國立聯合大學講座

99學年度成果報告書

講座名稱：電機資訊學院講座教授

中華民國　100年　8月　26　日

【封面格式】

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目錄

壹、總表

<table>
<tr><td>講座基本資料</td><td colspan="3">姓　　名：陳錕山　　職稱：教授
服務單位：中央大學太空及遙測研究中心　傳真：03-4273586
電　　話：03-4227151 ext.57617, 57644　E-Mail:dkschen@csrsr.ncu.edu.tw</td></tr>
<tr><td>聘期</td><td colspan="3">99 年 8 月 1 日至 100 年 7 月 31 日</td></tr>
<tr><td rowspan="4">計畫總經費</td><td>經費項目</td><td>學校核定補助經費</td><td>實際執行經費
（99 年 8 月 1 日~100 年 7 月 31 日）</td></tr>
<tr><td>獎助金</td><td>90,000</td><td>90,000</td></tr>
<tr><td>教學研究經費</td><td>90,000</td><td>90,000</td></tr>
<tr><td>合計</td><td>180,000</td><td>180,000</td></tr>
<tr><td>計畫聯絡人</td><td colspan="3">姓　　名：曾裕強　　職稱：教授
服務單位：電子系　　傳真：037-362809
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</table>

計畫主持人 陳錕山 （簽章）　　100 年 8 月 26 日

貳、成果報告（請詳予敘明實質協助項目，將達成之目標以量化數據或圖表方式說明之）

所提工作計畫	達成電資學院及學校需實質協助項目
1. 共同建立研究資源平台並研提跨校跨領域合作研究計畫。 A. 共同建立研究資源平台 (附件一) 1. 協助設置電機資訊學院遙測科技應用研究中心(已設立) B. 研提跨校跨領域合作研究計畫 (附件二) 1. 整合聯合大學、中興大學、明道大學及中州技術學院，共同申請100年度國科會整合型產學合作研究計畫。(100/11~103/10) 總計畫主持人聯合大學遙測科技應用研究中心曾裕強教授：應用於精準農業之微氣候環境監控系統 子計畫一主持人聯合大學遙測科技應用研究中心曾裕強教授：利用雲端運算技術建置微氣候環境監控系統 子計畫二主持人中興大學園藝學系宋妤教授：精準農業-設施作物栽培專家系統之建立 子計畫三主持人明道大學精緻農業學系劉程煒教授：精準灌溉系統對設施栽培蔬菜品質與產量的影響 子計畫四主持人中州技術學院自動化控制工程系鄭合志教授：栽培場環境e化遠距監控系統 2. 整合聯合大學及中央大學，共同執行100年度國科會整合型防災科技研究計畫。(100/8~103/7)	1.共同建立研究資源平台並研提跨校跨領域合作研究計畫。 2.協助爭取研究計畫與經費。

總計畫主持人中央大學太空及遙測研究中心任玄教授：極端氣候下可能產生之坡地崩塌潛勢評估與預警全天候高效能遙測資源平台構建 子計畫一主持人中央大學太空及遙測研究中心任玄教授：遙測於崩塌成災機率及災害程度範圍估計之數據分析 子計畫二主持人中央大學太空及遙測研究中心張中白教授：遙測資料於坡地崩塌發生潛勢調查及發生規模評估 子計畫三主持人聯合大學遙測科技應用研究中心曾裕強教授：利用衛星遙測資料與地面即時降雨資料反演全台即時土壤含水量 3. 整合聯合大學及中央大學，共同執行100年度中科院國防科技學術合作研究計劃 (100/7~100/11) 聯合大學遙測科技應用研究中心曾裕強教授：SAR目標檢測運算效能提昇 中央大學太空及遙測研究中心任玄教授：SAR影像輻射與幾合校正軟體開發 4. 整合聯合大學、交通大學及元智大學，共同執行99年度國防科技學術合作研究計畫(99/7~99/11) 總計畫主持人元智大學資傳系黃志芳教授：微型合成孔徑雷達整合型關鍵組件先期開發研究 子計畫一主持人元智大學資傳系黃志芳教授：以運動感測為基礎之雷達運動即時補償設計研究 子計畫二主持人交通大學機械系成維華教授：以雷達訊號為基礎	

之運動補償演算法設計 子計畫三主持人聯合大學遙測科技應用研究中心曾裕強教授：調頻連續波合成孔徑雷達成像演算法開發研究 5. 整合聯合大學及中央大學，共同執行99年度氣象局委託研究計畫「衛星遙測台灣地區土壤含水量與降雨量之作業化研究」(99/3~99/12)	
2. 協助推動國際學術合作及參與國際型研究計畫。 A. 協助推動國際學術合作 (附件三) 1. 與聯合大學遙測科技應用研究中心曾裕強教授共同撰寫由美國Massachusetts Dartmouth大學C. H. Chen教授主編書籍之專章 Kun-Shan Chen and Yu-Chang Tzeng, "On SAR image processing from focusing to target recognition" in *Signal and Image Processing for Remote Sensing*, 2nd Edition, (C. H. Chen ed.), Taylor and Francis Group, LLC, Florida, USA, in press. 2. 推薦聯合大學遙測科技應用研究中心曾裕強教授與伊朗Tehran大學J. Amini教授共同指導研究生H. Aghababaee並共同發表論文 H. Aghababaee, J. Amini and Y. C. Tzeng, 2011, "Integration of fractals and genetic algorithm in change detection of SAR images," *International Journal of Remote Sensing*, submitted. H. Aghababaee, J. Amini and Y. C. Tzeng, 2011, "Coastline Detection	1.協助本院推動國際學術合作及參與國際型研究計畫，強化本校與國內外著名學術與研究機構之合作以增加本校之研發能量。

in SAR images by Integrating Fractal Geometry and Fuzzy Logic," *The 4th International Congress on Image and Signal Processing*, (CISP 2011), October 15-17, Shanghai, China, accepted. H. Aghababaee, J. Amini and Y. C. Tzeng, 2011, " Change Detection from SAR Image with Fractal Analysis," *International Conference on Sensors and Models in Photogrammetry and Remote Sensing*, May 18-19, Tehran, Iran, accepted. B. 協助參與國際型研究計畫 1. 整合聯合大學及台北科技大學與西班牙Extremadura大學Antonio J. Plaza教授,共同申請國科會台西(CSIC)福爾摩沙研究計畫(研議中)	
3.共同指導研究生與發表國際期刊論文。 A. 共同指導研究生 1. 碩二生：林逸夫(聯大電子系)及畢業生 蘇育璿(聯大電子系)高效能運算應用於遙測影像處理 王俊偉(中大遙測學程)陸基 LFM-CW 合成孔徑雷達系統運動補償之研究 郭勁廷(中大遙測學程)差分干涉雷達地變形方向模糊的最佳分解 陳柏共(中大遙測學程)可調式都卜勒主動雷達校正器之改良研究 李永財(中大太空所)以FPGA設計輕型雷達之數位電路 王立農(中大太空所)利用合成孔	1.共同指導研究生與發表國際期刊論文。 2.以校名義發表國際期刊論文。

徑雷達探測海洋表面流速之研究 陳宗銘X-band散射儀之電控相列碟型天線系統設計研究 2. 碩一生：林啟源(聯大電子系)、高郡汝(中大太空所)、古瓊昇、程姿諭、劉進強(中大遙測學程) B. 共同發表國際期刊論文 (附件四) 1. Y. C. Tzeng, K. T. Fan, and K. S. Chen, 2011, "A Parallel Differential Box Counting Algorithm Applied to High Resolution Remote Sensing Image Classifications," *IEEE Geoscience and Remote Sensing Letters*, accepted. (SCI) 2. K. S. Chen, C. Y. Chu, and Y. C. Tzeng, 2011, "A Semi-Empirical Model of Rain Attenuation at Ka-Band in Northern Taiwan," *Progress in Electromagnetic Research M*, vol. 16, pp. 213-223. (SCI) 3. K. T. Fan, Y. C. Tzeng, and **K. S. Chen**, 2010, "Classifications of Multisource Remote Sensing Images," *Journal of National United University*, vol. 7, pp. 279-298. 4. Y. C. Tzeng, K. T. Fan, C. Y. Lin, Y. F. Lin, K. S. Chen, 2011, "Estimation of Soil Moisture from MODIS Data and Precipitation," *Proceedings of the IEEE International Geoscience and Remote Sensing Symposium*, (IGARSS'2011), July 25-29, Vancouver, Canada, accepted. (EI) 5. Y. C. Tzeng, K. T. Fan, C. Y. Lin, Y.	

