



TITLE OF THESIS

By

NAME OF STUDENT

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of (insert the name of the degree)

Month and year of Viva Voce

DEDICATIONS

Mum

Dad

...

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of (insert the name of the degree)

TITLE OF THESIS

By

NAME OF STUDENT

Month and Year of Viva Voce

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In this study, ...

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah ... (nama ijazah)

TAJUK TESIS

Oleh

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Fakulti: Nama Fakulti

Penyelidikan ini mengkaji ...

ACKNOWLEDGMENTS

First of all, I would like to thank

I certify that a Thesis Examination Committee has met on (**insert the date of viva voce**) to conduct the final examination of (**insert the student's name**) on his (or her) thesis entitled "**Title of thesis**" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the (**insert the name of relevant degree**).

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Universiti Putra Malaysia

(Member)

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Date:

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

(Signature)

NAME OF STUDENT

Date:

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LIST OF ABBREVIATIONS

VIM	Variational Iteration Method
MVIM	Multistage Variational Iteration Method
ODEs	Ordinary Differential Equations
PDEs	Partial Differential Equations
λ	Lagrange Multiplier
ADM	Adomian Decomposition Method
SADM	Standard Adomian Decomposition Method
MADM	Modified Adomian Decomposition Method
RK4	Fourth-order Runge-Kutta Method
HAM	Homotopy Analysis Method

CHAPTER 1
TITLE OF CHAPTER 1

There may be a preamble at the beginning of a chapter. The purpose may be to introduce the themes of the main headings.

1.1 Main Heading No.1 (Primary Level Numbering)

1.1.1 Subheading No.1 (Secondary Level Numbering)

There should be at least two subheadings to justify having subheadings.

1.1.2 Subheading No.2 (Secondary Level Numbering)

All first letters of principal words are capitalised and the subheadings is left justified.

1.1.2.1 Tertiary Heading No.1 (Under Subheading No.2)

There should be at least two tertiary headings to justify having tertiary headings.

1.1.2.2 Tertiary Heading No.2 (Under Subheading No.2)

Tertiary and subsequent headings should not be listed in the Table of Contents.

1.2 Main Heading No.2 (Primary Level Numbering)

1.3 Main Heading No.3 (Primary Level Numbering)

1.3.1 Subheading No.1 (Secondary Level Numbering)

1.3.2 Subheading No.2 (Secondary Level Numbering)

1.3.3 Subheading No.3 (Secondary Level Numbering)

CHAPTER 2

LITERATURE REVIEW

2.1 Citations

Please refer to the citation format listed in the file *bibli.bib* for:

- Article in a journal: e.g. (Beth and Gollmann, 1989).
“Beth, T. and Gollmann, D. 1989. Algorithm Engineering for Public Key Algorithm. *IEEE Journal on Selected Areas in Communications* **7** (4): 458–465.”
- Manuscript in a conference proceedings: e.g. (Burton, 1989).
“Burton, D. M. 1989. The Theory of Congruences. *In Proceedings of The 22nd Annual ACM Symposium on the Theory of Computation* (eds. Allyn and Bacon), 80–85. The Association of Number Theory, Boston, USA: Springer.”
- Chapter in a book: e.g. (Gilbert and Gilbert, 2005).
“Gilbert, J. and Gilbert, L. 2005. The Integers and Congruence. *In Elements of Modern Algebra*, 6th edn., 57–117. New York: Thomson, Chapter 2.”
- Book: e.g. (Hejhal et al., 1999).
“Hejhal, D. A., Friedman, J., Gutzwiller, M. C. and Odlyzko, A. M. 1999. *Emerging Applications of Number Theory*. 2nd edn. New York: Springer.”
- Ph.D. thesis: e.g. (Whitwell, 2004).
“Whitwell, G. 2004. *Novel Heuristic and Metaheuristic Approaches to Cutting and Packing*. PhD thesis, School of Computer Science and Information Technology. University of Nottingham.”

