UNIVERSITI PUTRA MALAYSIA

**CHANGE DETECTION IN MANGROVE FOREST
AREA USING LOCAL MUTUAL INFORMATION**

MAHIRAH BINTI JAHARI

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**MASTER OF SCIENCE
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CHANGE DETECTION IN MAGROVE FOREST AREA USING LOCAL MUTUAL INFORMATION

By

MAHIRAH BINTI JAHARI

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

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

CHANGE DETECTION IN MANGROVE FOREST AREA USING LOCAL MUTUAL INFORMATION

By

MAHIRAH JAHARI

November 2010

Chairman: **Siti Khairunniza bt Bejo, PhD**

Faculty: **Institute of Advance Technology**

This thesis unveils the potential and utilization of similarity measure for forest change detection. A new simple similarity approach based on local mutual information is used to detect any significant changes in the image of forest areas. Point similarity measure is defined as a measure which is used to calculate the similarity of individual pixels. The basic idea of the proposed method is that any change pixel will be maximally dissimilar, i.e. the value of similarity of these pixels will be low. The method has been tested to detect and identify changes caused by plant growth and plant loss in four sub-areas of Matang Mangrove Forest, Perak. Image of SPOT 5 satellite taken from band 1, band 2, band 3, and band 4 with the resolution of 10meter dated on 5 August 2005 and 13 June 2007 has been used to test the method. It is then compared with the results of Principal Component Analysis 1 (PCA 1). The plant loss areas has been successfully identified as any pixel with the value of local mutual information less than and equals to zero. The method has been refined to accurately detect changes caused by the growth areas by

thresholding the histogram of the average percentage of difference between joint probability and marginal probability. Results from the experiment showed that a threshold value of zero is the best threshold value to identify between changed and unchanged areas in all cases of the images. In overall, band 3 gives the best results of forest change detection compared to the other bands in all cases. Compared to the image differencing and normalized differenced vegetation index (NDVI), the proposed method not only can solve the problem on selecting the threshold value but also provides the highest percentage of successful classification at the fourth, second and first study area with the value of 95.07%, 89.47% and 87.66% respectively. From the results, it has been concluded that local mutual information is not only can be effectively used for change detection technique but also can be used to classify the plant growth and plant loss areas.

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

MENGESAN PERUBAHAN DI KAWASAN HUTAN PAYA BAKAU MENGGUNAKAN PENENTUAN KESERUPAAN SETEMPAT

Oleh

MAHIRAH JAHARI

November 2010

Pengerusi: **Siti Khairunniza bt Bejo, PhD**

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Tesis ini menyingkap potensi penggunaan penentuan keserupaan setempat dalam kaedah pengesanan perubahan bagi kawasan hutan. Satu pendekatan keserupaan yang baharu dan mudah berdasarkan maklumat salingan tempatan digunakan bagi mengesan apa sahaja perubahan penting dalam imej kawasan hutan. Titik keserupaan setempat ditakrifkan sebagai satu langkah yang digunakan bagi mengira persamaan pada piksel individu. Konsep asas bagi kaedah yang dicadangkan adalah piksel yang mempunyai perubahan akan menghasilkan perbezaan yang maksimum, i.e. nilai persamaan piksel ini akan menjadi rendah. Kaedah ini telah diuji bagi mengesan kawasan perubahan dan mengenal pasti sama ada perubahan itu disebabkan oleh pertumbuhan pokok atau kehilangan pokok dalam empat kawasan di Hutan Bakau Matang, Perak. Imej daripada satelite SPOT 5 dengan jalur 1, jalur 2, jalur 3 dan jalur 4 yang mempuyai resolusi 10meter bertarikh 5 Ogos 2005 dan 13 Jun 2007 telah digunakan untuk menguji kaedah ini. Ianya kemudian akan dibandingkan dengan keputusan daripada Analisis Komponen

Utama 1 (PCA1). Kawasan yang mengalami kehilangan pokok telah dikenalpasti dengan jayanya di mana nilai setempat maklumat salingan piksel di kawasan tersebut adalah kurang dan sama dengan sifar. Kaedah ini diperhalusi lagi untuk mengesan secara tepat kawasan-kawasan yang berubah akibat daripada pertumbuhan pokok dengan menggunakan kaedah pengembangan titik ambang pada histogram peratusan purata perbezaan antara kebarangkalian bercantum dan kebarangkalian sut. Keputusan menunjukkan bahawa nilai ambang yang terbaik untuk menentukan kawasan yang berubah dengan kawasan yang tidak berubah adalah nilai sifar. Secara keseluruhannya, dalam penentuan perubahan di kawasan hutan, band 3 memberikan nilai yang terbaik berbanding jalur-jalur lain dalam semua kes. Berbanding dengan kaedah pembezaan imej dan kaedah perbezaan normalisasi indeks tumbuhan (NDVI), kaedah ini bukan sahaja dapat menyelesaikan masalah pemilihan nilai ambang dalam kaedah penentuan perubahan tetapi juga memberikan peratusan kejayaan yang tertinggi di kawasan keempat, kawasan kedua dan kawasan pertama dengan nilai masing-masing adalah 95.07%, 89.47% dan 87.66%. Kesimpulan hasil daripada keputusan kajian menunjukkan maklumat salingan tempatan bukan saja berkesan digunakan sebagai teknik pengesanan perubahan tetapi juga boleh digunakan untuk mengenalpasti kawasan-kawasan pertumbuhan pokok dan kehilangan pokok.

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Utmost appreciation and heartfelt gratitude goes to my beloved parents and all family members for their patience, understanding, support and sacrifices throughout my study.

I certify that an Examination Committee met on XXXX to conduct the final examination of Mahirah binti Jahari on her Master of Science thesis entitled "Change Detection In Forest Area using Local Similarity Measure" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the candidate be awarded the relevant degree.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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Date: 10 March 2011

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 degree at Universiti Putra Malaysia or other institutions.

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MAHIRAH BINTI JAHARI

Date: 3 November 2010

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