UNIVERSITI PUTRA MALAYSIA

NOVEL DETECTION SOFT-COMPUTING ALGORITHM FOR STRUCTURAL HEALTH MONITORING SYSTEM

NG KIAN THENG

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NOVEL DETECTION SOFT-COMPUTING ALGORITHM FOR STRUCTURAL HEALTH MONITORING SYSTEM

By

NG KIAN THENG

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfillment of the Requirement for the Degree of Master Science

August 2013

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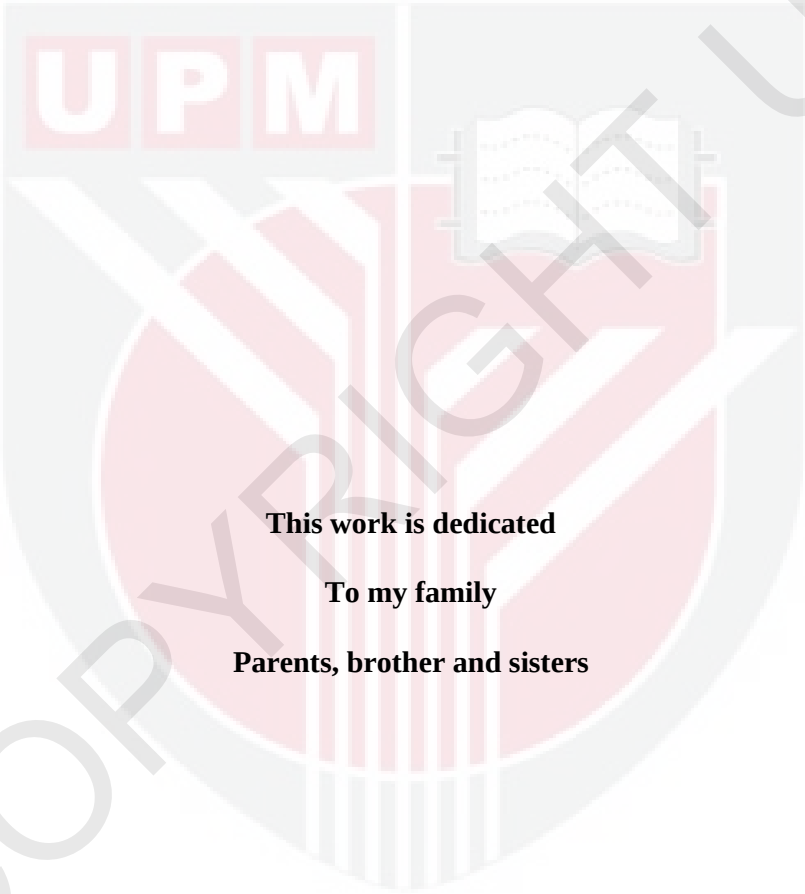

This work is dedicated

To my family

Parents, brother and sisters

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master Science

NOVEL DETECTION SOFT-COMPUTING ALGORITHM FOR STRUCTURAL HEALTH MONITORING SYSTEM

By

NG KIAN THENG

August 2013

Chairman: Faizal Mustapha, PhD

Faculty: Engineering

In view of the criticality of structural integrity, there are many approaches and Structural Health Monitoring (SHM) techniques developed to detect damage or crack in engineering structures. However, there is a lack of attention on developing SHM software for the damage detection in the market. This research aims to develop Novitect, a soft computing platform system for SHM. Novitect is developed using MATLAB 2008-Graphical User Interface (GUIDE) module and designed to formulate novelty detection method employing outlier analysis (OA) for multivariate problem. This system allows users to calculate the novelty index and to display the novelty index plot by processing the data which are in either .MAT or .XLSX format. For this work, the data was based on the acquired waveform response via a smart sensor, piezoceramic transducer (PZT). In the first phase of the designing the Novitect software, the validation of the developed soft computing platform was carried out using acquired data from a hollow cylinder-like structure available from the existing published work. The effectiveness of the developed Novitect was done by executing

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experiment work on aircraft spoiler which consist of two structural conditions; undamaged and damaged. It was discovered that Novitect is capable to be served as the in-service SHM maintenance tool.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

NOVEL PENGESAN YANG BERPERISIAN KOMPUTERAN ALGORITMA UNTUK SISTEM PEMANTAUAN KESIHATAN STRUKTUR

Oleh

NG KIAN THENG

Ogos 2013

Pengerusi: **Faizal Mustapha, PhD**

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Memandangkan integriti struktur adalah kritikal, terdapat beberapa kaedah dan teknik pemantauan kesihatan struktur yang telah dibangunkan untuk mengesan kecacatan atau retak pada struktur-struktur kejuruteraan. Walau bagaimanapun, dalam pasaran, terdapat kekurangan perhatian dalam membangunkan perisian pengesan kecacatan. Kajian ini bertujuan untuk membangunkan Novitect, satu pelantar pengkomputeran yang ringan bagi Pemantau Kesihatan Struktur (SHM). Novitect dibangun dengan menggunakan MATLAB 2008, grafik antaramuka pengguna modul *(GUIDE)* dan dicipta untuk merangka pengesanan novelti dengan menggunakan kaedah analisis outlier (OA) bagi masalah berbilang variat. Sistem ini membenarkan pengguna mengira indeks novelti dan memapar graf indeks novelti melalui pemprosesan data yang sama ada dalam format .MAT atau .XLSX. Dalam kajian ini, data adalah berdasarkan gerak balas gelombang yang diperolehi menerusi penderia pintar, transducer piezo seramik (PZT). Dalam fasa pertama, validasi rekabentuk perisian Novitect, pelantar pengesahan pengkomputeran telah dilaksanakan dengan

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menggunakan data yang sedia ada dari struktur seperti silinder berongga yang diperolehi daripada kerja yang telah diterbitkan. Keberkesanan perisian Novitect telah dibuktikan dengan melaksanakan kerja eksperimentasi pada spoiler pesawat yang mengandungi dua keadaan struktur; iaitu keadaan baikpulih dan kecacatan. Didapati bahawa Novitect mampu berkhidmat sebagai alat perkhidmatan penyelenggaraan SHM.

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Ng Kian Theng

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I certify that a Thesis Examination Committee has met on 02 August 2013 to conduct the final examination of Ng Kian Theng on her thesis entitled "Novel Detection Soft-Computing Algorithm for Structural Health Monitoring System" 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 Master of Science.

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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 other institutions.

NG KIAN THENG

Date: 02 August 2013

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