- MISC (e.g. dataset from the internet): (NHS Database, Retrieved 08/08/2008).
“NHS Database. Retrieved 08/08/2008, Website,
[http://www.nhs.uk/thenhsexplained/how the nhs works.asp](http://www.nhs.uk/thenhsexplained/how%20the%20nhs%20works.asp).”

CHAPTER 3

CONSTRUCTION OF FIGURES AND TABLES

3.1 Figures

Some examples of displaying the figures in L^AT_EX ...

One single figure ... e.g. Figure 3.1:

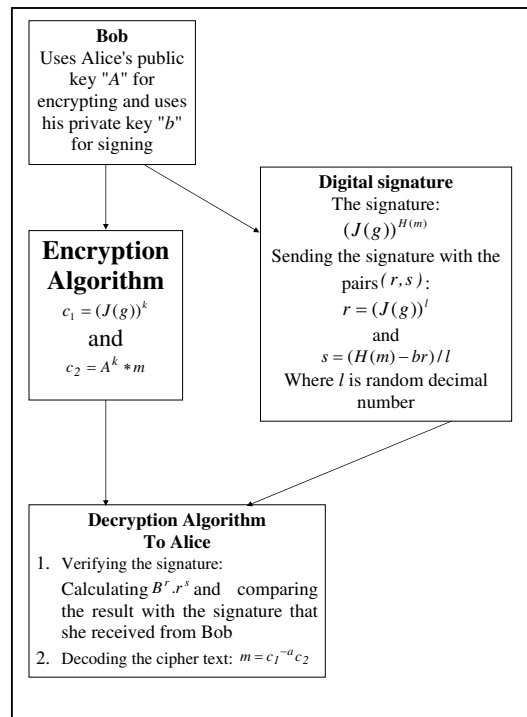


Figure 3.1: Block Diagram for the Digital Signature in Decimal Cryptosystem

Two-in-One figure ... e.g. Figure 3.2:

3.2 Tables

Some examples of creating tables in L^AT_EX ...

Simple table ... e.g. Table 3.1:

Slightly more complex table ... e.g. Table 3.2:



Figure 3.2: (a) The Exact Solution (b) The Numerical Results for $u(x, t)$ by means of 2-iterate VIM solution.

Table 3.1: Time for Encryption/Decryption of different length of Plain-texts

Decimal cryptosystem	Public key 0.4921			
	encryption		decryption	time
text	c_1	c_2	text	ms
130519	0.6511	919.03	130519	15
133519	0.5511	998.04	133519	0
987654	0.7249	310.75	987654	15

Table 3.2: Comparison of LGF with BLF, FC, and TP

Class	n	BLF	LGF	FC	TP	Class	n	BLF	LGF	FC	TP
I	20	1.09	1.03	1.06	1.05	VI	20	1.00	1.00	1.00	1.00
	40	1.12	1.04	1.08	1.06		40	1.40	1.40	1.40	1.40
	60	1.13	1.05	1.09	1.05		60	1.10	1.05	1.05	1.05
	80	1.15	1.06	1.09	1.06		80	1.00	1.00	1.00	1.00
	100	1.12	1.04	1.07	1.03		100	1.13	1.07	1.07	1.07
Average		1.122	1.044	1.078	1.050	Average		1.127	1.103	1.104	1.104
II	20	1.00	1.00	1.00	1.00	VII	20	1.22	1.19	1.19	1.13
	40	1.10	1.10	1.10	1.10		40	1.20	1.12	1.17	1.10
	60	1.10	1.05	1.05	1.00		60	1.20	1.10	1.18	1.12
	80	1.07	1.07	1.03	1.07		80	1.20	1.10	1.17	1.11
	100	1.06	1.03	1.03	1.00		100	1.19	1.09	1.17	1.11
Average		1.065	1.050	1.042	1.034	Average		1.202	1.119	1.176	1.114
III	20	1.20	1.06	1.18	1.06	VIII	20	1.23	1.15	1.16	1.16
	40	1.22	1.13	1.16	1.11		40	1.22	1.16	1.19	1.16
	60	1.26	1.10	1.19	1.11		60	1.19	1.09	1.18	1.11
	80	1.27	1.10	1.15	1.10		80	1.19	1.10	1.16	1.11
	100	1.23	1.08	1.13	1.08		100	1.19	1.09	1.17	1.12
Average		1.239	1.093	1.162	1.092	Average		1.204	1.116	1.172	1.132
IV	20	1.00	1.00	1.00	1.00	IX	20	1.01	1.01	1.00	1.01
	40	1.00	1.00	1.00	1.00		40	1.02	1.02	1.01	1.02
	60	1.10	1.15	1.10	1.10		60	1.01	1.01	1.01	1.01
	80	1.10	1.10	1.10	1.07		80	1.01	1.01	1.01	1.01
	100	1.13	1.07	1.07	1.03		100	1.01	1.01	1.01	1.01
Average		1.065	1.063	1.054	1.040	Average		1.011	1.011	1.008	1.012
V	20	1.15	1.09	1.08	1.06	X	20	1.15	1.20	1.15	1.20
	40	1.18	1.10	1.10	1.11		40	1.13	1.07	1.09	1.08
	60	1.16	1.09	1.11	1.08		60	1.14	1.08	1.09	1.09
	80	1.17	1.09	1.11	1.08		80	1.14	1.06	1.06	1.06
	100	1.16	1.08	1.10	1.08		100	1.11	1.07	1.07	1.06
Average		1.165	1.092	1.100	1.082	Average		1.135	1.098	1.092	1.098
						AVERAGE		1.133	1.079	1.099	1.076

