approval for presentation after correction

Inbox x

Robin cr Fri, 4 Dec, 22:07 (3 days ago)

Mr. Ajai V Babu Sun, 6 Dec, 09:22 (1 day ago)

to me

Robin,

You can proceed...

Ajai V Babu

DEC, RSET

On Fri, 4 Dec 2020 at 22:07, Robin cr <robin005cr@gmail.com> wrote:

CIRCULAR OBJECT DETECTION USING GABOR FILTER

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ABSTRACT

1. Filtering and detecting circular and deformed circular objects using Gabor Filter.
2. Tasks :
   - It should remove noise.
   - It should find the portions of circular shape in the image.

BLOCK DIAGRAM

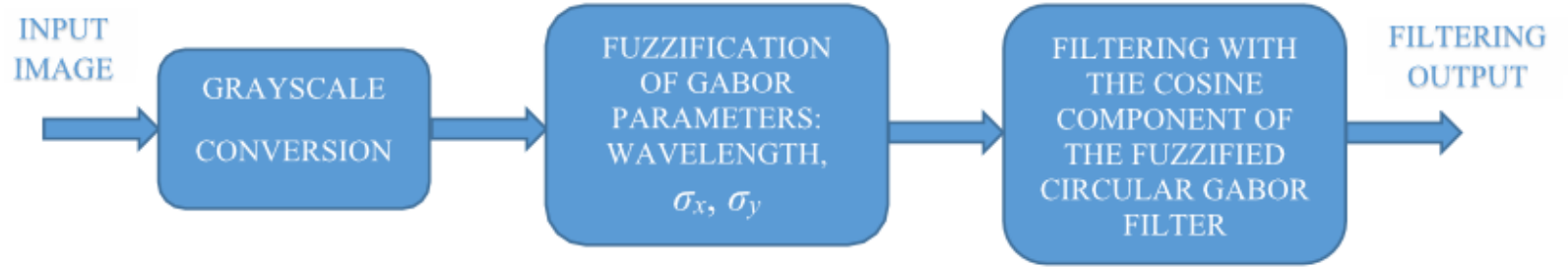

Figure 1: A 2-D Gabor filter obtained by modulating the sine wave with a Gaussian wave

GABOR FILTER

1. They are special classes of band pass filters.
2. They allow certain range of frequencies based on parameters.
3. Applications :
    - Edge detection
    - Feature extraction
    - Texture analysis

WORKING

1. It is a convolution filter representing a combination of gaussian and a sinusoidal term.
2. Both signals are taken in 2-D plane.
3. The gaussian component provides weights and the sine component provides the directionality.
4. It is used to generate features that represent texture and edges.

EQUATION

Gauss Function

$$g(x,y,f,\phi,\sigma) = Ae^{-\left(\frac{(x-x_0)^2}{2\sigma_x^2}+\frac{(y-y_0)^2}{2\sigma_y^2}\right)} e^{j(2\pi f(x\cos\phi+y\sin\phi)+\psi)}$$

$f =$ *spatial frequency*
$\phi =$ *Orientation of Gaborfilter*
$\sigma =$ *Standard deviation*
$\psi =$ *Phase offset*

GRAPHICAL REPRESENTATION

Response of Gabor filter

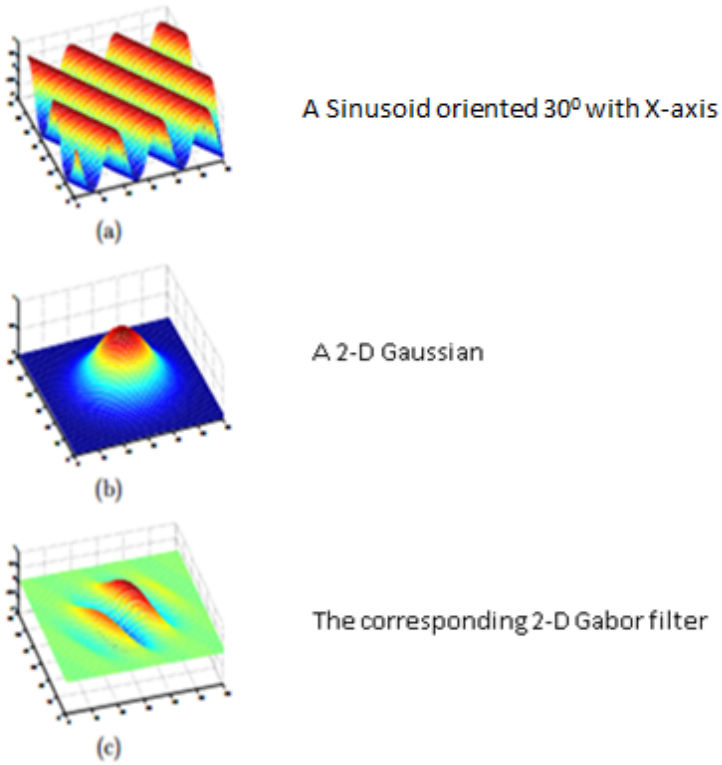

Figure 2: A 2-D Gabor filter obtained by modulating the sine wave with a Gaussian wave

