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Comparative Study for Color Edge Detection Using Least Square Numerical Method

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Outline:

- INTRODUCTION
- APPLIED METHODS
 - Least Square Method
- RESULTS
- CONCLUSION
- REFERENCES



Introduction:

- Edge detection plays an important role in image processing, pattern recognition and computer vision applications.
- The edge can be defined as a boundary between an object and the background.
- Most of edge detection schemes are based on finding maximum in the first derivative of the image function such as Roberts operator, Sobel operator, Prewitt operator.
- The others seek in the second derivative zero-crossing to edge detection, such as LOG operator, Canny operator.
- Various methods of edge detection for color images, including techniques extended from monochrome edge detection as well as vector space methods are presented.
- This research presents a comparative study on different methods of edge detection of color images.
- The methods are based on vector space, color space and numerical methods.

APPLIED METHOD

Least Square Numerical Method

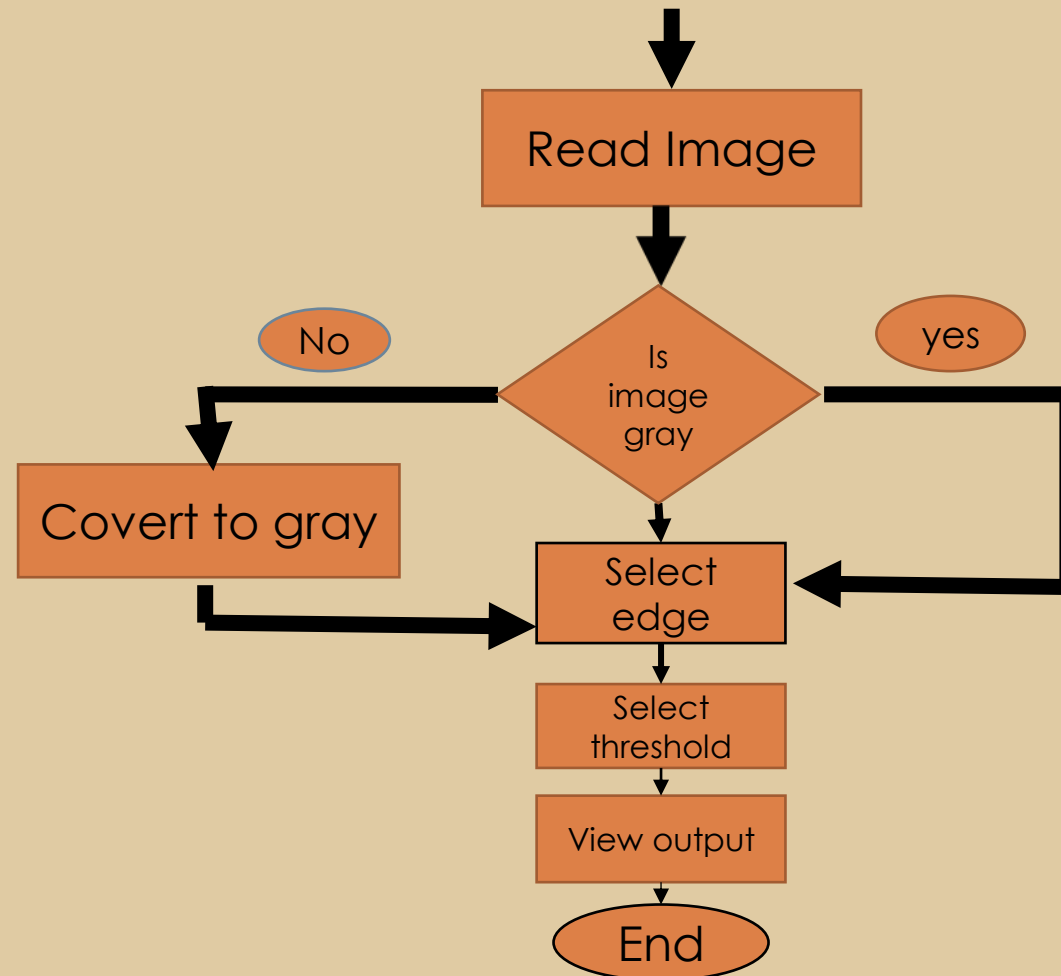
- Al-Nifaay in 2005 suggested a method of edge detection that depends on the algorithm of least square curve fitting.

