



UNIVERSITI PUTRA MALAYSIA

***NON-INVERTIBLE ONLINE SIGNATURE BIOMETRIC TEMPLATE
PROTECTION VIA SHUFFLING AND TRIGONOMETRY
TRANSFORMATION***

FAHAD LAYTH MALALLAH

FK 2014 2



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BIOMETRIC TEMPLATE PROTECTION VIA
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FAHAD LAYTH MALALLAH

**MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA**

2014



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TRANSFORMATION**

By

FAHAD LAYTH MALALLAH

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in
Fulfilment of the Requirements for the Degree of Master of Science**

January 2014

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**Dedicated to:
My father, mother, brothers and sisters.**



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

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FAHAD LAYTH MALALLAH

January 2014

Chair: Sharifah Mumtazah bt Syed Ahmad Abdul Rahman, PhD

Faculty: Engineering

This thesis reports on research work carried out on online handwritten signature biometrics template protection. Such a research effort is deemed necessary since like any other biometrics system, online signature biometric requires the use of template database which is vulnerable to attacks. The proposed template protection scheme is based on a hybrid of shuffling and trigonometry transformation functions which is addressed as 'BioTrigono'. Prior to template protection scheme, signature samples are normalized in length to 256 sampled points. The effectiveness of the template protection scheme has been tested via an online signature verification system on SIGMA database which consists of a huge set of signature samples belonging to 200 Malaysian nationals. In the online signature verification system, prominent features are extracted via Principal Component Analysis, which are later fed to the Artificial Neural Network module for signature classification purposes. Here, the final output is accept or reject decision on the status of the tested signature sample as belonging to the claimed reference identity. In this thesis, the noninvertible property of BioTrigono template protection scheme has been proven mathematically through the employment of trigonometry transform function. In addition, renewability testing has been conducted by plotting various Receiver Operating Characteristic (ROC) curves under different settings which results that BioTrigono template protection scheme has renewability property. The impact of BioTrigono template protection scheme on the accuracy of the online signature verification system has also been conducted and benchmarked against an existing template protection mechanism (i.e. BioConvolving). The verification results indicate that the online signature verification system has consistently produced a

better system accuracy when used together with BioTrigono template protection scheme as compared to its benchmarked counterpart.



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

**TANPA TERBALIKKAN SKIM PERLINDUNGAN TEMPLAT
TANDATANGAN BIOMETRIK ATAS TALIAN MELALUI TEKNIK
KOCAKAN DAN TRANSFORMASI TRIGONOMETRIK**

Oleh

FAHAD LAYTH MALALLAH

Januari 2014

Pengerusi : Sharifah Mumtazah bt Syed Ahmad Abdul Rahman, PhD

Fakulti : Kejuruteraan

Tesis ini melaporkan kerja penyelidikan bagi skim perlindungan templat biometrik tulisan tandatangan dalam talian. Kerja penyelidikan ini adalah penting memandangkan seperti kebanyakan sistem biometrik yang lain, biometrik tandatangan dalam talian memerlukan penggunaan pengkalan data templat yang terdedah kepada pelbagai serangan. Skim perlindungan templat yang dicadangkan adalah berdasarkan hibrid penggunaan teknik kocakan dan fungsi transformasi trigonometrik yang dinamakan sebagai 'BioTrigono'. Sebelum penggunaan skim perlindungan templat, panjang sampel tandatangan telah di normalkan kepada 256 titik pensampelan. Keberkesanan skim perlindungan templat telah diuji menggunakan sistem pengesahan tandatangan atas talian ke atas pengkalan data SIGMA yang mengandungi satu set besar tandatangan kepunyaan 200 warganegara Malaysia. Di dalam sistem pengesahan tandatangan atas talian, ciri-ciri unik tandatangan diekstrak melalui teknik Principal Component Analysis yang kemudiannya dihantar kepada modul *Artificial Neural Network* bagi tujuan klasifikasi. Di sini, hasil terakhir ialah keputusan penerimaan atau penolakan status sampel tandatangan yang diuji sama ada ia milik identiti rujukan seperti yang didakwa. Di dalam tesis ini, ciri tidak boleh terbalikkan skim perlindungan templat BioTrigono telah diuji dan dibuktikan melalui kaedah matematik ke atas penggunaan fungsi transformasi trigonometrik. Di samping itu, ujian pembaharuan telah dijalankan dengan melakar beberapa lengkungan *Receiver Operating Characteristic (ROC)* di bawah pelarasan yang berlainan di mana keputusannya telah membuktikan ciri-ciri pembaharuan skim perlindungan templat BioTrigono. Keberkesanan penggunaan skim perlindungan templat BioTrigono ke atas ketepatan sistem pengesahan tandatangan atas talian telah diuji dan dibandingkan dengan penggunaan skim perlindungan templat yang sedia ada (iaitu BioConvolving). Keputusan pengesahan menunjukkan bahawa sistem pengesahan tandatangan atas talian secara konsisten menghasilkan ketepatan yang lebih

baik apabila digunakan bersama skim perlindungan templat BioTrigono jika dibandingkan dengan teknik yang sedia ada.



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I certify that a Thesis Examination Committee has met on 28 January 2014 to conduct the final examination of Fahad Layth Malallah on his thesis entitles “Noninvertible Online Signature Biometric Template protection via Shuffling and Trigonometry Transformation” 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 degree of Master of Science.

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