Color Edge Detection Using Jacobian-Vector Value Method

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Agenda

- Introduction
- Vector Value Method
- Steps of Jacobian-Vector Value Method
- Results
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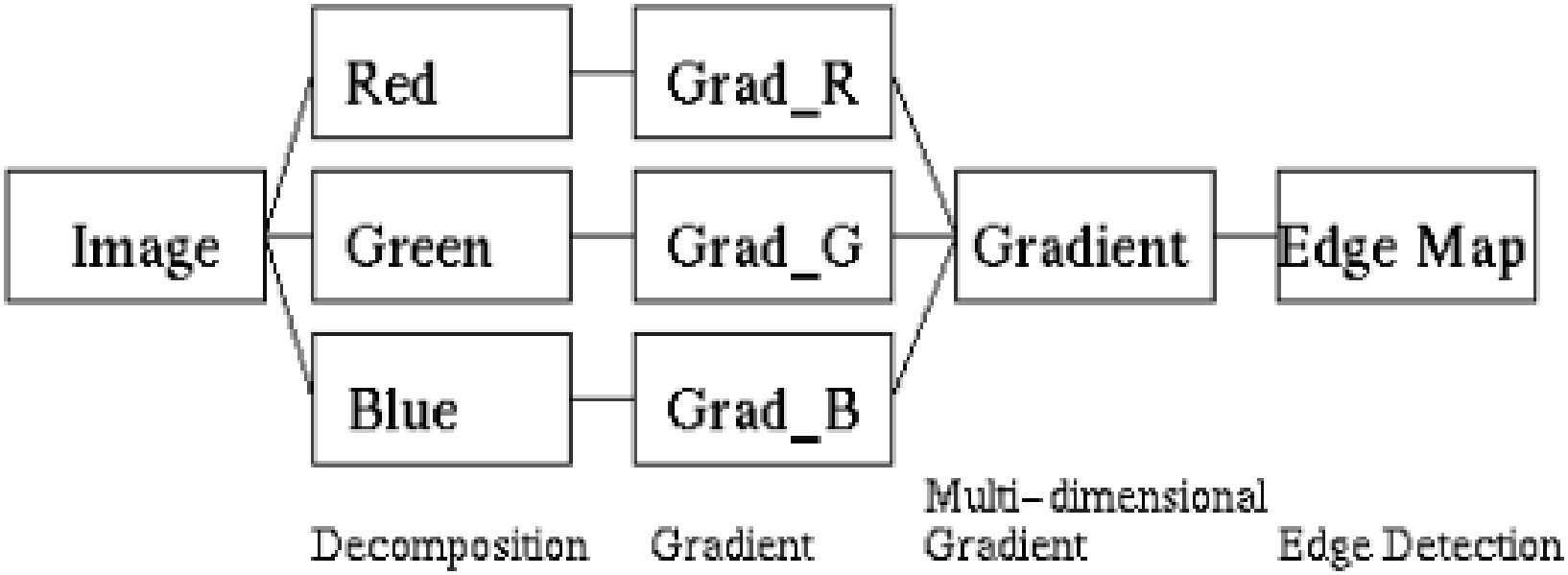
Introduction

- Edge detection plays an important role in image processing, pattern recognition and computer vision applications.
- The edge can 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 seeking 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.

Vector Value Method

- The vector-valued technique is applied on the color images and isolate individual component of RGB.



- The direct formulas for the Jacobian eigenvalues were used, so this function is vectorized and yields good results without sacrificing performance.

Steps of Jacobian-Vector value Method

- Determine the standard edge detection operator that will to be applied.
- Compute the x-direction derivative (rx, gx, and bx) for the three color component (RGB) separately.
- Compute the y-direction derivative (ry, gy, and by) for the three color component (RGB) separately.
- Compute the Jacobian matrix for the x-direction derivatives, y-direction derivatives and their combination.