F. Lin, K. S. Chen, 2011, "Estuary Wetland Detection in SAR Images," *Proceedings of the IEEE International Geoscience and Remote Sensing Symposium*, (IGARSS'2011), July 25-29, Vancouver, Canada, accepted. (EI) C. 共同指導學生參與國內外學術競賽(附件五) 1. 整合聯合大學及中央大學，共同執行2009美商國家儀器(NI)綠色能源工程獎助金計畫「建置台灣地區地表溫度與土壤濕度之水文監控系統」，並共同指導學生參與學術競賽 指導學生林逸夫、楊楷民、莊盟凱、及施善得以作品「Zigbee Module for CompactRIO」參加NI第二屆產品設計創業競賽，獲得佳作及評審特別獎。 指導學生林逸夫以「利用NI CompactRIO建置環境監測系統」參加第九屆NI應用徵文比賽，獲得學術組佳作	
4.系所發展方向建言。 A. 曾擔任院系諮詢委員 1. 電子系課程委員會諮詢委員 2. 電子系工程教育認證委員會諮詢委員 3. 電資學院院課程委員會諮詢委員	1.系所發展方向建言。 2.提供院課程諮詢建言。

參、檢討與建議

一、本計畫執行期間所遭遇之困難與因應對策

本計畫在執行期間所遭遇之困難在於電資學院教師參與之深度與廣度尚待加強，雖已協助設置電機資訊學院遙測科技應用研究中心做為溝通平台，以申請跨校、跨領域合作之研究計畫，但要擴大電資學院教師之參與，仍有很大的努力空間。因應此一困難的對策為，持續加強支援與合作的深度與廣度，並強化聯合大學與國內外著名學術與研究機構之合作，藉由研究計畫之執行，不斷累積聯合大學(電資院)教師相關之技術與經驗，屆時自可全面性的提升其研究成果的質與量。

二、本計畫執行績效之自我評估（請具體敘明提升本校教學研究成果之貢獻）

本計畫之執行已完成本計畫所提各項工作計畫，並已達成電資學院需實質協助之各項工作。本計畫之執行對提升學校教學研究成果之具體貢獻，略述如下述：

1. 在**共同建立研究資源平台並研提跨校跨領域合作研究計畫**方面，本年度已協助設置電機資訊學院遙測科技應用研究中心，並藉由此一溝通平台，整合研究團隊、建立特色，以申請跨校、跨領域合作之研究計畫，強化聯合大學與國內外著名學術與研究機構之合作。目前透過遙測科技應用研究中心執行中之計畫如，整合聯合大學及中央大學，共同執行之100 年度國科會整合型防災科技研究計畫「極端氣候下可能產生之坡地

崩塌潛勢評估與預警全天候高效能遙測資源平台構建」、以及整合聯合大學及中央大學，共同執行之 100 年度中科院國防科技學術合作研究計劃「SAR 目標檢測運算效能提昇」。執行中之計畫如，整合聯合大學、交通大學及元智大學，共同完成之 99 年度國防科技學術合作研究計畫「微型合成孔徑雷達整合型關鍵組件先期開發研究」、以及整合聯合大學及中央大學，共同完成之 99 年度氣象局委託研究計畫「衛星遙測台灣地區土壤含水量與降雨量之作業化研究」。審查中之計畫如，整合聯合大學、中興大學、明道大學及中州技術學院，共同申請之 100 年度國科會整合型產學合作研究計畫「應用於精準農業之微氣候環境監控系統」。利用研究計畫之執行，逐步累積研究能量，進而邀請電資學院教師參與大型之研究計畫。規劃中之計畫如，整合聯合大學及中央大學，共同申請 100 年度國科會計畫「建置全國遙測資訊平台之異地備援系統」，以備援中央大學 100 年度國科會計畫「全天候遙測資訊平台建構」，此為一長期性之計畫，遙測影像經接收及處理後，匯入此資訊平台，以供國內各需求單位使用。

2. 在**協助推動國際學術合作及參與國際型研究計畫**方面，本年度與聯合大學遙測科技應用研究中心曾裕強教授共同撰寫由美國 Massachusetts Dartmouth 大學 C. H. Chen 教授主編書籍之專章。同時，推薦聯合大學遙測科技應用研究中心曾裕強教授與伊朗 Tehran 大學 J. Amini 教授共同指導研究生 H. Aghababaee 並共同發表論文。目前，正研議整合聯合大

學及台北科技大學與西班牙 Extremadura 大學 Antonio J. Plaza 教授,共同申請國科會台西(CSIC)福爾摩沙研究計畫。

3. 在**共同指導研究生與發表國際期刊論文**方面，本年度與電資學院教師共同指導碩二研究生林逸夫及蘇育璿、王俊偉、郭勁廷、陳柏共、李永財、王立農、陳宗銘七位畢業生，及林啟源、高郡汝、古瓊昇、程姿諭、劉進強五位碩一研究生，並已共同發表多篇論文及參與學術競賽。

4. 在**系所發展方向建言**方面，曾擔任電子系課程委員會諮詢委員與工程教育認證委員會諮詢委員及電資學院院課程委員會諮詢委員，並於相關會議中，提出多項系所發展方向及院課程諮詢建言。

本計畫之執行對學校教學研究成果之提升有相當大的貢獻，以遙測科技應用研究中心為溝通平台，若能持續加強支援與合作的深度與廣度，應可逐步擴大電資學院師生之參與面，進而提升學校教師研究成果的質與量，對學校未來的整體發展亦有深遠之影響。

肆、參考資料

一、個人基本資料表

（一）基本資料

中文姓名	陳錕山	英文姓名	Chen Kun-Shan (Last Name) (First Name) (Middle		
國籍	中華民國	性別	■男 □女	出生日期	1959 年 5 月
聯絡地址	32001 中壢市中大路 300 號 國立中央大學太空及遙測研究中心				
聯絡電話	(公).03-4227151 ext.57617, 57644		(宅). 0937-456-514		
傳真號碼	(03) 427-3586		E-MAIL	dkschen@csrsr.ncu.edu.tw	

（二）主要學歷

畢／肄業學校	國別	主修學門系所	學位	起訖年月
德州大學阿靈頓分校	美國	電機工程系	博士	1987/ 9~1990/12
德州大學阿靈頓分校	美國	電機工程系	碩士	1985/ 9~1987/ 8
國立台灣工業技術學院	台灣	電機工程系	學士	1983/ 9~1985/ 6