$$Y(x) = a + b x$$

$$b = \frac{n \sum_{x=1}^n x \cdot y - \sum_{x=1}^n x \sum_{x=1}^n y(x)}{n \sum_{x=1}^n x - [\sum_{x=1}^n x]^2}$$

$$a = \frac{\sum_{x=1}^n y(x) - b \sum_{x=1}^n x}{n}$$

Least Square Numerical Method...Cont



Least Square Numerical Method...Cont

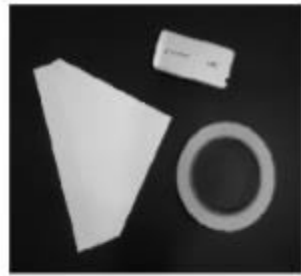
- Load the image.
- Input size of sliding mask (3x3).
- Input the value of threshold (th).
- Apply the sliding mask on the image plane, then extract the values from mask by using four major directions the horizontal direction, the vertical directions and the major diagonal direction, and the second diagonal direction, A very one independent on the other.
- Analyses every pixel value from the extracted pixels values to the (r, g, b,) band.
- Then re-ascending the resulted red band (r) data in increasing manner and present in a vector , where $(x=1, 2, 3...n)$, where n is the number of extracted values, initially used Red band (i.e. $y(x) = r$).
- Estimate a and b
- Estimate the absolute Error .
- Repeat the steps for (g band) and (b band)
- Estimate the threshold
- The result matrix it was the edge matrix.



Results:

- For implementation, Matlab R2013 is used on a computer that has Intel(R) Pentium (R) CPU with 4GB RAM
- Edge detection methods that are explain previously are applied on seven different images.
- The images were selected so they contain areas of fine details as well as areas of consistent colors.
- The 7 images and their results can be seen.

RESULTS – Cont.



a



b



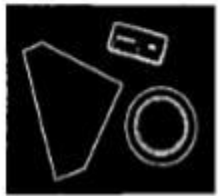
c



d



e



f



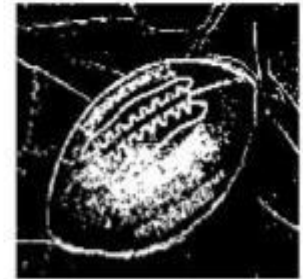
g



h



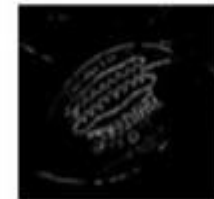
a



b



c



d



e



f



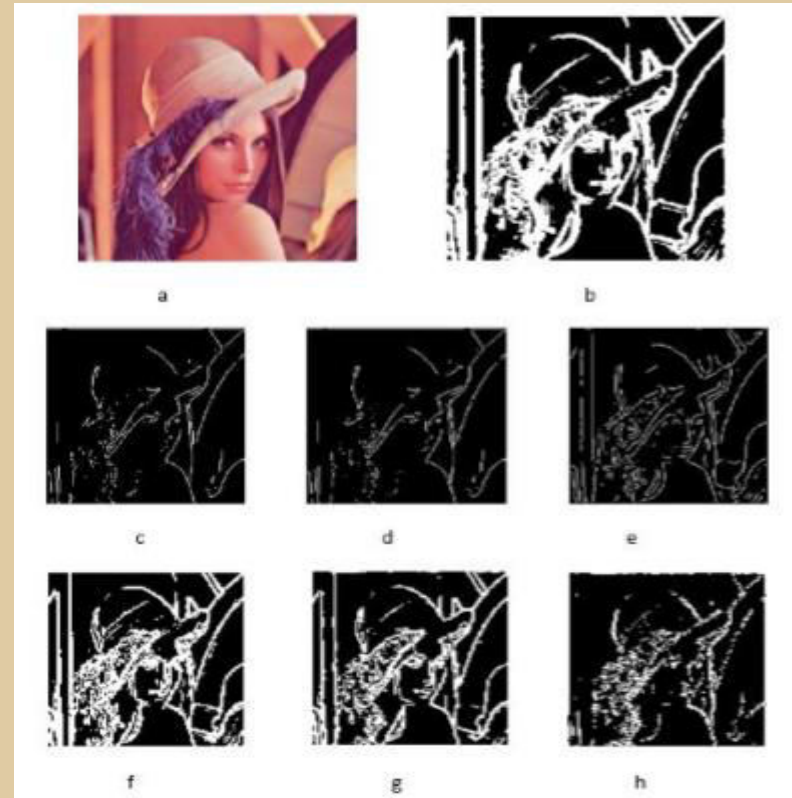
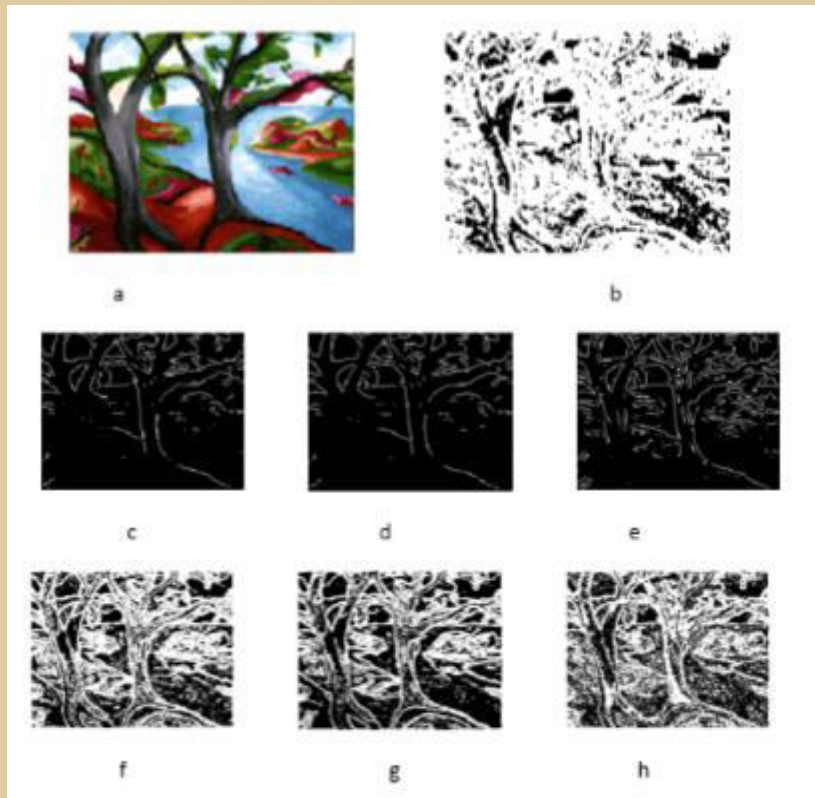
g