MODIFIED EQUATION

Gauss Function

$$G(x,y,F,\sigma) = Ae^{-\left(\frac{(x-x_0)^2}{2\sigma_x^2}+\frac{(y-y_0)^2}{2\sigma_y^2}\right)} e^{j2\pi F\left(\sqrt{x^2+y^2}\right)}$$

$f =$ *spatial frequency*
$\phi =$ *Orientation of Gaborfilter*
$\sigma =$ *Standard deviation*
$\psi =$ *Phase offset*

RESPONSE OF CIRCULAR GABOR FILTER

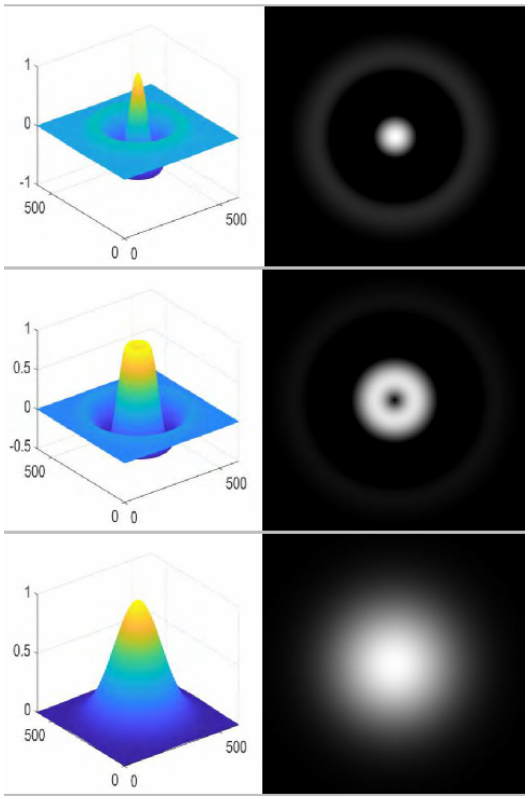

Figure 3: Spatial and frequency responses of (i)cosine (ii)sine (iii)amplitude

$$G = Re(G) + jImg(G)$$

$$Re(G) = Ae^{-(\frac{(x-x_0)^2}{2\sigma_x^2}+\frac{(y-y_0)^2}{2\sigma_y^2})}\cos 2\pi F(\sqrt{x^2+y^2})$$

$$Img(G) = Ae^{-(\frac{(x-x_0)^2}{2\sigma_x^2}+\frac{(y-y_0)^2}{2\sigma_y^2})}\sin 2\pi F(\sqrt{x^2+y^2})$$

Comparing sine, cosine and amplitude response , cosine component has the strongest response that forms a full circle.

FUZZIFICATION OF CIRCULAR GABOR FILTER

- Bell membership function is formulated as ,

$$u(z) = \begin{cases} S(z, \sigma_{x1}, \sigma_{x2}) & z < \sigma_{x2} \\ S(2\sigma_{x2} - z, \sigma_{x1}, \sigma_{x2}) & \sigma_{x2} \leq z \end{cases}$$

FEATURES OF FUZZIFIED GABOR FILTER

- Fuzzy systems with standard deviations in the directions of x and y - axes is created.
- A different fuzzy system for wavelength is also defined.
- The resulting system was then used in filtering algorithm.
- This experiment has 55 features in total: 17 for σ_x, 17 *for* σ_y *and* 21 *for wavelengths*.

PROCESS OF FILTERING

- The number of features can be changed easily, but large number of features will result in increased processing time.
- A series of circular Gabor filters and filter banks was created.
- This system provides the filtering result.
- It is to be noted that the series was used to perform filtering in accordance with the properties of the created fuzzy system.

