

COMPARISON OF TOPSAR POLARIZED ALGORITHMS
FOR MAPPING SHORELINE CHANGE

TING CHING HUI

FACULTY OF SCIENCE AND TECHNOLOGY
UNIVERSITY COLLEGE OF SCIENCE AND TECHNOLOGY MALAYSIA
2004

1100028970

PERPUSTAKAAN
KOLEJ UNIVERSITI SAINS & TEKNOLOGI MALAYSIA
(KUSTEM)

Pengarang ling ching hui		No. Panggilan	
Judul Comparison of topsar polarized			
Tarikh	Waktu Pemulangan	Nombor Ahli	Tanda tangan
6/2/07	11.15	UK12077	<i>[Signature]</i>
12/2/07		UK12077	<i>[Signature]</i>
5/3/07	10.30 pm	UK12077	<i>[Signature]</i>

1100028970

dw 1/1/18

LP 20 FST 2 2004



1100028970

Comparison of topsar polarized algorithms for mapping shoreline change / Ting Ching Hui.



PERPUSTAKAAN
KOLEJ UNIVERSITI SAINS & TEKNOLOGI MALAYSIA
21030 KUALA TERENGGANU

1100028970		

Lihat sebelah

HAK MILIK
PERPUSTAKAAN KUSTEM

COMPARISON OF TOPSAR POLARIZED ALGORITHMS FOR MAPPING
SHORELINE CHANGE

By

Ting Ching Hui

Research Report submitted in partial fulfillment of
the requirements for the degree of
Bachelor of Science (Marine Science)

Faculty of Science and Technology
Kolej Universiti Sains dan Teknologi Malaysia
2004

This project should be cited as:

Ting, C. H. 2004. Comparison of TOPSAR polarized algorithms for mapping shoreline change. Undergraduate thesis, Bachelor of Science in Marine Science, Faculty of Science and Technology, Kolej Universiti Sains dan Teknologi Malaysia, 67 pp.

No part of this project report could be reproduced by any mechanical, photographic or electronic process, or in the form of phonographic recording, nor may it be stored in a retrieval system, transmitted, or otherwise copied for public or private use, without permission from the author and supervisors of this project.

1100028970



**JABATAN SAINS SAMUDERA
FAKULTI SAINS DAN TEKNOLOGI
KOLEJ UNIVERSITI SAINS DAN TEKNOLOGI MALAYSIA**

**PENGAKUAN DAN PENGESAHAN LAPORAN
PROJEK PENYELIDIKAN I DAN II**

Adalah ini diakui dan disahkan bahawa laporan penyelidikan bertajuk:

Comparison of TOPSAR Polarized Algorithms for Mapping Shoreline Change oleh **Ting Ching Hui**, No. Matrik: **UK 5861** telah diperiksa dan semua pembetulan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Samudera sebagai memenuhi sebahagian daripada keperluan memperoleh **Ijazah Sarjana Muda (Sains Samudera)**, Fakulti Sains dan Teknologi, Kolej Universiti Sains dan Teknologi Malaysia.

Disahkan oleh:

DR. MAGED MOHMOUD MARGHANY
Pensyarah
Jabatan Perikanan dan Sains Samudera
Fakulti Sains dan Teknologi
Kolej Universiti Sains dan Teknologi Malaysia
21030 Kuala Terengganu, Terengganu.

Penyelia Utama

Nama: Dr. Maged Mahmoud Marghany

Cop rasmi:

Tarikh: 30/3/04

PROF. MADYA DR. HJ. ROSNAN HJ. YAACOB
Fellow
Institut Oseanografi
Kolej Universiti Sains dan Teknologi Malaysia
21030 Kuala Terengganu, Terengganu.

Penyelia Kedua

Nama: Prof. Madya. Dr. Rosnan b. Yaacob

Cop rasmi:

Tarikh: 29/3/04

Ketua Jabatan Sains Samudera

Nama: Prof. Madya. Dr. Kamaruzzaman bin Yunus

Cop rasmi:

ASSOC. PROF. DR. KAMARUZZAMAN B. YUNUS
Head
Department of Marine Science
Faculty of Science and Technology Malaysia
Kolej Universiti Sains dan Teknologi Malaysia
(KUSTEM)
21030 Kuala Terengganu.

Tarikh: 31/3/04

ACKNOWLEDGEMENTS

First of all, I would like to express my deepest gratitude and appreciation to my supervisor Dr. Maged Mahmoud Marghany for all his guidance in this study. His hard work to push forward this study to international remote sensing conference is gratefully acknowledged. I would like to thank my co-supervisor, Associate Professor Dr. Rosnan b. Yaacob as he guided me and giving all the valuable opinions in carrying out this research, especially in field works and the conditions of the study area.