（三）現職及與專長相關之經歷

服務機關	服務部門／系所	職稱	起訖年月
國立中央大學	通訊系統研究中心	主任	2008/3~迄今
中國科學院	遙感應用研究所	客座教授	2009/9~迄今
國立中央大學	太空及遙測研究中心	講座教授	2008/1~迄今
國立中央大學	太空及遙測研究中心 太空科學研究所	教授	1996/8~迄今
國立中央大學	資訊工程研究所	教授	2005/8~迄今
國立中央大學	太空及遙測研究中心	教授兼主任	2001/8~2004/7
國立中央大學	通訊工程研究所	教授	2001/8~2004/7
浙江大學(中國)	國際電磁學院	兼任教授	2004/8~迄今
加州大學(聖塔芭芭拉分校)	計算遙測地球科學研究所	訪問學者	2000/7~迄今
華盛頓大學(西雅圖)	電機及電腦工程系	訪問學者	1999/8~2000/2
國立中央大學	太空及遙測研究中心	副教授	1992/8~1996/7

（四）專長

電波傳播散射	微波遙測與通訊	信號影像處理	微波系統工程

二、曾獲國際著名學術獎或在學術上有卓越貢獻者（請簡述如下）：

1. IEEE Fellow, 2007
2. The Electromagnetic Academy Fellow, 2004
3. 2008~2010 年國立聯合大學講座教授
4. 國立台北科技大學電機工程系 97 學年度傑出系友
5. 2008 年國立中央大學講座教授
6. 2006 年國立中央大學特聘教授
7. 2005 年國立中央大學傑出研究獎
8. 1993 年國際無線電聯合會(URSI)Young Scientist Award
9. Deputy Editor-in-Chief, IEEE Journal of Selected Topics in Earth Observations and Remote Sensing, 2007-present
10. Founder and Chairman, Taipei Chapter, IEEE Geoscience and Remote Sensing Society, 2004~ present
11. Associate Editor (microwave), IEEE Trans. Geoscience and Remote Sensing , 2000~present
12. Guest Editor, Special Issue on Remote Sensing Applications in Natural Disaster Monitoring, IEEE Trans. Geoscience and Remote Sensing, 2007
13. 總編輯， Journal of Photogrammetry and Remote Sensing, 2001~2007
14. Administrative Committee Member, IEEE Geosciences and Remote Sensing Society, 2006-present
15. 美國 NASA HYDROS 衛星計畫 Science Team Member 2004~present
16. 國際無線電聯合會(URSI)台灣 F 組(電波與遙測)召集人 2002~-present
17. 2009 年~迄今 中華民國安全科技與管理學會理事長
18. 2005 年～迄今 海峽兩岸遙測/遙感研討會技術主席（Technical Chairman)
19. 1999 年 Technical Chairman, Progress in Electromagnetic Research Symposium (500 attended from 40 countries), Taipei

三、近五年執行之研究計畫

年度	計畫名稱	計畫內擔任工作	起迄年月	補助機構
95	運用衛星影像輔助山坡地變異點判釋	主持人	94/12~95/12	農委會水保局
95	衛星災害監測及預警機制建立（2/2）	主持人	95/4~95/12	經濟部水利署
95	氣象局 MODIS 衛星於水文氣象觀測產品作業化之研究	主持人	95/4~95/12	經濟部水利署
95	衛星雷達影像應用於台灣海岸線變遷之研究（1/2）	主持人	95/5~95/12	經濟部水利署水規所
95	綠資源 NDVI 調查（V）	主持人	95/5~95/12	農委會林務局農航所
95	網狀化聯合作戰 C4ISR 系統之學術研究-空時自適應處理演算法在合成孔徑雷達影像技術研究	主持人	95/6~95/12	國防部軍備局中科院
95	東亞地函動力及板塊互動研究-雷達干涉法於地震斷層地表變形研究	主持人	95/8~96/7	國科會
96	整合衛星影像輔助山坡地變異點判釋及石門水庫集水區現況監測計畫	主持人	96/1~96/12	農委會水保局
96	SAR 衛星偵照陣地防護之研究	主持人	96/4~96/12	國防部軍備局中科院
96	綠資源 NDVI 調查（VI）	主持人	96/1~96/12	農委會林務局農航所
96	衛星雷達影像應用於台灣海岸線變遷之研究（2/2）	主持人	96/1~96/12	經濟部水利署水規所
96	MODIS 衛星應用於水文觀測網建置先期研究計畫（1/2）	主持人	96/6~96/12	經濟部水利署
96	東亞地函動力及板塊互動研究（II）-雷達干涉法於地震斷層地表變形研究（II）	主持人	96/8~98/7	國科會
96	衛星合成孔徑雷達特定目標自動化辨識	主持人	96/9~99/8	前瞻通訊實驗室
97	合成孔徑雷達(SAR)微波目標特徵擷取及資料庫建構	主持人	97/1~97/12	國科會
97	運用遙測技術輔助山坡地變異點判釋與監測	主持人	97/1~97/12	農委會水保局
97	SAR 衛星偵照陣地防護驗證	主持人	97/1~97/11	國防部軍備局中科院
97	綠資源 NDVI 調查（VII）	主持人	97/1~97/12	農委會林務局農航所

97	遙測影像應用於東部海岸線變遷之研究	主持人	97/6~97/12	經濟部水利署水規所
97	東亞地函動力及板塊互動研究(III)-多衛星雷達干涉法於地震斷層地表變形研究（III）	主持人	97/8~98/7	國科會
97	MODIS 衛星應用於水文觀測網建置先期研究計畫（2/2）	主持人	97/9~98/6	經濟部水利署
98	衛星遙測台灣地區土壤含水量與降雨量之研究	主持人	98/2~98/12	中央氣象局
98	微衛星 SAR 任務發展研究	主持人	98/4~99/8	國家太空中心
98	山坡地變異點判釋與監測	主持人	98/1~98/12	農委會水保局
98	應用雷達衛星遙測資料進行近岸海流變化分析之研究(1/2)	主持人	98/4~98/12	經濟部水利署
98	多元衛星遙測於全島綠資源調查、追蹤、分析比較	主持人	98/4~98/12	農委會林務局農航所
98	低耗能、輕型合成孔徑雷達開發之可行性研究	主持人	98/6~99/5	經濟部技術處
98	東亞地函動力及板塊互動研究—整合C及L波段衛星雷達干涉法於越北斷層地表變形研究	主持人	98/8~100/7	國科會
98	莫拉克風災(88 風災)前、後衛星影像崩塌地調查資料計畫	主持人	98/11~98/12	農委會林務局農航所
98	莫拉克風災後之緊急成災原因與地質變化調查-（子計畫二）利用衛星影像分析進行莫拉克颱風災後環境變化分析	主持人	98/12~100/10	國科會
99	雷達地表反射係數資料庫	主持人	98/12~99/8	國防部軍備局中科院
99	衛星遙測台灣地區土壤含水量與降雨量之作業化研究	共同主持人	99/3~99/12	中央氣象局
99	運用衛星遙測技術輔助山坡地進行地形地貌變異監測	主持人	99/3~99/12	農委會水保局
99	雷達影像觀測技術於坡地災害之應用	主持人	99/6~99/12	農委會
99	總計畫暨子計畫:颱洪災防數位境況決策支援系統之建立與測試應用	主持人	99/8~102/7	國科會
99	全天候遙測資訊平台建構服務型計畫	共同主持人	99/8~100/7	國科會
100	全天候遙測資訊平台建構(1/2)	主持人	100/8~101/7	國科會

四、論文著作

Books

1. Adrian K. Fung and Kun-Shan Chen, *Microwave Emission and Scattering Models for Users*, December, Artech House, USA, 2009.