CHAPTER 4
THEOREM, PROPOSITION, DEFINITION, LEMMA,
COROLLARY AND CONJECTURE

4.1 Defining Theorem, Lemma, Corollary, and ...

Command for **Definition**:

```
\begin{definition}{\bf:}
```

...

```
\end{definition}
```

For example:

Definition 4.1 : *Let ... and ... then ...*

$$R(0.j_1j_2 \cdots j_{k-1}j_k \cdots) = \begin{cases} 0, & \text{when } j_1 < 4, \\ 1, & \text{when } j_1 \geq 5 \text{ or when } j_1 \geq 4 \text{ and } j_2 \geq 5 \end{cases} \quad (4.1)$$

$\forall 0.j_1j_2 \cdots j_{k-1}j_k \cdots \in (0, 1)$ where $j_i \in Z$, $i = 1, 2, \dots$. We call R the **rounding off function**.

Command for **Proposition**:

```
\begin{proposition}{\bf:}
```

...

```
\end{proposition}
```

For example:

Proposition 4.1 :

Given ... Thus ...

Command for **Theorem**:

```
\begin{theorem}{\bf:}
```

...

```
\end{theorem}
```

For example:

Theorem 4.1 :(name of the theorem if needed)

Let...

$$\text{Round}[m \cdot (x/x)] = m \tag{4.2}$$

if and only if the number $[m \cdot (x/x)]$ takes the form of either

- i. $m + 0.j_1j_2 \cdots j_{r-1}j_r \cdots$, where $R(0.j_1j_2 \cdots j_{r-1}j_r \cdots) = 0$ or,*
- ii. $(m - 1) + 0.h_1h_2 \cdots h_r \cdots$, where $R(0.h_1h_2 \cdots h_r \cdots) = 1$.*

Command for **Proof**:

```
\begin{proof}
```

...

```
\end{proof}
```

For example:

Proof:

We ...

1. In condition (i),...
2. In condition (ii), ...

In chapter 2, section 2.1 we proved that ...

Command for **Remark**:

```
\begin{remark}{\bf:}
```

...

```
\end{remark}
```

For example:

Remark 4.1 : *A square is a rectangle.*

Command for **Note**:

```
\begin{note}{\bf:}
```

...

```
\end{note}
```

For example:

Note 4.1 : *Value for b is always equal to 1.*

Command for **Example**:

```
\begin{example}{\bf:}
```

...

```
\end{example}
```

For example:

Example 4.1 : *2×2 is a square.*

Command for **Lemma**:

```
\begin{lemma}{\bf:}  
...  
\end{lemma}
```

For example:

