CONTENTS

	PAGE
ABSTRACT	iii
ACKNOWLEDGEMENTS	v
CONTENTS	vi
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF SYMBOLS	x
LIST OF TECHNICAL VOCABULARY AND ABBREVIATIONS	xi
CHAPTER	
1. INTRODUCTION	**1**
1.1 Overview	1
1.2 Objectives	2
1.3 Scopes of this Thesis	2
1.4 The Proposed Procedures	2
1.5 Outline of this Thesis	2
2. LITERATURE SURVEY	**3**
3. RELATED THEORY	**9**
3.1 The Basic of OTA	9
3.2 Artificial Neural Network (ANN)	9
3.2.1 Feed-forward Backpropagation	10
3.2.2 Neuron Model (logsig, tansig, purelin)	11
3.3 BIQUAD Filter	12
4. PROPOSED METHOD	**15**
4.1 Experimental Process	15
4.2 Utilizing an Artificial Neural Network to be Applied	16
4.3 Data Collection	16
4.3.1 Pre-process Collection	16
4.3.2 Initializing the Training Set	17
4.4 Sequential Training and Utilization	17
4.5 Tuning Scheme	19
5. EXPERIMENTAL RESULTS	**20**
5.1 BIQUAD Filter Experiment	20
5.2 Setting Experiment Parameters	24
5.3 Sample Tuning	25
5.4 Massive Tuning	26
5.4.1 Effect of the Sizes of Training Set	26
5.4.2 Feasibility Analysis	27
5.5 Comparison Experiments	29
5.5.1 Sequentially Trained ANN versus the Generally Trained ANN	29
5.5.2 Sequentially Trained ANN versus the PSO	31
6. CONCLUSION	**32**

REFERENCES **33**

APPENDIX PUBLICATIONS **34**

CURRICULUM VITAE **43**

LIST OF TABLES

TABLE		PAGE
2.1	Requirement of bandpass response (GA based ANN)	5
2.2	Specifications of bandpass response (Generally trained ANN)	6
2.3	Specifications of bandpass response (PSO)	7
3.1	Second-order Filter Function	12
4.1	Key parameters of sampled tuning scheme	19
5.1	Transistor dimensions	24
5.2	Performances of the OTA at specified bias current	25
5.3	Specification of bandpass response	25
5.4	The response of varying the training set	26
5.4	The response of varying the training set (Cont.)	27
5.5	One-way ANOVA: Average error versus size	27
5.6	Summation of performance on threshold = 10%	29
5.7	The percentage deviations of the Sequentially Trained ANN versus the Generally Trained ANN with the same random BIQUAD specifications	30
5.8	The compared performances between the generally trained model and the sequentially trained model of ANN	31
5.9	The compared performances between the Sequentially Trained ANN and PSO	31

LIST OF FIGURES

FIGURE		PAGE
2.1	(a) A first-order lowpass circuit and (b) an alternative circuit	3
2.2	Two alternative first-order highpass circuits	3
2.3	Active compensated Tow-Thomas BIQUAD filter	3
2.4	Experimental plots of amplitude and phase response of 20 dB non-inverting amplifier with various active compensation schemes	4
2.5	Experimental plots of variation of quality factor Q_o as a function of resonant frequency ω_o of Tow-Thomas BIQUAD	4
2.6	OTA simulations of resistors	4
2.7	OTA simulations of inductor: (a) grounded and (b) floating	5
2.8	The response of obtained bandpass of GA based ANN	6
2.9	The response of obtained bandpass of ANN-generated parameter	7
2.10	The response of obtained bandpass of PSO-based tuning	8
3.1	Single-stage OTA with plus (a) and minus (b) outputs	9
3.2	Construction of Neural Network	10
3.3	Model of backpropagation	10
3. 4	Equation of output	11
3.5	Architecture of the backpropagation network	11
3.6	Low pass filter	12
3.7	High pass filter	13
3.8	Band pass filter	13
3.9	Band reject filter	13
4.1	The experimental process	15
4.2	Predefined bias points	17
4.3	The matching BIQUAD parameter	17
4.4	The sequentially trained data set	18
5.1	The experiment of BIQUAD circuit	20
5.2	OTA simplifications with C-Miller	20
5.3	Miller's theorem divided capacitors	21
5.4	OTA-C selections from circuit experiment	22
5.5	OTA simplifications without C-Miller.	22
5.6	The response of bandpass obtained from sequentially tuned ANN	26
5.7	The responded tuning of training set is 10	28
5.8	The responded tuning of training set is 20	28
5.9	The responded tuning of training set is 30	29

LIST OF SYMBOLS

SYMBOL		UNIT
V_{DD}	positive supply voltage	V
I_0	bias current	A
I_i	input current	A
Q_p	Q-factor	
ω_p	pole frequency	Hz
K	gain	dB
g_m	transconductance	S
f_b	opened loop bandwidth	Hz
R_o	output resistance	A
F_{ANN}	function of ANN	
Δ_D	desired quantizing resolution	
L_Q	quantizing level	

LIST OF TECHNICAL VOCABULARY AND ABBREVIATIONS

A	=	ampere
A/D	=	analog/digital
ANN	=	Artificial Neural Network
ANOVA	=	analysis of variance
CF	=	cascade-forward
CMOS	=	complementary MOS
CT	=	continuous–time
D/A	=	digital/analog
DC	=	direct current
dB	=	decibel
G	=	giga
GA	=	Genetic Algorithm
GHz	=	gigahertz
Hz	=	hertz
IC	=	Integrated Circuit
k	=	kilo
M	=	mega
MHz	=	megahertz
MOSFET	=	metal-oxide-semiconductor field-effect transistor
mV	=	millivolt
NMOS	=	n-channel MOSFET
OTA	=	operational transconductance amplifier
PMOS	=	p-channel MOSFET
PSO	=	Particle Swarm Optimization
rad/s	=	radian per second
V	=	volt
α	=	alpha
β	=	beta
Ω	=	ohm
μ	=	micro
μA	=	micro ampere