Contributed Book Chapters

1. Radiative Transfer Models for Microwave Radiometry, in press, Editor C. Matzler, Institute of Electrical Engineers, StevenAge, UK, 2006.
2. Mitnik, L.M., K. S. Chen and C. T.Wang, Estimation of Average Surface Currents from ERS SAR Images of Oil-Tank Cleaning Spills, in Marine Surface Films: Chemical Characteristics, Influence on Air-Sea Interactions, and Remote Sensing, M. Gade, H. Huhnerfuss, and G.M. Korenowski (Eds.), Springer, Heidelberg, pp. 315-336, 2006.
3. K. S. Chen, A dynamic learning neural network in remote sensing: image classification and parameters retrieval, in Information Processing for Remote Sensing, (C.H. Chen ed.), World Scientific Publishing, 1999
4. K. S. Chen, Integration of SPOT and SAR images for monitoring of environmental changes by a fuzzy neural network, in Remote Sensing in Geoscience, (N.K. Tripathi and V. N. Bajpai ed.), Anmol Publications PVT, Ltd., 1998
5. K. S. Chen and A.K. Fung, Comparison between FDM and standard moment method in surface scattering, in Integral Methods in Science and Engineering, (Haji-Sheikh, A. ed.), pp. 259-271, Hemisphere Pub. Co. Washington, 1991.

Refereed Journal Articles

1. Ronglin Tang, Z. L. Li, and Kun-Shan Chen, "Validating MODIS-derived land surface evapotranspiration with in-situ measurements at two AmeriFlux sites in a semiarid region," Journal of Geophysical Research, Vol. 116, D04106, doi:10.1029/2010JD014543, 2011. (IF:3.082)
2. Ronglin Tang, Zhao-Liang Li, Yuanyuan Jia, Chuanrong Li, Kun-Shan Chen, Xiaomin Sun, Jinyong Lou, "Evaluating one- and two-source energy balance models in estimating surface evapotranspiration from Landsat-derived surface temperature and field measurements," accepted to International Journal of Remote Sensing, 2011.
3. Yu-Chang Tzeng, Kou-Tai Fan, and Kun-Shan Chen, "A Parallel Differential Box Counting Algorithm Applied to High Resolution Remote Sensing Image Classifications," IEEE Geosciences and Remote Sensing Letter, 2011.

4. Kun-Shan Chen, Chih-Yuan Chu and Yu-Chang Tzeng, "A Semi-Empirical Model of Rain Attenuation at Ka-Band in Northern Taiwan," Progress In Electromagnetics Research-M, vol. 16, pp. 213-223, 2011, (IF:4.735)

5. Kun-Shan Chen , Hsiu-Wen Wang, Chih-Tien Wang, and Wen-Yen Chang," A Study of Decadal Coastal Changes on Western Taiwan Using a Time Series ERS Satellite SAR Images," IEEE Journal of Selected Topics in Earth Observations and Remote Sensing, accepted, 2011.

6. Chih-Tien Wang, Kun-Shan Chen , Jyr-Ching Hu, and Wen-Yen Chang ,Wolfgang M. Boerner, "Long-Term Mapping of Land Uplift and Subsidence in the Industrial Parks in Northern Taiwan by Radar Interferometry," International Journal of Remote Sensing, in press, 2010. (IF:1.089)

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8. Kun-Shan Chen, An-Ming Wu, Jeng-Shing Chern, and L. C. Chen "FORMOSAT-2 Mission: Current Status and Contributions to Earth Observations," Proceedings of the IEEE, vol.98, no.5, pp.878-891, 2010. (IF:4.878)

9. S. Huang, L. Tsang, E. Njoku, Kun-Shan Chen, "Backscattering Coefficients, Coherent Reflectivities, and Emissivities of Randomly Rough Soil Surfaces at L-Band for SMAP Applications Based on Numerical Solutions of Maxwell Equations in Three-Dimensional Simulations," IEEE Transactions on Geoscience and Remote Sensing, Volume 48, no. 6, pp.2557-2568, 2010. (IF:2.344)

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12. Lingmei Jiang, Jiancheng Shi, Saibun Tjuajua, Kunshan Chen, Jinyang Du,and Lixin Zhang, "Estimation of Snow Water Equivalence Using the Polarimetric Scanning Radiometer from the Cold Land Processes Experiments (CLPX03)," IEEE Geoscience and Remote Sensing Letters, in press, 2010. (IF:1.8)

13. Ronglin Tang, Z. L. Li, and Kun-Shan Chen, "Validating MODIS-derived land surface evapotranspiration with in-situ measurements at two AmeriFlux sites in a semiarid region," accepted to Journal of Geophysical Research, 2010.

14. Ronglin Tang, Zhao-Liang Li, Kun-Shan Chen and Yuanjun Zhu, "Evaluation of Land Surface Evapotranspiration Estimation from Remote Sensing Spatial contextual Information," accepted to IEEE Geoscience and Remote Sensing Letters, 2010.(IF:1.8)

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16. Kun-Shan Chen, An-Ming Wu, Jeng-Shing Chern, and L. C. Chen "FORMOSAT-2 Mission: Current Status and Contributions to Earth Observations," to be published in Proceedings of IEEE, 2009. (IF:3.82)

17. L. Chen, J. C. Shi, Wigneron, J.-P., and Kun-Shan Chen, "A Parameterized Surface Emission Model at L-Band for Soil Moisture Retrieval," in press, IEEE Geoscience and Remote Sensing Letters, 2010.

18. Cheng-Yen Chiang, Kun-Shan Chen, and Chih-Tien Wang, "Feature Enhancement of Stripmap Mode SAR Images Based on an Optimization Scheme," IEEE Geoscience and Remote Sensing Letters, vol.6, no.4, pp.870-874, 2009. (IF:1.8)

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附件

國立聯合大學講座經費收支報告表

單位：元

經費項目		核定經費（1）	實際支付數（2）	請購未銷數（3）	小計（4）＝（2）＋（3）	執行率（5）＝（4）/（1）%	結餘數（6）＝（1）－（4）	7月份規劃執行經費
獎助金（A）		90,000	90,000		90,000	100%	0	
教學研究經費	人事費							
	設備費	90,000	90,000		90,000	100%	0	
	其他經費請自行增列							
	小計（B）	90,000	90,000		90,000	100%	0	
總計（C）＝（A）＋（B）		180,000	180,000		180,000	100%	0	

填報人：　　推薦單位主管：

備註：填報起迄時間為 99 年 8 月 1 日起至 100 年 7 月 31 日止。

國立聯合大學電機資訊學院遙測科技應用研究中心設置要點

98 年 9 月 30 日聯合秘字第 0989990110 號函訂定

一、國立聯合大學(以下簡稱本校)為加強有關遙測科技應用研究之合作及發展，提升研究及服務環境，特在電機資訊學院（以下簡稱本院）附設遙測科技應用研究中心（以下簡稱本中心）。

二、本中心成立之宗旨在加強協調整合研究資源、提昇本院遙測科技應用研究水準，並提供政府與民間遙測科技應用服務。

三、本中心之任務如下：

（一）組織專案研究計畫團隊，爭取研究資源。

（二）促進國內外學術研究單位之交流。

（三）辦理開發遙測科技應用相關技術。

（四）舉辦學術演講、研討會、講習會及訓練班。

（五）其他和遙測科技應用研究與服務之相關事宜。

四、本中心置主任一人，綜理本中心業務，由本院院長推薦本院遙測專長教師提請校長聘兼之，任期三年，得連任。

五、本中心得設諮詢委員會，協助訂定本中心發展目標及研究方向。委員由本中心主任聘任之。

六、本中心因業務需要，得聘請校內外專家為特聘研究人員，並得約聘研究人員、技術人員及行政人員若干人。

七、本中心每學期至少召開會議一次，由中心主任召集之，出席人員包括中心主任、特聘研究人員、約聘研究人員及技術人員。

八、本要點經電機資訊學院院務會議通過並報行政會議核定後實施。

十、整合型研究計畫項目及重點說明：(總計畫及子計畫之主持人均需分年填寫此表)