OTHER EXPERIMENTS

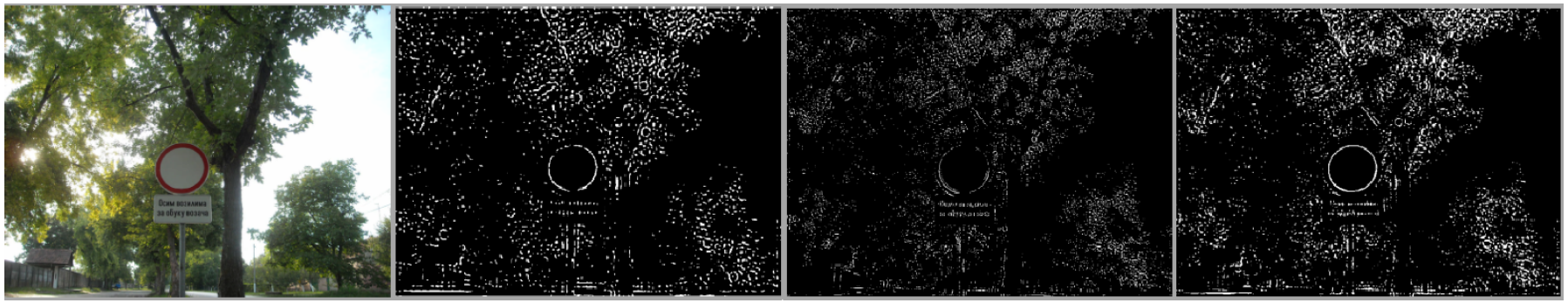

Figure 4: (a)input image (b)circular Gabor filter at [3] (c)classic circular Gabor filter (d)fuzzified circular Gabor filter

1. The input image shows a traffic sign consisting of two shapes a rectangle and circle.
2. The background of the image has various details and shadows.
3. Circular Gabor filter for invariant texture segmentation and fuzzified Circular gabor filter shows a better response.

RESULTS

- The cosine component of the fuzzified circular gabor filter was used for filtering in all experiments and it produces a stronger response to the edges of circular objects.
- The circular shape of traffic sign is well detected in an image with complex background.

GRAPHICAL REPRESENTATION

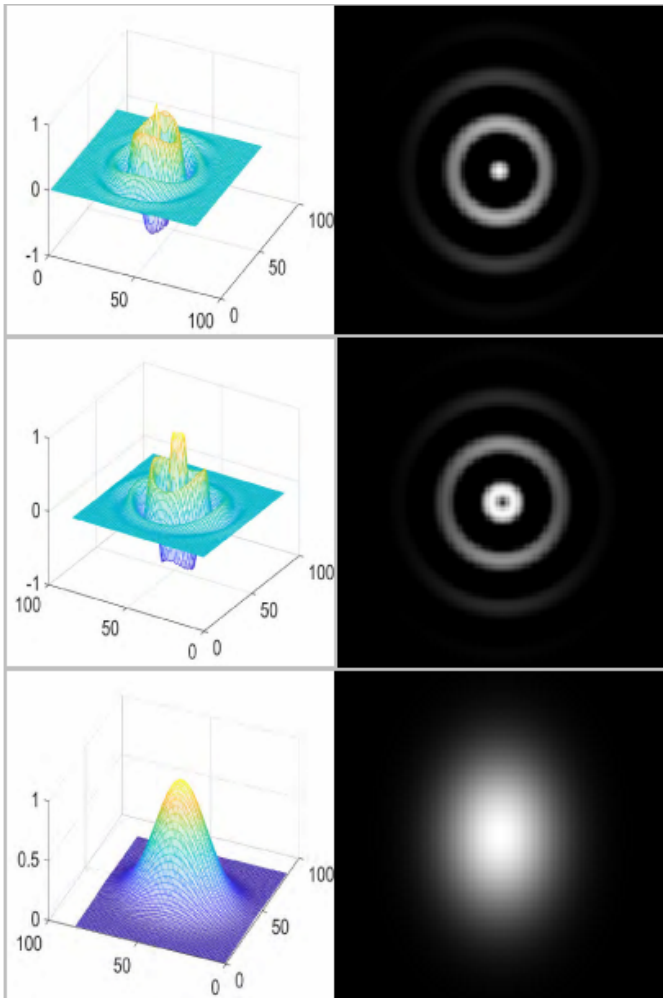

Figure 5: Spatial and frequency responses of of a sample image after fuzzification (i)cosine (ii)sine (iii)amplitude

CONCLUSION

1. Circular object detection is achieved through Gabor filter with fuzzified parameters, wavelength and standard deviations.
2. Efficient extraction of the segments of interest can be achieved, by using the cosine component of the filter.
3. Circular shape is detected from complex images of various origins.

REFERENCE

[1]. V.Tadic, A. Toth, Z. Vizvari , P. Odry and A. Odry,*"Fuzzified Circular Gabor Filter for Circular and Near-Circular Object Detection,"* Eng. Appl. Artif. Intell., May. 2020.

[2]. V.Tadic, M.Popovic, and P. Odry,*"Fuzzified Gabor filter for license plate detection,"* Eng. Appl. Artif. Inte, vol. 48, pp. 40-58, Feb. 2016.

[3]. J.Zhang,T.Tan, and L.Ma,*"Invariant texture segmentation via Circular Gabor Filters,"* in Proc. Object.Recognit. Supported User Interact. Service Robots, Aug. 2002.