Lemma 4.1 : *Suppose ... then ...*

Command for **Corollary**:

```
\begin{corollary}{\bf:}  
...  
\end{corollary}
```

For example:

Corollary 4.1 : *Assume ... hence ...*

Command for **Conjecture**:

```
\begin{conjecture}{\bf:}  
...  
\end{conjecture}
```

For example:

Conjecture 4.1 : *If ... then ... else ...*

BIBLIOGRAPHY

- Beth, T. and Gollmann, D. 1989. Algorithm Engineering for Public Key Algorithm. *IEEE Journal on Selected Areas in Communications* 7 (4): 458–465.
- Burton, D. M. 1989. The Theory of Congruences. In *Proceedings of The 22nd Annual ACM Symposium on the Theory of Computation* (eds. Allyn and Bacon), 80–85. The Association of Number Theory, Boston, USA: Springer.
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- Hejhal, D. A., Friedman, J., Gutzwiller, M. C. and Odlyzko, A. M. 1999. *Emerging Applications of Number Theory*. 2nd edn. New York: Springer.
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- Whitwell, G. 2004. *Novel Heuristic and Metaheuristic Approaches to Cutting and Packing*. PhD thesis, School of Computer Science and Information Technology. University of Nottingham.

APPENDIX A

ALGORITHMS

A.1 Simulated Annealing

```
Random decimal numbers  $g$  to  $a$  and  $T$  to  $T_0$ 
Loop - Cooling
  Loop - Local Search
    Derive a neighbour,  $j$  of  $i$ 
     $\Delta E := E(j) - E(i)$ 
    If  $\Delta E < 0$ 
      Then  $i := j$ 
    Else derive random number  $r \in [0, 1]$ 
      If  $r < e^{-\frac{\Delta E}{T}}$ 
        Then  $i := j$ 
      End If
    End If
  End Loop - Local Search
  Exit (when goal is satisfied or the stopping criterion is reached)
   $T = C(T)$ 
End Loop - Cooling
```

Figure A.1: Algorithm of Simulated Annealing

A.2 Genetic Algorithm

- | |
|--|
| <p>S1: [Start] Generate an initial population P_{pop}, of n chromosomes.</p> <p>S2: [Fitness] Evaluate the fitness $g(x)$ of each chromosome x in the population.</p> <p>S3: [New Population] Create a new population by repeating the following steps until the new population is complete.</p> <ol style="list-style-type: none">i. [Selection] Select 2 parent chromosomes from a population according to their fitness (the fitter, the better chance of being selected).ii. [Crossover] With a crossover probability p_c, cross over the parents to form 2 new offspring (children). If no crossover was performed, the offspring is an exact copy of parents.iii. [Mutation] With a mutation probability p_m, mutate new offspring at each locus (position in chromosome).iv. [Replace] Place new offspring in the new population. <p>S4: [Fitness] Evaluate the fitness $g(x')$ of each chromosome x' in the new population.</p> <p>S5: [Test] If the end condition is satisfied, STOP, and return the fittest solution found; otherwise, go to S3.</p> |
|--|

Figure A.2: Algorithm of a Genetic Algorithm

A.3 Tabu Search

```

procedure SEARCH( $t, k, diversify, z$ ):
   $penalty^* := +\infty$ ;
  for each  $j \in S_t$  do
    for each  $k$ -tuple  $K$  of bins not including  $t$  do
       $S := \{j\} \cup (\bigcup_{i \in K} S_i)$ ;
       $penalty := +\infty$ ;
      case
         $A(S) < k$ :
          execute the move and update the solution value  $z$ ;
           $k := \max\{1, k - 1\}$ ;
          return;
         $A(S) = k$ :
          if the move is not tabu or  $S_t \equiv \{j\}$  then
            execute the move and update the solution value  $z$ ;
            if  $S_t \equiv \{j\}$  then  $k := \max\{1, k - 1\}$ ;
            return
          end if;
         $A(S) = k + 1$  and  $k > 1$ :
          let  $I$  be the set of  $k + 1$  bins used by  $A$ ;
           $\bar{t} := \arg \min_{i \in I} \{\varphi(S_i)\}$ ,  $T := (S_t \setminus \{j\}) \cup S_{\bar{t}}$ ;
          if  $A(T) = 1$  and the move is not tabu then
             $penalty := \min\{\varphi(T), \min_{i \in I \setminus \{\bar{t}\}} \{\varphi(S_i)\}\}$ 
          end case;
       $penalty^* := \min\{penalty^*, penalty\}$ ;
    end for;
  end for;
  if  $penalty^* \neq +\infty$  then execute the move corresponding to  $penalty^*$ 
  else if  $k = k_{\max}$  then  $diversify := \text{true}$  else  $k := k + 1$ 
return.