(一) 整合型研究計畫項目：

第一年:

計畫項目	主持人	服務機構/系所	職稱	計畫名稱	申請經費(新台幣元)
總計畫	曾裕強	聯合大學遙測科技應用研究中心	教授	應用於精準農業之微氣候環境監控系統	1,212,250
子計畫一	曾裕強	聯合大學遙測科技應用研究中心	教授	利用雲端運算技術建置微氣候環境監控系統	1,445,340
子計畫二	宋妤	國立中興大學園藝學系	教授	精準農業-設施作物栽培專家系統之建立	1,432,800
子計畫三	劉程煒	明道大學精緻農業學系	助理教授	精準灌溉系統對設施栽培蔬菜品質與產量的影響	1,435,400
子計畫四	鄭合志	中州技術學院自動化控制工程系	助理教授	栽培場環境 e 化遠距監控系統	1,428,900
合計					6,954,690

第二年:

計畫項目	主持人	服務機構/系所	職稱	計畫名稱	申請經費(新台幣元)
總計畫	曾裕強	聯合大學遙測科技應用研究中心	教授	應用於精準農業之微氣候環境監控系統	1,221,400
子計畫一	曾裕強	聯合大學遙測科技應用研究中心	教授	利用雲端運算技術建置微氣候環境監控系統	1,445,340
子計畫二	宋妤	國立中興大學園藝學系	教授	精準農業-設施作物栽培專家系統之建立	1,432,800
子計畫三	劉程煒	明道大學精緻農業學系	助理教授	精準灌溉系統對設施栽培蔬菜品質與產量的影響	1,450,200
子計畫四	鄭合志	中州技術學院自動化控制工程系	助理教授	栽培場環境 e 化遠距監控系統	1,428,900
合計					6,978,640

第三年:

計畫項目	主持人	服務機構/系所	職稱	計畫名稱	申請經費（新台幣元）
總計畫	曾裕強	聯合大學遙測科技應用研究中心	教授	應用於精準農業之微氣候環境監控系統	1,268,424
子計畫一	曾裕強	聯合大學遙測科技應用研究中心	教授	利用雲端運算技術建置微氣候環境監控系統	1,445,340
子計畫二	宋妤	國立中興大學園藝學系	教授	精準農業-設施作物栽培專家系統之建立	1,432,800
子計畫三	劉程煒	明道大學精緻農業學系	助理教授	精準灌溉系統對設施栽培蔬菜品質與產量的影響	1,436,160
子計畫四	鄭合志	中州技術學院自動化控制工程系	助理教授	栽培場環境ｅ化遠距監控系統	1,428,900
合　　計					7,011,624

（二）整合型研究計畫重點說明：

1.整合之必要性：包括總體目標、整體分工合作架構及各子計畫間之相關性與整合程度。

台灣自古以農立國，農業向來是支持國家經濟發展的重要產業。隨著國民所得的增加以及社會結構的改變，國人生活水準逐漸提升，消費者對農產品的需求更趨於多元化，也更加重視農產品的衛生、安全及品質。因此，農業生產結構也應隨著消費結構的改變而因應調整，以滿足消費者之需求。另一方面，臺灣加入世界貿易組織(WTO)以後，農產貿易自由化的腳步更加快速，對於目前的農業產業已經造成嚴重衝擊。因此，加速調整農業產銷之結構，提高農產品的品質，以增進國人對國產農產品的支持與信心，將有助於提升臺灣農業之競爭力。因此，為因應全球化及國際經貿自由化，確保農業永續發展，發揮台灣農業的科技優勢與地理條件，農委會乃基於健康、效率、永續經營的施政理念，在 2009 年提出「精緻農業健康卓越方案」。行政院並將精緻農業(Quality Agriculture)與生技、觀光、綠能、醫療照護、及文創等產業共同列入六大新興產業。在四年內，行政院合計將投入新台幣 242 億元經費，至民國 101 年精緻農業產值預期將倍增為 1,589 億元。其目標是在這段期間創造 3 萬 1,000 個就業機會、促進農漁村經濟繁榮、提高農民所得、提供安全的農產品，同時進行更多的造林綠化、減少污染，以提高國人的生活品質。

面對全球化競爭的局勢，決定產業優勢的關鍵因素為安全、品質、速度及創意。因此，台灣農業要追求永續發展，就必須走向科技化、資訊化與企業化，發展重點與潛力產品，使農業全面轉型升級。臺灣農業科技發達，整合相關技術發展精緻農業，生產「安全、健康、高品質」的農產品以提高產業競爭力，並解決耕作面積小且生產成本高的問題。由於技術之進步，臺灣農業已逐漸由傳統農業

第 1800 次 討論 378-2 100/06/15 (第 1800 次通過)

100年度 【 極端氣候下可能產生之坡地崩塌潛勢評估與預警全天候高效能遙測資源平台構建－子計畫:利用衛星遙測資料與地面即時降雨資料反演全台即時土壤含水量(I) 】經費核定清單

執行機構：國立聯合大學　　主　持　人：曾裕強　　教授(遙測科技應用研究中心)

補助項目	申請金額	核定金額	說　　明
業務費	1,094,340	586,000	一、研究人力費：336,000元 1. 碩士班研究生研究助學金2名144,000元 2. 講師級研究酬金1名72,000元 3. 本會依規定主動增核研究主持費1名，月支10,000元(12.000月計) 二、耗材、物品及雜項費用：250,000元
國外差旅費	100,000	80,000	一、出席國際會議差旅費：80,000元 二、本項目不核列管理費
管理費	164,151	69,000	研究主持費不核列管理費
合　　計	1,358,491	735,000	執行期限： 100/08/01 ～ 101/07/31 計畫編號： NSC 100-2625-M-239 -002 -

研究類型：一般型研究計畫(整合型)　　學門名稱：永續發展研究-自然科學　　流水號： 99WFAB000091
研究性質：應用研究　　承辦人： 魏良榮
應繳報告：完整報告
研究成果歸屬：國立聯合大學
各項費用之支用請依「行政院國家科學委員會補助專題研究計畫經費處理原則」規定辦理。