The Informatics Laboratory of Institute of Oceanography (INOS) and GIS laboratory of the Faculty of Science and Technology (FST) had provides a place, equipments, and some data for the research in this study. I would like to expand my appreciations to Mohd. Suffian Idris in INOS for his guidance and demonstrations in process the remote sensing data. Raja Razali b. Raja Ghani of Oceanography Laboratory, FST is thankfully acknowledged for his kind assistance and demonstrations during the field sampling.

I would like to express my appreciations to Lee Meng Ho, Johnson C. C. Koh and Lam Yoke Hou for their helps and assistance in getting the ground truth data. Andy in University of Malaya is very much appreciated for his technical supports.

My parents, Mr. and Mrs. Ting are gratefully respected for their supports in this study. I would like to offer the most sincere gratitude to my beloved partner Iris Hii for all her encouragements. All the thankfulness, and glory, to almighty Lord the highest.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	i
TABLE OF CONTENTS	ii
LIST OF TABLES	iv
LIST OF FIGURES	v
LIST OF ABBREVIATIONS	vi
LIST OF APPENDICES	viii
ABSTRAK	x
ABSTRACT	xi
1.0 INTRODUCTION	1
2.0 LITERATURE REVIEW	5
2.1 Shoreline Change	5
2.2 Coastal Erosion in Malaysia	6
2.3 East Coast – Kuala Terengganu	9
2.3.1 <i>Coastal Processes</i>	10
2.3.2 <i>Sand Sources and Lost</i>	12
2.3.3 <i>Erosion</i>	12
2.4 Remote Sensing	14
2.4.1 <i>Roles of Remote Sensing</i>	15
2.5 Shoreline Change Mapping	15
2.6 TOPSAR	17
2.6.1 Radar	17
2.6.2 Radar Imaging	18
2.6.3 Radar Image	19
2.6.4 TOPSAR Band	20
2.6.5 Polarization	21

3.0	METHODOLOGY	22
3.1	Study Area	22
3.2	Data Acquisition	24
3.2.1	<i>TOPSAR Data</i>	24
3.2.2	<i>Topography Map</i>	25
3.2.3	<i>SPOT Data</i>	25
3.2.4	<i>Ground Truth Data</i>	26
3.3	Data Preprocessing	27
3.3.1	<i>Lee-filter</i>	27
3.3.2	<i>Geometric Correction</i>	28
3.3.3	<i>Image Enhancement</i>	29
3.3.4	<i>Digitization</i>	29
3.4	Shoreline Change Model	30
3.5	Data Comparison	30
4.0	RESULT	32
4.1	TOPSAR Shoreline Change Mapping	32
4.2	Comparison with SPOT Data	34
4.3	Ground Truth Data	35
4.3.1	<i>Beach Profile</i>	36
5.0	DISCUSSION	40
6.0	CONCLUSION	48
7.0	REFERENCES	49

LIST OF TABLES

Table		Page
2.1	Classification summary – shoreline condition in Malaysia.	8
2.2	Shoreline classification of Kuala Terengganu state.	13
3.1	Properties of various TOPSAR bands and polarizations.	24
3.2	Various data acquired for the study.	26
4.1	Ground data sampling locations.	35

LIST OF FIGURES

Figure		Page
2.1	Movements of long shore current at Kuala Terengganu.	11
2.2	Radar transmits a pulse measures reflected echo (backscatter).	19
3.1	The Kuala Terengganu map.	23
3.2	Block diagram of methodology.	31
4.1	Output of shoreline change model using Topomap 1959 as baseline.	32
4.2	Output of shoreline change model using Topomap 1980 as baseline.	33
4.3	Shoreline change of SPOT and TOPSAR image using (a) Topomap 1959 and (b) Topomap 1980 as baseline.	34
4.4	Ground truth data and TOPSAR shoreline change comparison using (a) Topomap 1959 and (b) Topomap 1980 as baseline.	36
4.5:	Beach profile at Station 1.	37
4.6	Beach profile at Station 2.	37
4.7	Beach profile at Station 3.	37
4.8	Beach profile at Station 4.	38
4.9	Beach profile at Station 5.	38
4.10	Beach profile at Station 6.	38
4.11	Beach profile at Station 7.	39
4.12	Beach profile at Station 8.	39
4.13	Beach profile at Station 9.	39

LIST OF ABBREVIATIONS

GIS	-	Global Information System
SAR	-	Synthetic Aperture Radar
AIRSAR	-	Airborne Synthetic Aperture Radar
TOPSAR	-	Topographic Synthetic Aperture Radar
SPOT	-	Satellite Pour l' Observation de la Terre
Topomap	-	Topography Map
IRS-IA	-	Indian Remote Sensing Satellite
ERS-1	-	European Remote Sensing satellite
GCPs	-	Ground Control Points
RMS	-	Root Mean Square
HH	-	horizontally transmit, horizontally receive
VV	-	vertically transmit, vertically receive
HV	-	horizontally transmit, vertically receive
VH	-	vertically transmit, horizontally receive
C-VV	-	C-band VV polarization
L-VV	-	L-band VV polarization
L-HH	-	L-band HH polarization

