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README - fe_region_growth.c

Electrical Subsystem

fe_region_growth ()

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Description:

The function is used to get the coordinates of the centroid of each star in the input image. Here, the portion that is classified as a star are the set of 4-connected pixels whose value is above a particular threshold.

The function **get_Data** is called within the fe_region_growth function and keeps track of the following information for a particular star:

- Weighted sum of x coordinates
- Weighted sum of y coordinates
- Sum of the pixel intensities
- Number of pixels the star is made of

Formula & References:

The centroid of a star is defined as:

$$(x_{centroid}, y_{centroid}) = \left(\frac{\sum_{p \in region} I_p x_p}{\sum I_p}, \frac{\sum_{p \in region} I_p y_p}{\sum I_p} \right)$$

where I_p is the intensity of the pixel and (x_p, y_p) are the coordinates of the pixel.

The algorithm searches from the top-left corner of the image and looks for a pixel whose intensity value is greater than the threshold, once it finds the first pixel, it calls the fe_get_data function, which gets the weighted sums of the x and y coordinates and the sum of pixel intensities required. Once it is doing getting that information for the whole image, it simply divides the numerator with the denominator in the equation shown above and gets the centroids. This algorithm is called the Region Growth Algorithm.[1]

Input parameters:

1. **arr_in_img** : (*short* 2D array) - input image, with pixel location wrt the top left corner as indices ([i, j]); and the reading at the corresponding pixel as the value stored at [i, j]
2. **arr_out_img** : (*short* 2D array) - input image padded with zeroes using the function *padZeroes()*.
3. **img_num**:(*unsigned short*) - variable to test the function on set of images.

Output:

1. **centroids_st**: (*double* centroids_st[MAX_STARS][3]) - the shape is (no. of stars, 3), with each row having format (Sr_{no} , x_{center} , y_{center}).

Remark: The function outputs the data in two .csv files for each test image. '**fe_rg_centroid_data.i.csv**' having row format(x_sum, y_sum, pixel_sum, num_pixels), '**fe_rg_centroids.i.csv**' having row format(ID, x_cen, y_cen) for i^{th} test image. Number of test cases can be modified by tuning 'n' in *int_main* function.

The simulation result(expected output) for each image can be found at following drive link:

<https://drive.google.com/drive/folders/113X9Li2ktrxWsYvD067Bnmny8t1lCSsF>

References

- [1] Alexander O. Erlank, *Development of CubeStar : a CubeSat-compatible star tracker*, 2013.