主持人：上校代所長李明家

審查委員：計品會幕幼小組（預估3員）、企劃處承辦及主管（預估1員）、各督導副所長（3員）

列席人員：各學合案執行之相關單位單位主管

地點：中科院357館206會議室

時間：100年9月X日（約0901-0915）

項次	時間	計畫名稱	合作學校	需求單位
A1	0900-0905	主席致詞		
A2	0905-0925	新型多通道高功率微波旋轉耦合器研製	**大學(**系***教授)	地面雷達組(楊慶源)
A3	0925-0945	一對二高功率高速射頻切換裝置研製	**大學(**系***教授)	相列雷達組(吳建邦)
A4	0945-1005	SAR目標檢測運算效能提昇	聯合大學(電子系曾裕強教授)	空用電子組(蘇忠開)
A5	1005-1025	SAR影像輻射與幾何校正軟體開發	中央大學(太遙中心任玄教授)	空用電子組(蘇忠開)
A6	1025-1045	中場休息		
A7	1045-1105	多感測器對多火力系統分配法則研究	**大學(**系***教授)	相列雷達組(郭啟全)
A8	1105-1125	被動雷達組網之目標偵測與追蹤研究	**大學(**系***教授)	相列雷達組(謝旺達)
A9	1125-1145	多感測器對抗低空目標追蹤與融合法則研究	**大學(**系***教授)	空用電子組(陳國鎮)
A10	1145-1300	中午休息（用餐）		
A11	1300-1320	主動式電子掃瞄系統前瞻關鍵技術探及	**大學(**系***教授)	微波導標組(林清泉)
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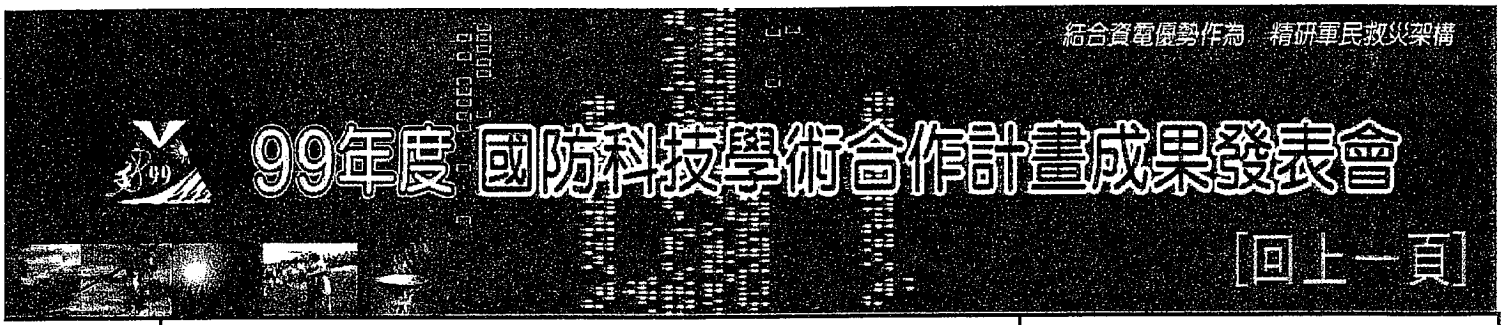

編號	論文題目	作者
62	奈米液體防彈纖維材料開發及其特性研究	顏瑞良、張章平、胡文華、葛明德 陳幼良、周進義
63	低頻下LAZ1110鎂鋰合金制振能及其高溫制振背景值之研究	張世航、林克駿、吳錫侃、王建義 薄慧雲
64	用於燃料電池供電之電流型轉換器研究	蔡明村、黃志銘、賴維祥、黃耿彬 李俊毅、翁炳志
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Journals:

- Wavelet Transforms in Fractal Analysis for Edge Detection in SAR Image, Iranian society for surveying and Geomatic engineering, (In Persian)
- Edge Detection on Microwave Remote Sensing Images Based on Fractal-Fuzzy Algorithm, Engineering Journal of Geospatial information Technology, (In Persian)

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- Proposed a Measure for Change Detection of SAR images by Fractal-Genetic Method
- Improving change detection methods from SAR image by fractal geometry

Conference presentations/proceedings:

- Web-GIS Application in Real-Estate management, National Conference and Exhibition, Geomatics 90, 2011
- Fuzzy Logic for Production of Landslide Susceptibility Map, International Conference on Sensors and Models in Photogrammetry and Remote Sensing,2011
- Wavelet for Estimation of Fractal Dimension in ALOS-PALSAR Images, 5thSASTech, Khavaran Higher-education Institute, Mashhad, Iran. May 12-14, 2011
- Change Detection from SAR Images with Fractal Analysis, International Conference on Sensors and Models in Photogrammetry and Remote Sensing,2011
- Coastline Detection in SAR images by Integrating Fractal Geometry and Fuzzy Logic, The 4th International Congress on Image and Signal Processing

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02-Aug-2011

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International Conference on Sensors and Models in Photogrammetry and Remote Sensing, Tehran, Iran. May 18-19 (2011)

CHANGE DETECTION FROM SAR IMAGE WITH FRACTAL ANALYSIS

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KEY WORDS: Change detection, Fractal dimension, Spatial chaotic model

ABSTRACT:

In this paper, we present a method of change detection in SAR images based on fractal dimension. Speckle in SAR images is a chaotic phenomenon because the scattering signals within a cell are summed up coherently. Therefore, SAR signal can be modelled by a spatial chaotic system and characterized by its fractal dimension. There are several methods to estimate fractal dimension. The use of wavelet analysis combined with fractional Brownian motion (fBm) analysis may be provide an interesting approach to compute fractal dimension. In this paper we first apply fractal analysis on two SAR images to determine the fractal images or local fractal dimension (LFD) and then the difference fractal images is derive from two fractal images that contain the changes of two SAR images. The result of this method compares with principal component analysis (PCA) technique over the study area. The data of study area that obtained by JERS-1 satellite, belong to north region of Iran (Bandar-e-Anzali) with latitude 37°28'30" N and longitude 49°20'50"E.

1. INTRODUCTION

Remote sensing is one of the most important technologies to monitor changes that occur on the Earth surface (e.g.: Landuse and land cover change analysis, nature disaster estimation, etc.). Change detection is useful for monitoring urbanization, agricultural development, forest land management, ice forecasting, etc. with satellite image. There are several methods to detecting the changes with satellite image and the most widely used methods are: Difference Image, Ratio Image, Classification Comparison, and Change Vector Analysis. In remote sensing earth monitoring, images acquired by synthetic aperture radar (SAR) compare to optical imagery, have been less exploited in the context of change detection. This is mainly due to the intrinsic complexities of SAR data, which require both an intensive pre-processing phase and the development of effective data analysis techniques capable of dealing with multiplicative speckle noise. However, unlike optical remote sensing, SAR sensors present the advantage that they are independent of atmospheric and sunlight condition. In this point of view, SAR data present high potentialities for monitoring application in some regions where it is cloudy or rainy (Fan et al., 2007).

Change detection is the process of identifying difference in the state of an object or phenomena by observing it at different times. The objective of change detection is to compare spatial representation of two points in time by controlling all variances caused by differences in variable that are not of interest and to measure changes caused by differences in variable of interest (Haihang et al., 2008). Change detection techniques have been proved particularly successfully in many applications related to environmental monitoring, agricultural surveys, urban studies, and forest monitoring. Studies related to satellite based SAR imagery are much fewer, because of the speckle phenomenon which is typical phenomenon of the SAR images. Owing to the speckle noise of SAR image, the change detection result from the method based on comparing pixel usually contain some isolated point and the consistency of change region cannot be guaranteed. So the accuracy of change detection result based on comparing pixel in SAR image usually relies on signal to noise ratio of the original image.

Usually, change detection in SAR images is based on a three step procedure: 1) image despeckling; 2) pixel-by-pixel comparison of two images; and 3) image thresholding. The aim of image despeckling is to increase the SNR of the considered images. However, applying of a speckle reduction algorithm will result in altering the SAR signal in some extent. In spite of its noisy appearance, speckle is indeed a SAR signal in nature (Tzeng et al., 2007). Speckle is a chaotic phenomenon which results from coherent energy imaging as by SAR. Therefore, SAR signals can be modelled by a nonlinear deterministic dynamical system. As a result, SAR image characterize by its fractal dimension (Tzeng et al., 2006).

