table 2: Computational cost for parallel strategies of BRIAN and DOUGLAS schemes

m scheme	Communication cost
coefficients	0
BRIAN	$12L(m\times m)t_{data}+6L(t_{startup}+t_{idle})$
DOUGLAS	$12L(m\times m)t_{data}+6L(t_{startup}+t_{idle})$
GSRB	$12L((m\times m)/2)t_{data}+6L(t_{startup}+t_{idle})$

L = number of interaction

Table 3. Communication cost for parallel strategies of BRIAN and DOUGLAS schemes



Graphs of the execution time, speed up, efficiency, effectiveness and temporary performance vs. number of processor vs. number of processor using (70X70X70) and

ACKNOWLEDGEMENT

The authors wish to express their gratitude and indebtedness to the Technology University of Malaysia and the Malaysian government for providing the moral and financial support under the e-science grant (vote 72919) forth-successful completion of this project.