h

a: original image , b: least square, c: YCbCr Sobel, d:YCbCr Prewitt, e: YCbCr log, f:Jacobian Sobel, g: Jacobian Prewitt , h: Jacobian Log.

RESULTS – Cont



a: original image , b: least square, c: YCbCr Sobel, d:YCbCr Prewitt, e: YCbCr log, f:Jacobian Sobel, g: Jacobian Prewitt , h: Jacobian Log.

RESULTS – Cont



a



b



c



d



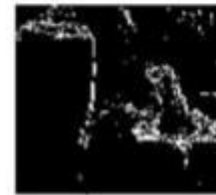
e



f



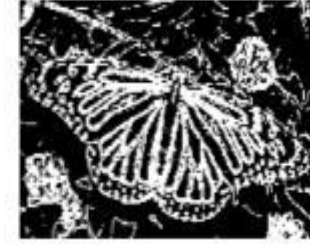
g



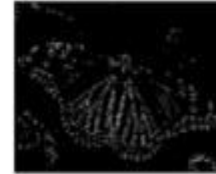
h



a



b



c



d



e



f



g



h

a: original image , b: least square, c: YCbCr Sobel, d:YCbCr Prewitt, e: YCbCr log, f:Jacobian Sobel, g: Jacobian Prewitt , h: Jacobian Log.

RESULTS – Cont.

- The Mean Square Error (MSE). It is used to compare image edge detection quality.
- The MSE value gives the average difference of the pixels throughout the original image with edge detected image.

TABLE 1 MSE RESULTS

Image	Numerical Method	YCbCr Method			Jacobian Method		
	<i>Least Square</i>	<i>Sobel</i>	<i>Prewitt</i>	<i>Log</i>	<i>Sobel</i>	<i>Prewitt</i>	<i>Log</i>
1	0.2895	0.2769	0.2769	0.2689	0.2869	0.2821	0.2786
2	0.2156	0.0974	0.0957	0.1222	0.1720	0.1341	0.1903
3	0.6244	0.3487	0.3480	0.3392	0.5473	0.5028	0.5361
4	0.4170	0.4090	0.4091	0.3791	0.4089	0.4055	0.4194
5	0.5728	0.5115	0.5114	0.5001	0.5651	0.5569	0.5396
6	0.5584	0.5729	0.5729	0.5561	0.5610	0.5677	0.5686
7	0.3247	0.1604	0.1608	0.1751	0.3171	0.2725	0.1971



Conclusions:

- Edge detection methods that are explain previously are applied on seven different images in order to analyze the performance of these methods and discover the best one.
- We conclude that the Jacobian method produce a thick and disconnected edge with all operators Sobel, Prewitt and Log.
- While the least square method produce edges that are much thicker but continuous.
- The good performance was found when using YCbCr method, the edges are sharpen, continuous, and not thickness.
- They are similar with Sobel and Prewitt operators but with some missing edges while it is better with Log operator.



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Thank you