There were one-to-one relations between the textures of a land cover type and a unique fractal dimension value, and then the fractal dimension could be viewed as the 'fractal signature' of that land cover type (Sun et all. 2006). So if occur change in phenomena, their fractal dimension also will change. Tzeng et al. (2006) proposed a spatial chaotic model (SCM) for SAR image change detection. In the SCM method, fractal images are acquired by computing local fractal dimensions of original SAR images and then changes are obtayined by a simple thresholding on fractal images. The effective factor in the SCM is the determination of fractal dimension. There are several methods to computing fractal dimension and one of them is power spectrum method. It is seems that power spectrum method to yield very accurate estimates. Actually it used the wavelet analysis combined with fractional Brownian analysis.

This paper is organized as follows: in Section 2 we will introduce the power spectrum method to compute fractal dimension and the SCM method is revealed. In Section 3, we present conclusion and result of the research.

Coastline Detection in SAR images by Integrating Fractal Geometry and Fuzzy Logic

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Abstract—**This paper presents an algorithm for coastline detection in synthetic aperture radar (SAR) images, which uses the fractal self-similarity character of image edges based on fractal geometry. Local fractal dimension appear to be stable estimators to differentiate edges in SAR images. We used the power spectrum method for computing local fractal dimension of SAR satellite images by multi-window approach based on fuzzy logic. Theoretically, microwave signals can be characterized as a chaotic phenomenon because the scattering signals within a resolution cell are summed up coherently. So SAR image can be model in non-linear dynamic system. As a result, SAR signal usually can be characterized by its fractal dimension. The Present method (Fractal-Fuzzy algorithm) is applied to ALOS-PALSAR images for coastline detection. The final result shows that the coastlines detected by Fractal-Fuzzy method in compare with classical edge detection method like canny operator do not suffer from speckle noise effect and detect the coastline correctly.**

Keywords- Coastline detection;Edge Detection; Fractal Dimension;Fuzzy logic; SAR image;Spatial Chaotic Model

I. INTRODUCTION

Coastline is defined as the line of contact between land and the water body. Coastline is one of the most important linear features on the earth's surface, which has a dynamic nature [1]. Knowledge of coastline is essential in activities such as land and ocean resources management, automatic navigation and geographic mapping. Detecting the shorelines by remote sensing technology became increasingly important over the recent decades and using the SAR satellite image is more popular. SAR images are very useful tools to coastline detection especially in regions where optical data are rarely available. SAR satellite systems are independent from weather conditions, so they can provide images during the day as during the night. With respect to optical imagery, this all time and all weather observation capability remains the most valuable distinctive advantage.

Automated coastline extraction is a boundary detection problem in the field of image processing. Edge detection and image segmentation are two conventional approaches for boundary detection [2]. Until now several methods of coastline detection from SAR images has been proposed, for example Mason et al. (1996) proposed a method based on speckle-sensitive edge detector [3], Touzi et al. (1988) proposed the contrast ratio filter that combined with a contour model [4], Niedermeier et al. (2000) proposed a detection algorithm based on wavelet methods [5], Yu et al. (2004) proposed a coastline detection method based on a speckle-reducing anisotropic diffusion tool [6] and Kim et al. (2007) studied the dependence of the coastline mapping on the radar frequency [7].

However, coastline detection in SAR images suffers from the presence of speckle noise effect and most of the shoreline extraction methods are sensitive to the speckle noise effect. Commonly adaptive filter uses for noise reduction or de-speckling in SAR images but applying noise reduction algorithm will results in altering SAR signal in some extent. Speckle noise is not really noise in the classic sense and there is information to be obtained from it, because speckle is radar signature of the target under a particular set of circumstances. So speckle is indeed a SAR signal in nature. Hence, it can be represented by a nonlinear dynamic system and characterized by its fractal dimension [8]. Because speckle can be modeled properly and characterized by its fractal dimension in spatial chaotic model (SCM), image despeckling process is no longer required for coastline detection [8-10].

Fractal analysis in remote sensing image has been investigated at last since a decade. Fractal dimension of remote sensing images locally obtained by a window centered on each point. Local fractal dimension is sensitive to the size of window and different window size result in different fractal dimension. So the computation of optimum window size is as a problem that at this article we use fuzzy logic to address it.

The rest of this paper is organized as follows: in Section II, The edge detection method (Fractal-Fuzzy) for coastline detection based on fractal geometry and fuzzy logic is revealed. In section III results of implementation and data Descriptions are given and some concluding remarks are drawn from this study in section IV.

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A Parallel Differential Box Counting Algorithm Applied to Hyperspectral Image Classification

Yu-Chang Tzeng, Kuo-Tai Fan, and Kun-Shan Chen

Abstract—**In this study, spatial information through fractal measures was adopted to combine with the spectral information to improve the land covers classification. The spectral features alone and later combined with texture features, using MODIS/ASTER (MASTER) airborne simulator imagery, were fed into a neural classifier. Classification performance was evaluated by a confusion matrix measured by overall accuracy and kappa coefficient. In particular, a parallel differential box-counting (DBC) algorithm for fractal estimation was implemented on a multi-core PC. The computation efficiency was ensured through the use of parallel DBC algorithm which is much faster than that of the original DBC. Further, multi-core processors offer great potential for speeding up the computation by partitioning the load among the cores. Multithreading technique is adopted to fully explore its multi-core capability. Experimental results demonstrate that the proposed approach provides substantial improvements in classification accuracy while requires much less computation time without extra hardware resources.**

Index Terms—**fractal dimension, differential box-counting, multi-core, multithreading**

I. Introduction

With the revolutionizing advents in sensor technology, hyperspectral images are increasingly being produced. Considering the amount of data to be processed and the high computational cost required by image processing algorithms, conventional computing environments are simply impractical. High performance computing techniques such as cluster computing, grid computing, and parallel algorithms on a multi-core processor go a long way to increasing computational performance [1-3]. Of these, multi-core processors present an opportunity for speeding up the computation by partitioning the load among the cores [4-6]. As multi-core processor systems are becoming more widespread, the demand for efficient parallel algorithms in the field of remote sensing of images is also increasing.

Traditional spectral based classifiers suffer from ineffective due to the lack of image's spatial properties. Sometimes, spectral analysis methods fail to produce satisfactory results because objects with similar spectral signatures cannot be spectrally separated and thus distinguished. It has been realized that data captured in neighboring pixels may provide useful and yet supplementary information. Hence, integration of information from both a spectral and spatial domain has potential to enhance the classification performance [1, 7-9]. Fractal dimension (FD) was introduced to characterize spatial complexity of geographic phenomena at multiple scales in terms of self-similarity [10]. It is useful in the measurement, analysis, segmentation, and classification of shape and texture. However, the use of fractal dimension as a texture measure has limitations because some textures may have the same fractal dimension but yet with quite different appearances. Mandelbrot [10] also introduced the lacunarity to characterize different texture appearances, which may share the same fractal dimension value. Lacunarity measures the deviation of a geometric structure from translational invariance (or gappiness) [11]. In other word, lacunarity represents the distribution of gap sizes: low lacunarity geometric objects are homogeneous because all gap sizes are the same, whereas high lacunarity objects are heterogeneous [12]. It is worth to note that lacunarity is a scale dependent texture measure, in that objects that are homogeneous at a small scale can be heterogeneous at a larger scale [13].

In this study, texture information is extracted and combined with the spectral information to get better classification accuracy. Fractal dimension, the texture information applied, is estimated by a differential box-counting (DBC) technique [14]. Li *et al.* [15] proposed a model to assign the smallest number of boxes to cover the entire image surface at each selected scale as required, thereby yielding more accurate estimates. However, the original DBC suffers computational inefficiency because the fractal dimension is computed sequentially. It is not problematic if the image size is relatively small. However, it becomes troublesome when it is applied to hyperspectral images. As such, a parallel DBC (PDBC) is proposed to improve the computation efficiency. The PDBC algorithm is described in the following section. In Section III, application to a hyperspectral image for land cover classification is given. Computational efficiency of both methods is evaluated. The effectiveness of integrating spatial information with spectral information is also assessed. Finally, conclusions are drawn.

