sphericImage Class

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Abstract

This class privide some methods for image segmentation, based on a spherial image interpretation and using a chromatic distace (usually). To improve this chromatic distance, in this class we have some hybrid distances and the corresponding hybrid gradients. For different hybrid methods we have different kernel functions. Be attent!!

Memebers

double[,] Zenith; //double matrix for zenith angles

double[,] Azimuth; //double matrix for azimuth angles

double[,] L; //double matrix for vector longs

int rows; // image size

int col;

Methods

public sphericImage(Image<Bgr, byte> I)

Is the constuctor of this class, where for each pixel we calculate:

```
l = Math.Sqrt((R * R) + (G * G) + (B * B));
L[f, c] = l;
Zenith[f, c] = Math.Atan(G / R);// zen;
Azimuth[f, c] = Math.Acos(B / l);// azi;
```

This values are not normalized.

public double[,] getL()

return L matrix

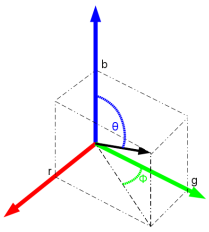

Figure 1: Spherical transformation

public double[,] getZenith()

Return Zenith angle matrix

public double[,] getAzimuth()

Return Azimuth angle matrix

public double[,] getNormalizedL()

Return the normalized L matrix

public double[,] getNormalizedZenith()

Return the normalized zenith matrix

public double[,] getNormalizedZenith()

Return the normalized zenith matrix

public double[,] SobelChromaticGradient()

Return a chromatic gradient based on the well-know Sobel masks

public double[,] PrewittChromaticGradient()

Return a chromatic gradient based on the well-know Prewitt masks

public double[,] SwChromaticGradient()

Return a fast , efficient and less noised chromatic gradient based in pseudo Prewitt masks

public double[,] PrewittIntensityGradient()

Return a intensity gradient based in the widely used Prewitt masks

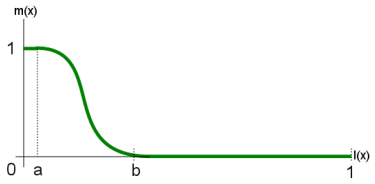

Figure 2: Function for the hybrid gradient

public double[,] HybridGradient(double a, double b)

This function provide us a gradient with all good properties of the intensity and chromatic gradients and without their problems.

This method follow the equation expresed in the below sketch.

This figure express the used of the intensity gradient depending of the image intensity. I we name this function v and $\bar{v} = 1 - v$ then the hybrid gradient HG is expressed with the bellow equation

$$HG = v * IntensityGradient + \bar{v} * ChromaticGradient$$

There are so important the parameters a and b.

public ArrayList watershed(double[,] IG, double threshold, int steps)

This function return a segmented an labeled image. This information is contained in a ArrayList that conatins two objects.

1. The first one is a int[,] matrix with the labeled image.
2. The second one containt a List<double[2]> object. For each label i in the labeled matrix, the mean chromaticity of this region is contained in the i position in this List.

This method is based in a watershed process and a chromatic distance.

Prameмters

- The input parameter IG is a Gradient. We are free to use someone, however use the hybrid Gradient is a good idea.
- threshold is the noise tolerance (usually close to 0.05) The admited range is [0-1]
- steps is the levels amoung for the watershed method [40-200]

public ArrayList watershedV(double[,] IG, double threshold, int steps)

This method is equivalent tho the last one, execpt that in this case we can see the watershed edge.

public ArrayList fastSegmentation(double threshold)

This method provide us a fast segmentation method focused in robotic contexts.

For this goal we explore the image for rows and coluumns.

Each pixel is processed only once.

We use only 4 neighboors (nord - west).

x_1	x_2	x_3
x_4	o	

This method is based in a chromatic distance

Parameters

- The input parameter is the noise tolerance.
- The output is the same that tha last two methods.

public ArrayList fastSegmentation2(double threshold, double Ap, double Bp, double Cp)

This method is more or less the same that the last one, but in this case we are going to use a hybrid distance. We'll have in account the neighboor chromatic information and the intensity information.

This method tray to answer how important is the chromaticy, how important important is the intensity and in what measurement.

Intensity is important for a correct edge detection in achromatic surfaces, then we'll use this information int he closest neighboors. By other hand Chromaticity is a photometric invariant, it's independent of the intensity and it's depend of the chromatic sourface properties. We'll take this information as a property of a region.

Each region is a chromatic homogeneous surface an represented by a label.

Intensity provide us a manner to close edde detection.

This ideas are expresed in the next sketch

I we name this function v and $\bar{v} = 1 - v$ then the hybrid distance is expressed with the bellow equation

$$hybridDistance = v * chromaticDistanceToLabel + \bar{v} * intensityDistanceToNeighboor$$

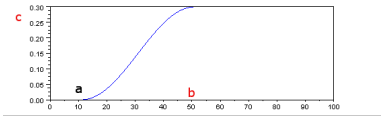

Figure 3: Hybrid distance function (a=.1, b=.5, c=1/3)

Parameters

- threshold for the noise
- a: minimum senosoidal parameter variation
- b: maximum senosoidal parameter variation
- c: maximum image value

Observations

1. if a =b=c=0 is the last segmentation method ... fastSegmentation(double threshold)
2. if a =b=0 and c=1 is a segmentation method using only the intensity
3. c express the default weight value for the intensity and chromatic distance

We must to experiment for detect correct input parameters (.012,.1,.4,.6) for example