

ห้องสมุดงานวิจัย สำนักงานคณะกรรมการวิจัยแห่งชาติ



E46959

A NOVEL EDGE DETECTION FOR ILL-DEFINED EDGES
IN NOISY IMAGES

KRIT SOMKANTHA

DOCTOR OF PHILOSOPHY
IN ELECTRICAL ENGINEERING

THE GRADUATE SCHOOL
CHIANG MAI UNIVERSITY
JULY 2010

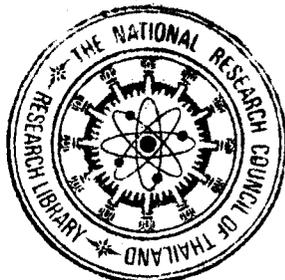
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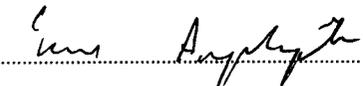
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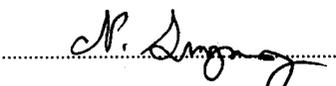
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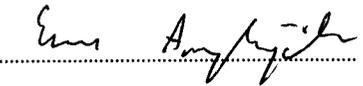
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16 July 2010

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Acknowledgements

I am especially grateful to my supervisor, Associate Professor Dr. Nipon Theera-Umpon, for his great assistance, great advice and kindness.

I would like to thank my co-supervisor, Assistant Professor Dr. Sansanee Auephanwiriyaikul, for her great advice and help during research at Department of Computer Engineering, Faculty of Engineering, Chiang Mai University.

I would like to thank Assistant Professor Dr. Sermsak Uatrongjit for his helpful discussions.

I would like to thank Dr. Juntima Euathrongchit, Dr. Arintaya Phrommintikul, Dr. Jakri Tanyanopporn, Dr. Wasarut Rutjanaprom, Dr. Wichai Kultangwattana, Dr. Supamit Arworn for the ground truths of medical images which are used in this research.

I would like to express thanks to all of members of the Computational Intelligence Research Laboratory for their friendship.

I would like to express my gratitude to all those who gave me the possibility to complete this thesis.

I would like to my gratitude to my parents and my sister for their endless love and support.

Finally, I would like to thank the Office of the Higher Education Commission, Thailand for supporting by grant fund under the program Strategic Scholarships for Frontier Research Network for the Ph.D. Program Thai Doctoral degree for this research.

Krit Somkantha

ชื่อเรื่องวิทยานิพนธ์ การหาขอบภาพแบบใหม่สำหรับขอบ ไม่ชัดเจนในภาพที่มีสัญญาณรบกวน

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บทคัดย่อ

E46959

วิทยานิพนธ์นี้ นำเสนอวิธีการหาขอบภาพแบบใหม่สำหรับขอบ ไม่ชัดเจนในภาพที่มีสัญญาณรบกวน และนำไปใช้ตรวจหาขอบของวัตถุในภาพที่มีสัญญาณรบกวน ดังเช่นภาพทางการแพทย์ต่างๆ จุดอ่อนของการหาขอบภาพ คือ จะมีผลกระทบจากสัญญาณรบกวนและไม่สามารถหาขอบได้ในกรณีที่ภาพมีสัญญาณรบกวนสูง ดังนั้น การหาขอบที่ถูกต้องในภาพที่มีสัญญาณรบกวนยังคงเป็นปัญหาที่แก้ได้ยาก จุดมุ่งหมายของงานวิทยานิพนธ์นี้ คือ การพัฒนาเทคนิคการหาขอบภาพแบบใหม่โดยอัตโนมัติสำหรับการตรวจหาขอบของวัตถุในภาพที่มีสัญญาณรบกวน

