## **CONTENTS**

		rage
ENGLIS	H ABSTRACT	i
THAI AI	ii	
ACKNO'	iii	
CONTEN	iv	
LIST OF TABLES		vi
LIST OF FIGURES		viii
LIST OF	ABBREVIATIONS	ix
CHAPT		
	ODUCTION	1
1.1		
1.2		1
1.3	11	2
	Research Contribution	2
1.5	Report Overview	2
	RATURE SURVEY AND BACKGROUND STUDY	3
	Literature Survey	3
	IDS for Offline Data	3
	IDS for Online Data	8
2.2	2	15 15
	Artificial Intelligence Machine Learning	15
	Fuzzy Logic	16
	Fuzzy Rule	17
	Genetic Algorithm (GA)	17
	KDD99 Dataset	19
3. RESE	ARCH METHODOLOGY	22
3.1	Preprocessing Phase	23
3.2	Training Phase	24
3.2.1	Fuzzy Logic Algorithm	24
3.2.2	Genetic Algorithm	25
3.2.3	6	26
3.2.4	Fuzzy Genetic Algorithm	26
3.3	Detecting Phase	28
3.3.1	Data Normalization	28
3.3.2	Data Classification	28
3.3.3	Evaluation Criteria	28
3.4	Simulation Tools	29
<b>4. EXPE</b>	RIMENTAL RESULTS AND DISCUSSION	30
4.1	Offline Detection	30
4.1.1	•	30
4.1.1.1	1 One-Rule	31
4.1.1.2	2 Two-Rule	33

# **CONTENTS** (Cont.)

		PAGE
4.1.2	Fuzzy GA with Real-time Dataset	34
4.1.2.	1 One-Rule	34
4.1.2.	2 Two-Rule	35
4.1.3	Fuzzy GA with Unknown Detection	36
4.1.4	Intrusion Detection with Various Approaches	37
4.2	Online Detection	40
4.2.1	Experimental Setting	40
4.2.2	Experimental Result	40
5. CONCLUSION		41
REFERENCES		42
CURRIC	CULUM VITAE	45

## LIST OF TABLES

TAI	BLE	PAGE
2.1	Distribution of different classes in training and testing datasets	5
2.2	Detection rate with different numbers of KDD99 features	5
2.3	Data record taken for training and testing in	6
2.4	Summary of offline IDS	7
2.5	Real-time detection rate of RT-UNNID using SOM ART-1 and ART-2	8
2.6	Attack name (left) and feature name in proposed approach (right)	9
2.7	Threshold for attacking graphlets	11
2.8	Feature list of real-time network IDS for large-scale attacks based	
	on incremental mining approach	12
2.9	Features in online dataset	13
2.10	Attack names in the dataset	14
2.11	Features used in NIDSs	14
2.12	Summary of online IDS	15
2.13	Number of each attack in 10% version file of KDD99 dataset	19
2.14	Forty one features of KDD99 dataset	20
3.1	Twelve essential features in pre-processed data	23
3.2	Attack type and simulation tools	29
4.1	Number of records of each attack in KDD99 dataset (A-full version and	
	B-10% version containing approximately 5,000,000 records and	
	200,000 records respectively)	30
4.2	Experimental result from Fuzzy Genetic Algorithm with KDD99 dataset	31
4.3	Detection rule of KDD99 dataset obtained from training process	31
4.4-1	Experimental results of Fuzzy Genetic Algorithm with KDD99 dataset	32
4.4-2	Experimental results comparing different numbers of features used for Back attack and Pod attack	32

# **LIST OF TABLES (Cont.)**

TABLE		PAGE
4.5	Experimental results of Fuzzy Genetic Algorithm with KDD99 dataset	33
4.6	DoS rule with KDD99 dataset obtained from Dos training process	33
4.7	Probe rule with KDD99 dataset obtained from Probe training process	34
4.8	Experimental results of Fuzzy Genetic Algorithm with real-time dataset	34
4.9	Detection rule of real-time dataset obtained from training process	34
4.10	Experimental results of Fuzzy Genetic Algorithm with real-time dataset	35
4.11	Detection rate of real-time dataset from using two rules of Fuzzy	36
	Genetic Algorithm	
4.12	Probe rule of real-time dataset from training process	36
4.13	DoS rule of real-time dataset from training process	36
4.14	Seven test cases with unknown data types	37
4.15	Experimental results with unknown attack type with real-time dataset	38
4.16	Number of KDD99 data records in training dataset and testing dataset	38
4.17	Results from various detection algorithms	39
4.18	Experimental result from CPE network environment	40

### LIST OF FIGURES

FIGURE	PAGE
1.1 Network environments and intrusion detection system	1
2.1 Optimizing fuzzy K-means for network anomaly framework	4
2.2 Block diagram of proposed IDS from using K-means, fuzzy neura	al network
and SVM algorithm	6
2.3 RT-UNNID systems	8
2.4 DoS attack graphlets	10
2.5 CPU initialized for LD <sup>2</sup> (left) and snort (right)	10
2.6 Memory usage for LD <sup>2</sup> (left) and snort (right)	10
2.7 Architecture of NIDS	11
2.8 Network topology for simulation	12
2.9 Similarity degradation during flooding for DoS.Win32.IIS	12
2.10 Boolean logic and fuzzy logic	16
2.11 Trapezoidal membership function	17
2.12 Fuzzy rule	17
2.13 Example of chromosome	17
2.14 Genetic algorithm crossover multi values	18
3.1 Real-time detection model	22
3.2 Trapezoidal fuzzy set {a=2, b=3, c=4, d=5}	24
3.3 Fuzzy encoding for each feature {a=2, b=3, c=4, d=5}	26
3.4 Encoding string	26
3.5 Fuzzy genetic algorithm pseudo code	27
4.1 Real-time network environments	40

#### LIST OF ABBREVIATIONS

AI Artificial Intelligent

ANN Artificial Neural Network

ART Adaptive Resonance Theory

DoS Denial of Service

DR Detection Rate

FA False Alarm

HIDS Host-Based Intrusion Detection System

IDPS Intrusion Detection and Prevention System

IDS Intrusion Detection System

KDD99 International Conference on Knowledge Discovery

and Data Mining 1999

LD2 Lightweight Detection System

MAWI Measurement and Analysis on WIDE Internet

METROSEC Metrology for Security and Quality of Service

MOGFIDS Multi-Objective Genetic Fuzzy Intrusion Detection System

N/A Not Available

NIDS Network-Based Intrusion Detection System

Probe Port Scan

PSO Particle Swarm Optimization

R2L Remote to Local Attack

RT-UNNID Real-Time Unsupervised Neural-Net-Based Intrusion Detector

SOM Self Organizing Maps

SVM Support Vector Machine

TN True Negative Rate

U2R User to Root

### LIST OF ABBREVIATIONS (Cont.)

UI User Interface

UNN-Engine Unsupervised Neural-Net-Based Engine

WIDE Widely Integrated Distributed Environment

UDP User Datagram Protocol

TCP Transmission Control Protocol

ICMP Internet Control Message Protocol

ARP Address Resolution Protocol

IP Internet Protocol