

COMPARISON OF DIFFERENT ALGORITHMS FOR
SHORELINE BOUNDARIES EXTRACTION USING
RADARSAT-1 SAR IMAGERY

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This thesis is dedicated to My Mother

MASOUD KARAMALI

**Thesis Submitted in Fulfillment of the Requirement for the
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MASOUD KARIMATI

October 2014

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Shoreline extraction from Synthetic Aperture Radar (SAR) data belongs to the boundary detection problem in the field of image processing, in which edge detection algorithm, texture analysis algorithm and image segmentation are three conventional approaches to the boundary detection. The presence of speckle makes edge detection and texture analysis algorithms in SAR images difficult and image segmentation inadequate. Therefore, speckle reduction is an important and essential procedure in pre processing.

This research study intends to extract shoreline boundaries from SAR imagery for shoreline mapping. Several algorithms (Sobel, Prewitt, Canny, and Telesma) and their were applied on Radarsat-1 SAR data and compared for their ability in extraction of shoreline boundaries along the Kuala Terengganu shoreline.

Multiple image processing algorithms include noise removal, edge detection, and texture analysis were utilized to remove high frequency noise in speckle and extracting shoreline boundaries. Data processing involves image processing and

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MASOUD KARAMALI

October 2006

Chairperson : Professor Mohd Lokman Husain, Ph.D.

**Member : Mohd Suffian Idris, M.Sc.
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Faculty : Institute of Oceanography (INOS)

Shoreline extraction from Synthetic Aperture Radar [SAR] data belongs to the boundary detection problem in the field of image processing, in which edge detection algorithm, texture analysis algorithm and image segmentation are three conventional approaches to the boundary detection. The presence of speckle makes edge detection and texture analysis algorithms in SAR images difficult and image segmentation inadequate. Therefore, speckle reduction is an important and essential procedure in pre processing.

This research study intends to extract shoreline boundaries from SAR imagery for shoreline mapping. Several algorithms [Sobel, Prewitt, Canny, and Texture analysis] were applied on Radarsat-1 SAR data and compared for their ability on extraction of shoreline boundaries along the Kuala Terengganu shoreline.

Multiple image processing algorithms include noise removal, edge detection, and texture analysis were utilized to remove high frequency noise or speckle and extracting shoreline boundaries. Data processing involves image processing and

Geographic Information System [GIS] analysis for assessing the capability of shoreline extraction technique and identifies the performance of each algorithm by using Radarsat-1 SAR imagery and Differential Ground Positioning System [DGPS] ground data measurement.

Speckle noise effects and the strong signal return from a wind roughened, wave modulated water surfers cause a frequent lack of contrast in SAR images. Therefore, it is difficult to extract the shoreline boundaries from SAR imagery by conventional methods like classical edge detection algorithms such as Sobel and Prewitt algorithms or texture analysis algorithm as similar to the true image.

Gamma filter size 7x7 was provided the best results without losing the image spatial information and degrading the sharpness of the edges to remove speckle noise on the SAR imagery.

It can be concluded that the Canny algorithm has capability for shoreline extraction on the SAR imagery without involving further processing analysis such as image segmentation and classification and it can be determined the true water/land boundaries.

Canny edge detection algorithm can be used as automatic tools for shoreline boundaries detection from SAR data. It is obvious that the Canny algorithm can extract the concave shoreline boundaries as well along the shoreline of Kuala Terengganu.

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

**PERBANDINGAN PELBAGAI ALGORITMA BAGI PENGEKSTRAKKAN
SEMPADAN GARIS PANTAI MENGGUNAKAN IMEJ RADARSAT-1 SAR**

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October 2006

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Ekstrak garis pantai dari data 'Synthetic Aperature Radar [SAR]' adalah berdasarkan masalah pengesanan sempadan dalam bidang pemrosesan imej, di mana algoritma pengesanan sisi, algoritma analisis tekstur dan segmentasi ini merupakan tiga pendekatan biasa dalam menentukan sempadan sesuatu kawasan. Kehadiran 'speckle' menyebabkan pengesanan sisi dan algoritma analisis tekstur dalam imej (SAR) sukar dijalankan dan segmentasi imej kurang efisien. Oleh yang demikian, pengurangan 'speckle' ini amat penting dalam prosedur pemrosesan awal.

Kajian ini bertujuan untuk mengekstrak garisan sempadan dari imej [SAR] bagi melakukan pemetaan garisan sempadan pantai. Beberapa algoritma [analisis 'Sobel', 'Prewit', 'Canny', dan 'Tekstur'] digunakan ke atas data Radarsat-1 SAR dan perbandingan dibuat di atas keupayaan algoritma-algoritma ini dalam mengekstrakkan sempadan garis pantai di sepanjang Kuala Terengganu.

Pelbagai algoritma pemrosesan imej termasuk penyingkiran 'noise', pengesanan sisi dan analisis tekstur digunakan untuk menyingkirkan 'noise' atau 'speckle' berfrekuensi tinggi dan mengekstrakkan sempadan garis pantai. Pemrosesan data

termasuk pemrosesan imej dan analisis Sistem Maklumat Geografi [GIS] untuk menilai keupayaan teknik pengekstrakkan garisan pantai dan mengenalpasti keupayaan bagi setiap algoritma dengan menggunakan imej Radarsat-1 SAR dan pengukuran data lapangan 'Differential Ground Positioning System [DGPS]. Kesan 'speckle' dan pembalikan berisyrat tinggi dari gangguan angin kencang serta ombak laut menyebabkan pengurangan kontras yang kerap terjadi dalam imej [SAR].

Oleh yang demikian, agak sukar untuk mengekstrak sempadan garis pantai daripada imej [SAR] dengan teknik biasa seperti algoritma pengesanan sisi klasik 'Sobel' dan 'Prewitt' atau algoritma analisis tekstur yang sama seperti imej sebenar.

Ini menyebabkan penggunaan kaedah Penapis Gamma bersaiz 7x7 diaplikasikan dan menghasilkan keputusan yang terbaik tanpa kehilangan maklumat imej ruang dan tanpa pengurangan ketepatan sisi dalam menghilangkan 'noise' atau 'speckle' pada imej [SAR].

Dengan ini dapat disimpulkan bahawa "Canny Algorithm" berkeupayaan untuk mengekstrak garis pantai berdasarkan imej [SAR] tanpa melibatkan pemrosesan analisis yang lebih mendalam seperti segmentasi imej dan klasifikasi serta penentuan sempadan sebenar antara air atau daratan.

Selain itu juga, "Canny edge detection algorithm" boleh digunakan sebagai alat yang dapat mengesan sempadan garis pantai dari data [SAR] secara automatik. Adalah jelas sekali bahawa "Canny Algorithm" dapat mengekstrak sempadan garis pantai yang melengkung dan sepanjang persisiran pantai Kuala Terengganu.