เทคนิคที่นำเสนอสามารถตรวจหาขอบของวัตถุในภาพที่มีสัญญาณรบกวน โดยการใช้เทคนิคการตามรอยขอบภาพแบบใหม่ ซึ่งคำนวณรูปแบบสนามเวกเตอร์ขอบเฉลี่ยและคำนวณแผนที่ขอบ รูปแบบสนามเวกเตอร์ขอบเฉลี่ยที่นำเสนอได้มาจากการเฉลี่ยจากสนามเวกเตอร์ขอบ ซึ่งทิศทางและขนาดจะถูกนำมาใช้ในการพิจารณา แผนที่ขอบที่นำเสนอได้มาจากวิธีการของลักษณะพื้นผิวแบบลอว์และวิธีการหาขอบแบบแคนนี่ รูปแบบสนามเวกเตอร์ขอบเฉลี่ยและแผนที่ขอบถูกใช้ในการเลือกขอบที่ดีในวิธีการของการตามรอยขอบ ประสิทธิภาพของวิธีการได้ถูกทดสอบกับภาพที่สังเคราะห์ขึ้นมา ภาพอัลตราซาวด์ต่อมลูกหมาก ภาพคลื่นแม่เหล็กไฟฟ้าหัวใจห้องล่างซ้าย

ภาพคลื่นแม่เหล็กไฟฟ้าเส้นเลือดแดงใหญ่ ภาพรังสีระนาบข้อต่อหัวเข่า และภาพเอกซเรย์กระดูก
ข้อมือ วิธีการหาขอบภาพแบบใหม่จะเปรียบเทียบกับวิธีการหาขอบแบบ แอคทีฟคอนทราสต์โมเดล
(ACM), จีโอเดซิกแอคทีฟคอนทราสต์ (GAC) และ เกรเดียนต์เวกเตอร์ฟิลด์ (GVF) โดยใช้ผลที่ได้
ของแพทย์ผู้เชี่ยวชาญเป็นข้อมูลความเป็นจริง จากผลการทดลองแสดงให้เห็นว่า วิธีการหาขอบ
แบบใหม่สามารถที่จะทำการหาขอบของวัตถุในภาพที่มีสัญญาณรบกวนได้อย่างมีประสิทธิภาพ
และดีกว่าวิธีการที่ทำการเปรียบเทียบ และผลที่ได้จากการหาขอบของวัตถุมีประสิทธิภาพใกล้เคียง
กับผลที่ได้จากแพทย์ผู้เชี่ยวชาญ วิธีการหาขอบภาพแบบใหม่เป็นประโยชน์อย่างมากในการ
ช่วยเหลือแพทย์ในการแยกแยะภาพวัตถุที่สนใจในภาพทางการแพทย์ วิธีการหาขอบแบบใหม่ยัง
สามารถนำไปประยุกต์ใช้งานกับภาพอื่นๆ ที่มีปัญหาในการหาขอบที่ไม่ชัดเจนด้วย

Thesis Title A Novel Edge Detection for Ill-Defined Edges in Noisy Images

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ABSTRACT

E46959

This thesis proposes a novel edge detection for ill-defined edges in noisy images and implements the proposed method to detect the edge of object in noisy images such as medical images. The weaknesses of edge detection are the sensitivity to noise and bad performance in the cases where images contain high level of noise. Therefore, finding the correct edge in noisy images is still a difficulty task. The goal of this thesis is to develop an automated edge detection technique for detecting the edge of object in noisy images.

Our proposed technique can detect the edge of object in noisy images using the novel edge following technique. We calculate the average edge vector field model and the edge map. The proposed average edge vector field model is derived by averaging edge vector fields in which both direction and magnitude are taken into account. The proposed edge map is derived from Law's texture feature and Canny edge detection. The average edge vector field and the edge map are used to select the strong edges in the edge following technique. The performance and robustness of the technique have been tested on noisy images such as synthetic noisy images, prostate ultrasound images, left ventricle in cardiac magnetic resonance images, aorta in cardiovascular magnetic resonance images, knee joints in computerized tomography

images and carpal bone in X-ray images. We also compare the proposed edge detection technique with the active contour models (ACM), geodesic active contour (GAC) and gradient vector flow (GVF) by using the opinions of the skilled doctor as the ground truth. The experimental results show that the proposed technique is able to provide more accurate edge detection results than the classical contour models and visually close to the manual segmentation by the skilled doctor. The proposed technique is very useful in assisting radiologists to accomplish the task of segmenting the boundary of object in noisy images much more efficiently. The new technique can further be applied to any image processing problems in which the ill-defined edge detection is encountered.

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