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A SEMI-EMPIRICAL MODEL OF RAIN ATTENUATION AT KA-BAND IN NORTHERN TAIWAN

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Abstract—Combining a two-year measurement and numerical approach, a semi-empirical model has been developed for prediction of rain attenuation at Ka-band in northern Taiwan. This was done using the drop size distribution (DSD) measurement and the extinction coefficient calculated by T-matrix, followed by regressing with rain attenuation measurements in all seasons. The attenuation due to rain can be estimated by calculating the extinction coefficient over all of the rain drops within the antenna beam volume. Comparing with the measured data demonstrates that the proposed model proves sufficiently accurate for Ka-band signal attenuation in site specific. For purpose of cross reference, we also compared the proposed model with Crane and ITU-R-P838 rain attenuation models. The RMS error and chi-square test shows that the proposed semi-empirical model has better performance to predicted rain attenuation than Crane and ITU-RP383 models, implied that both model predictions may not be quite reliable in some specific areas. Analysis suggests that seasonal effects are strong in signal attenuation due to rain types. It means that rain rate itself is not a quite reliable enough to be the single parameter in the rain attenuation model.

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Classifications of Multisource Remote Sensing Images

K. T. Fan[1,*] Y. C. Tzeng[2]

abstract

The use of remote sensing images from various sensors is supposed to be able to improve land cover classification accuracies. The important prospect of data fusion is focused on exploiting the complementary information among different sensors. Data fusion can take advantage of the use of complementary information to obtain a better overall accuracy than using single data source only. In this paper, multisouce classifiers are adopted to fully utilize the complementary information among different data sources. Because the multisource data are not necessarily in common units and therefore scaling problems may arise at fusing different sources of data. To overcome the scaling problems, two types of the multisouce classifier, neural networks and multiple classifiers systems, are introduced. The performances of utilizing the multisouce classifiers to the application of multisource remote sensing images classification are demonstrated and compared. For the multiple classifiers systems, three different weighting policies (rms distance weighting, average distance weighting, and adaptive thesholding) are examined. Experimental results show that both the neural networks and multiple classifiers systems approaches can dramatically improve the classification accuracy. In addition, the multiple classifiers systems approaches outperforms the neural networks approach. Besides, the classification performance of the adaptive thresholding multiple classifiers system is better than those of the distance weighted multiple classifiers systems. Moreover, the classification performance of the average distance weighting multiple classifiers system is slightly better than that of the rms distance weighting multiple classifiers system.

Key Words: data fusion, neural networks, multiple classifiers system

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Dear Yu-Chang Tzeng,

Regarding presentation of the following accepted papers:
- ESTUARY WETLAND DETECTION IN SAR IMAGES
- ESTIMATION OF SOIL MOISTURE FROM MODIS DATA AND PRECIPITATION

The 2011 IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2011) continues to be the signature conference of the IEEE Geoscience and Remote Sensing Society. The Technical Program Committee worked very hard to compile a technical program consisting of outstanding papers.

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This letter of invitation is not an offer to contribute to the financial costs of registration, travel to and from the conference, or subsistence while in Canada. This invitation is issued on the expectation that presenting authors will register for the conference and pay the required fees as notified on the website by the due date. Authors are responsible for the entire travel costs, to and from their home countries, including hotel expenses during the conference period.

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ESTIMATION OF SOIL MOISTURE FROM MODIS DATA AND PRECIPITATION

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1. INTRODUCTION

Soil moisture, the water content in the upper layer of soil, is a very important parameter that controls the interactions between land surface and atmospheric process. The space-time characteristics of soil moisture content are mainly governed by rainfall distribution, soil texture, vegetation cover, and land surface topography [1]. Knowing the spatial and temporal features of soil moisture dynamics is essential for proper water resource management, fertilization management, and crop production [2]. It has been shown that the impact of rainfall on the spatial variability of the soil moisture field is limited to the period of raining [3]. The problem becomes one-dimensional in time by assuming that the change of average land surface condition does not alter its spatial variability [4]. Therefore, the temporal soil moisture dynamics can be modeled by a recurrent neural network. A recurrent neural network has at least one feedback loop which results in a nonlinear dynamical behavior. The application of feedback enables recurrent networks to acquire state representations, which make them suitable devices for such applications as nonlinear estimation and modeling [5]. In this study, a recurrent dynamic learning neural network (RDLNN) was proposed to estimate soil moisture evolution by rainfall forcing. Preliminary results suggested that RDLNN is a promising tool for soil moisture content estimation.

2. THE PROPOSED APPROACH

MODIS provides daily observations of the land surface temperature (LST) and normalized difference vegetation index (NDVI) over the Earth. Carlson *et al.* [6] proposed a regression model to estimate soil moisture content from NDVI and LST

$$s = \sum_{i=0}^{m} \sum_{j=0}^{m} a_{ij} NDVI^{*(i)} LSTI^{*(j)} \tag{1}$$

where a_{ij} is the coefficient to be determined by regressing the ground measurements and $NDVI^*$ and LST^* is the scaled NDVI and LST, correspondingly. The scaled NDVI and LST can be obtained by

ESTUARY WETLAND DETECTION IN SAR IMAGES

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1. INTRODUCTION

Wetland detection in sea-land interactions of estuaries is an important subject from the viewpoint of conservation of ecosystem and wetland change. Because of its all-weather and all-time characteristics, SAR images are particularly effective to detect estuary wetlands. Referred to the relationship between polarization, wavelength and wetland detection efficiency, Henderson *et al.* [1] concluded that L-band is necessary for forest wetland detection, C-band data has produced favorable results in herbaceous wetlands and some wooded wetlands, and C-band and X-band have signal enhancement in leaf-off conditions. Also, HH polarization is preferred over VV, cross-polarized data seems to contribute more in some cases, and fully-polarized data seems comparable to HH in accuracy. By applying a back-propagation neural network, Ghedira *et al.* [2] incorporated textural information into the classification process to delineate forested and open wetlands and to distinguish between wetland categories using RADARSAT SAR data. By fusing optical and SAR data, Henderson *et al.* [3] adopted an unsupervised classification approach for coastal wetland mapping under C-CAP guidelines. Touzi *et al.* [4] introduced the Touzi decomposition and Huynen's target helicity to discriminate shrub bogs from poor fens.

Sensing in wavelength outside the visible and infrared regions of the electromagnetic spectrum, SAR provides information on surface roughness, dielectric properties, etc. It has already been recognized that ocean areas in SAR images are almost always much more homogeneous in grey levels than land areas [5]. Therefore, features reflecting the roughness of an image can be very useful for detecting estuary wetland. However, estuary wetland detection in SAR images suffers from the presence of speckle effect. Therefore, it can be a difficult, if not impossible, task to detect the wetlands simply by image segmentation and/or classification. Image despeckling process inevitably leads to loss of the geometrical details to some extent. That subsequently degrades the detection performance. Speckle is a chaotic phenomenon which results from coherent energy imaging as by SAR. To represent its geometric property, an SAR signal can be modeled by the spatial chaotic model (SCM) and characterized by its fractal dimension [6]. When speckle has been modeled properly, the image despeckling process is no longer required. This is very advantageous, since no spatial information is lost. In this study, SCM

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