```

Figure A.3: Unified Tabu Search: Procedure SEARCH

APPENDIX B

TABLES

B.1 Complex Tables

Example of complex table ... e.g. Table B.1

Table B.1: Typology of Machine Scheduling Problems

Characteristic	Symbol	Description	
Machine Environment α	$\alpha_1 = \circ$	a single machine	
	$\alpha_1 = P$	identical parallel machines	
	$\alpha_1 = Q$	uniform parallel machines	
	$\alpha_1 = R$	unrelated parallel machines	
	$\alpha_1 = F$	a flow shop	
	$\alpha_1 = O$	an open shop	
	$\alpha_1 = J$	a job shop	
		$\alpha_2 = \circ$ $\alpha_2 = m$	the number of machines is arbitrary there are a fixed number of machines m
Job Characteristics β	$\beta_1 = \circ$ $\beta_1 = r_j$	no release dates are specified jobs have release dates	
	$\beta_2 = \circ$ $\beta_2 = \bar{d}_j$	no deadlines are specified jobs have deadlines	
	$\beta_3 = \circ$ $\beta_3 = s_{ifg}$ $\beta_3 = s_{fg}$ $\beta_3 = s_{if}$ $\beta_3 = s_f$	there are no setup times there are general family setup times there are machine independent family setup times there are sequence independent family setup times there are machine and sequence independent family setup times	
	$\beta_4 = \circ$ $\beta_4 = prec$ $\beta_4 = pmtn$	no precedence constraints are specified jobs have precedence constraints preemption of jobs is allowed	
	Optimality Criterion γ (involves the minimisation of)	C_{\max}	maximum completion time
		L_{\max}	maximum lateness
		$\sum_j (w_j) C_j$	total (weighted) completion time
		$\sum_j (w_j) T_j$	total (weighted) tardiness
		$\sum_j (w_j) U_j$	total (weighted) number of late jobs
		$\sum_j (w_j) E_j$	total (weighted) earliness