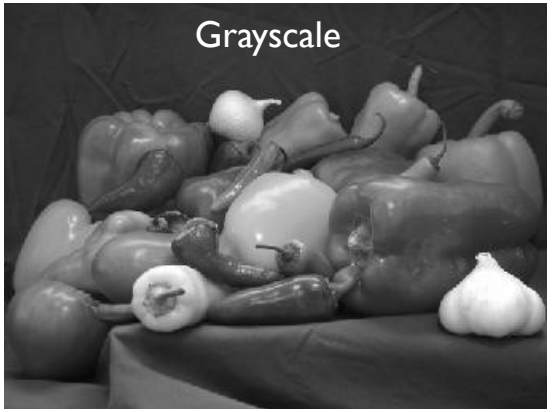
  $Jx = rx^2 + gx^2 + bx^2$
  $Jy = ry^2 + gy^2 + by^2$
  $Jxy = rx * ry + gx * gy + bx * by$

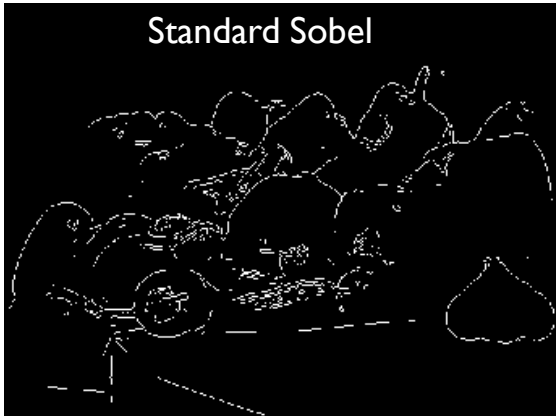
- compute first (greatest) eigenvalue (e1) of 2x2 matrix J' *J.
  $D = \sqrt{abs(Jx2 - 2 * Jx * Jy + Jy2 + 4 * Jxy2)}$
  $e1 = (Jx + Jy + D)/ 2$

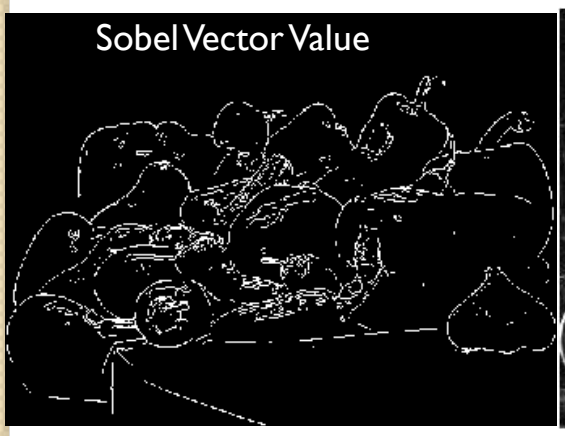
- Find the edge magnitude.
  edge magnitude = $\sqrt{e1}$

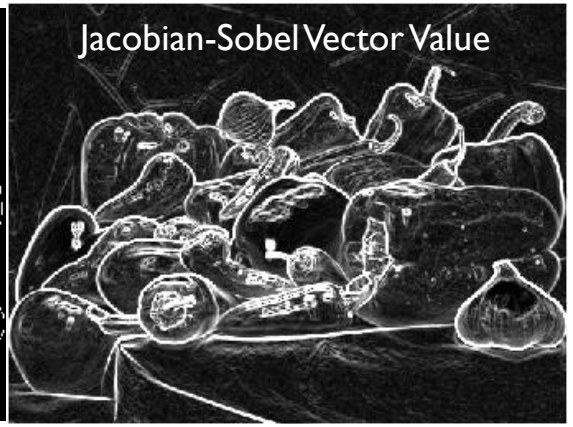
Results

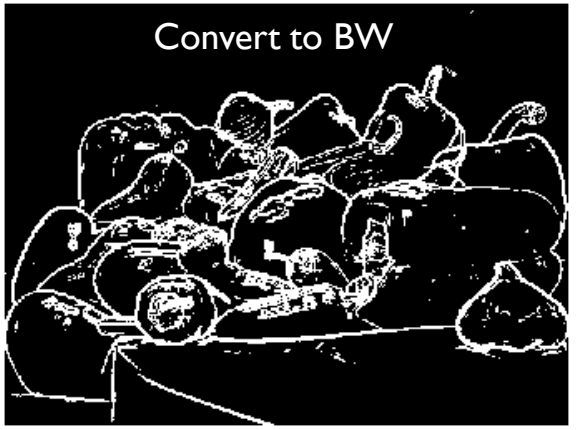

Original


Grayscale


Standard Sobel


Sobel Vector Value


Jacobian-Sobel Vector Value


Convert to BW

Conclusion

- Extracts the edges of a color image without converting it to grayscale.
- Changes in color are detected even when the grayscale color of two pixels are the same.
- The edge strength is typically greater or equal to the magnitude obtained by simply filtering a grayscale image.
- Optionally, the edge orientation can also be returned.

  edge_orientation1 = $\tan^{-1}$(-Jxy, e1 - Jy);

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Thank You!