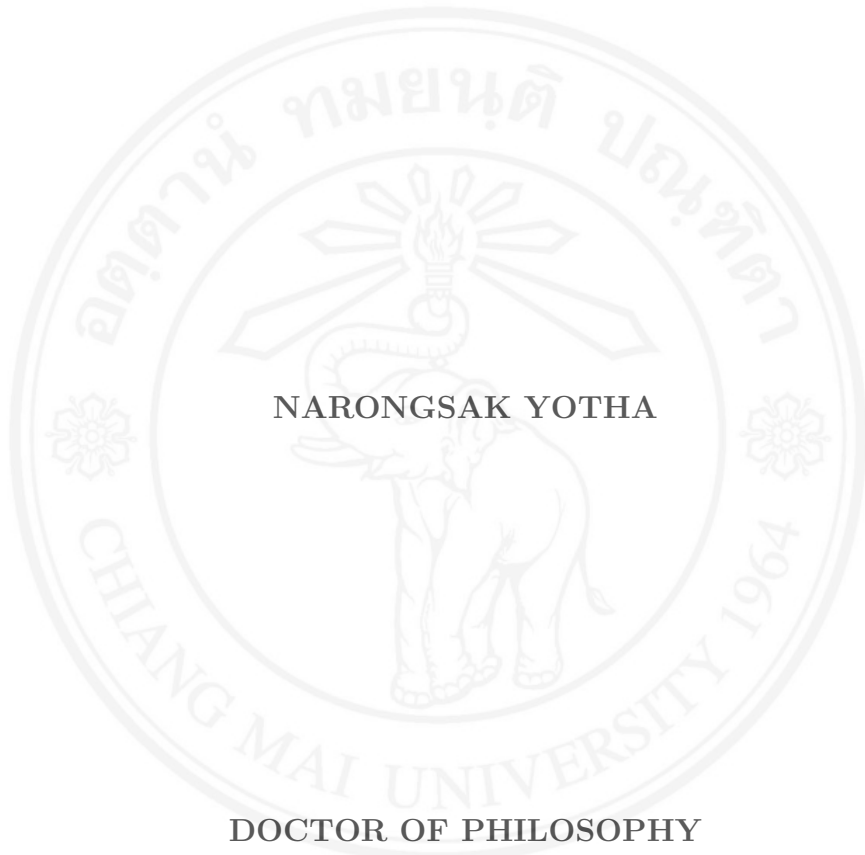


CONTROLLER DESIGN FOR SYNCHRONIZATION
OF NEURAL NETWORKS WITH TIME-VARYING
DELAYS AND HYBRID COUPLINGS

The seal of Chiang Mai University is a circular emblem. It features a central figure of an elephant standing and facing left. Above the elephant's head is a five-pointed star with a flame-like center. The entire emblem is encircled by a border containing the university's name in Thai script at the top and 'CHIANG MAI UNIVERSITY 1964' in English at the bottom.

NARONGSAK YOTHA

DOCTOR OF PHILOSOPHY
IN MATHEMATICS

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
Copyright© by Chiang Mai University
All rights reserved

GRADUATE SCHOOL
CHIANG MAI UNIVERSITY
SEPTEMBER 2014

**CONTROLLER DESIGN FOR SYNCHRONIZATION
OF NEURAL NETWORKS WITH TIME-VARYING
DELAYS AND HYBRID COUPLINGS**

NARONGSAK YOTHA

**A THESIS SUBMITTED TO CHIANG MAI UNIVERSITY IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN MATHEMATICS**

ลิขสิทธิ์โดย Chiang Mai University
All rights reserved

**GRADUATE SCHOOL, CHIANG MAI UNIVERSITY
SEPTEMBER 2014**

CONTROLLER DESIGN FOR SYNCHRONIZATION OF NEURAL
NETWORKS WITH TIME-VARYING DELAYS AND HYBRID
COUPLINGS

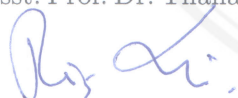
NARONGSAK YOTHA

THIS THESIS HAS BEEN APPROVED TO BE A PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN MATHEMATICS

Examination Committee :


..... Chairman
(Asst. Prof. Dr. Kanit Mukdasai)


..... Member
(Asst. Prof. Dr. Thanasak Mouktonglang)


..... Member
(Assoc. Prof. Dr. Piyapong Niamsup)

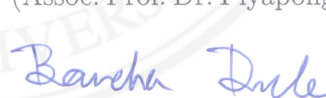

..... Member
(Asst. Prof. Dr. Bancha Panyanak)


..... Member
(Dr. Thongchai Botmart)

Advisory Committee :


..... Advisor
(Asst. Prof. Dr. Thanasak Mouktonglang)


..... Co-advisor
(Assoc. Prof. Dr. Piyapong Niamsup)


..... Co-advisor
(Asst. Prof. Dr. Bancha Panyanak)

26 September 2014

Copyright © by Chiang Mai University

ACKNOWLEDGEMENT

I would like to express my deepest thank to my supervisor, Asst. Prof. Dr. Thanasak Mouktonglang and Dr. Thongchai Botmart, for his initial idea, guidance and encouragement which enable me to carry out my study successfully.

This work contains a number of improvement based on comments and suggestions provided by Assoc. Prof. Dr. Piyapong Niamsup, Asst. Prof. Dr. Bancha Panyanak and Asst. Prof. Dr. Kanit Mukdasai. It is my pleasure to express my sincere thanks to them all for their generous assistance. Thanks are also extended to all my best friends at Chiang Mai University for their help, friendship and moral support. Moreover, I gratefully appreciate my beloved family for their love and encouragement.

Finally, I extend my sincere thanks to Rajamangala University of Technology Isan and the Graduate School, Chiang Mai University which made my doctoral study possible.

Narongsak Yotha

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
Copyright© by Chiang Mai University
All rights reserved