Example of landscape (or sideways) table ... e.g. Table B.2

Table B.2: A Comparison of Different Local Search Algorithms

Due Date Class	Data Class	SGA			MXGA _F			UTS _{LGF}			RDM		
		Ratio	OBU	ARD	Ratio	OBU	ARD	Ratio	OBU	ARD	Ratio	OBU	ARD
A	I	1.056	83.10	16.58	1.042	85.26	12.37	1.053	83.42	16.02	1.088	78.73	22.27
	II	1.033	63.69	17.38	1.020	66.19	11.15	1.025	64.92	13.17	1.025	65.36	12.00
	III	1.109	71.36	30.86	1.078	75.40	22.00	1.084	74.51	27.90	1.092	73.23	26.59
	IV	1.047	60.68	21.74	1.047	61.65	17.29	1.033	62.25	19.09	1.040	61.77	18.95
	V	1.087	72.45	24.24	1.070	74.46	18.00	1.077	73.61	21.97	1.076	73.53	21.73
	VI	1.110	54.51	23.23	1.093	56.01	16.66	1.110	54.41	21.49	1.103	55.34	19.34
	VII	1.120	74.45	33.48	1.090	78.54	23.52	1.107	76.70	29.67	1.099	77.10	29.46
	VIII	1.125	74.14	33.96	1.089	78.79	23.31	1.102	77.26	29.99	1.103	76.41	29.03
	IX	1.007	44.07	1.68	1.007	44.10	1.68	1.007	42.92	1.74	1.007	43.17	2.12
	X	1.099	74.96	27.90	1.080	77.27	23.89	1.089	76.59	32.05	1.093	74.93	27.54
Average		1.079	67.34	23.10	1.062	69.77	16.99	1.069	68.66	21.31	1.073	67.96	20.90
B	I	1.065	81.82	34.93	1.046	84.73	24.17	1.069	81.58	31.78	1.088	78.46	38.27
	II	1.033	63.61	47.72	1.027	65.52	33.98	1.038	64.05	39.68	1.032	63.68	33.46
	III	1.132	68.91	66.78	1.088	73.90	46.21	1.128	69.99	64.99	1.107	71.50	56.46
	IV	1.060	59.27	53.45	1.047	61.70	35.98	1.063	59.58	49.09	1.060	59.22	45.72
	V	1.113	69.66	48.58	1.080	73.43	35.51	1.104	70.91	48.33	1.094	71.59	40.41
	VI	1.110	54.34	48.85	1.110	54.93	37.73	1.090	55.34	46.41	1.097	55.00	42.01
	VII	1.133	72.88	71.94	1.102	76.80	52.17	1.135	73.47	65.82	1.122	74.28	58.16
	VIII	1.143	72.19	72.72	1.099	77.38	49.41	1.122	75.08	67.28	1.118	74.27	60.49
	IX	1.007	43.84	2.42	1.007	43.97	2.42	1.007	43.09	2.53	1.007	43.30	3.79
	X	1.113	73.38	67.45	1.087	76.31	53.48	1.125	72.90	81.02	1.110	73.23	64.39
B Average		1.091	65.99	51.48	1.069	68.87	37.11	1.088	66.60	49.69	1.084	66.45	44.32
C	I	1.085	79.30	136.69	1.054	83.50	92.98	1.083	79.76	115.41	1.104	76.50	128.02
	II	1.050	61.80	232.20	1.040	64.02	149.48	1.048	62.60	165.41	1.040	62.44	179.75
	III	1.164	65.80	180.45	1.093	73.28	124.96	1.148	68.01	173.81	1.127	69.10	148.03
	IV	1.070	58.68	223.21	1.053	60.59	153.24	1.063	60.12	210.69	1.063	59.19	183.06
	V	1.134	67.32	149.25	1.088	72.38	105.04	1.134	68.20	142.07	1.106	69.88	121.12
	VI	1.110	54.34	274.92	1.110	54.43	241.31	1.110	54.42	264.36	1.117	53.73	251.38
	VII	1.161	70.18	296.58	1.106	76.20	209.59	1.164	70.42	261.95	1.134	71.77	227.27
	VIII	1.153	70.86	421.53	1.101	76.79	273.28	1.172	69.72	387.14	1.135	72.15	320.40
	IX	1.007	43.71	9.93	1.007	43.81	9.93	1.008	43.14	15.13	1.008	43.29	18.72
	X	1.131	71.33	396.65	1.100	75.24	318.50	1.148	70.83	412.62	1.134	70.87	345.31
C Average		1.107	64.33	232.14	1.075	68.02	167.83	1.108	64.72	214.86	1.097	64.89	192.31

BIODATA OF THE STUDENT

The author was born in Sibuluan, Sarawak on ...

LIST OF PUBLICATIONS

(Publications that arise from the study)- if applicable. For example . . .

1. H. Nazif and **L.S. Lee**. 2010. Optimised Crossover Genetic Algorithm for Vehicle Routing Problem with Time Windows. *American Journal of Applied Sciences*. 7(1): 95 – 101.
2. H. Nazif and **L.S. Lee**. 2010. Solving Single Machine Scheduling Problem with Maximum Lateness using a Genetic Algorithm. *Journal of Mathematics Research*. (Accepted for publication)
3. **L.S. Lee** and H. Nazif. 2009. A Genetic Algorithm for Vehicle Routing Problem. In *Proceedings of the 4th International Conferences on Research and Education in Mathematics*, 21 – 23 October 2009, Kuala Lumpur, MALAYSIA, pp: 625 – 631.