RGB	-	Red, Green, Blue
cm	-	centimeter
m	-	Meter
km	-	kilometer
m/yr	-	meter per year
m ³ /yr	-	cubic meter per year
pix	-	pixels
m/pix	-	meter per pixel
%	-	percentage
MHz	-	Mega hertz
GHz	-	Giga hertz
R ²	-	Correlation Coefficient
E	-	East
N	-	North

LIST OF APPENDICES

Appendix		Page
I	TOPSAR shoreline change mapping result using Topomap 1959 as baseline	53
II	TOPSAR shoreline change mapping result using Topomap 1980 as baseline	54
III	T-test result for TOPSAR L-HH and C-VV band.	55
IV	T-test result for TOPSAR L-VV and C-VV band.	56
V	T-test result for TOPSAR L-HH and L-VV band.	57
VI	Comparison result of TOPSAR and SPOT data using Topomap 1959 as baseline.	58
VII	Comparison result of TOPSAR and SPOT data using Topomap 1980 as baseline.	58
VIII	Comparison result of TOPSAR and ground truth data using Topomap 1959 as baseline.	59
IX	Comparison result of TOPSAR and ground truth data using Topomap 1980 as baseline.	59
Xa	Regression model comparing SPOT data and TOPSAR C-VV band using Topomap 1959 as baseline.	60
Xb	Regression model comparing SPOT data and TOPSAR L-HH band using Topomap 1959 as baseline.	60
Xc	Regression model comparing SPOT data and TOPSAR L-VV band using Topomap 1959 as baseline.	60
XIa	Regression model comparing SPOT data and TOPSAR C-VV band using Topomap 1980 as baseline.	61
XIb	Regression model comparing SPOT data and TOPSAR L-HH band using Topomap 1980 as baseline.	61
XIc	Regression model comparing SPOT data and TOPSAR L-VV band using Topomap 1980 as baseline.	61

XIIa	Regression model comparing ground data and TOPSAR C-VV band using Topomap 1959 as baseline.	62
XIIb	Regression model comparing ground data and TOPSAR L-HH band using Topomap 1959 as baseline.	62
XIIc	Regression model comparing ground data and TOPSAR L-VV band using Topomap 1959 as baseline.	62
XIIIa	Regression model comparing ground data and TOPSAR C-VV band using Topomap 1980 as baseline.	63
XIIIb	Regression model comparing ground data and TOPSAR L-HH band using Topomap 1980 as baseline.	63
XIIIc	Regression model comparing ground data and TOPSAR L-VV band using Topomap 1980 as baseline.	63
XIV	Distribution of GCPs resampling area in TOPSAR image.	64
XV	SPOT image 1994 of Kuala Terengganu.	64
XVI	Output of TOPSAR C-VV, L-HH and L-VV imagery.	65
XVII	Output of TOPSAR polarimetric imagery after the application of Linear, Gaussian, and Equalization enhancement.	66
XVIII	TOPSAR single band grey scale image.	67

ABSTRAK

Kajian ini bertujuan untuk menentukan jaluran berkutub TOPSAR (L-HH, L-VV dan C-VV) yang mana paling sesuai digunakan untuk memetakan hakisan pantai. Penapis Lee dan gabungan kontras linear, Gaussian, serta keseimbangan histogram digunakan untuk menguatkan kualiti imej. Garisan pantai pada setiap imej digariskan pada lapisan vektor. Ujian-t dilakukan untuk menentukan kewujudan perbezaan di antara jalur-C dan jalur-L. Perbandingan dengan imej SPOT dan data lapangan dijalankan untuk menentukan jaluran TOPSAR yang paling sesuai digunakan dalam kajian perubahan hakisan pantai. Ujian regresi telah menunjukkan bahawa jalur-C yang paling sesuai digunakan untuk pemetaan perubahan garisan pantai. Ujian-t menunjukkan bahawa jalur-L adalah berbeza dengan jalur-C. Kajian ini mendapati bahawa hakisan pantai berlaku di kawasan Batu Rakit dengan kadar – 1.1 m/tahun dan sedimentasi maksimum berlaku di kawasan pantai berdekatan KUSTEM dengan kadar 2.5 m/tahun.

ABSTRACT

This study aims to determine the suitable polarized TOPSAR band for mapping shoreline change, using the L-HH, L-VV and C-VV band. Lee algorithm and combination of linear contrast, Gaussian and histogram equalization enhancement was used to determine the shoreline edge morphology. The manual vector layer digitizing was applied to extract the shoreline for the different bands. The statistical analysis, t-test was used to find the significant difference between the different bands. Comparison with SPOT and ground truth data was conducted to determine the best algorithms for TOPSAR shoreline change mapping. The regression model shows that C-band VV polarization is more suitable for shoreline change detection compared to others band. The t-test shows that there is a significant difference between L- band and C-band. The study showed that erosion occurred at Batu Rakit area at a rate of -1.1 m/year. The maximum accretion occurred at KUSTEM beach by 2.5 m/year.