Computer Vision - Week 2 - Image Segmentation

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Image segmentation – the process of partitioning a digital image into multiple regions/ segments that represent objects or meaningful parts of objects.

Common Approaches to Segmentation:

* Edge-based method
* Region-based method

Other approaches:

* K-means, mean shift
* Energy minimization
* Deep learning

Edge Detection:

Edges correspond to large changes in intensity of neighbours pixels in at least one direction

Prewitt and Sobel are implementations of first order derivitate edge detection, in Sobel two masks are also used Gx and Gy but instead of using 1s and -1s, 1s and 2s are used to show significance of the pixel.

Laplacian is an implementation of a second order derivative of dege detection

Difference between first and second order, the second other provides thinner edges and better responds to fine details.

Noise removal: it is necessary to remove noise with derivative based methods because they are very sensitive to image noise. Therefore, you typically smooth an image to try to remove the noise before we apply edge detection.

One method of smooth is the Gaussian Filter. It is a standard smoothing method. The bigger the standard deviation used, the smoother an image would be. This can could be a reason for too much smoothing, resulting in images that are not sharp enough for edge detection.

Because edge detection is a convolution process, for each pixel we look at pixels along an area, therefore they take local measurements

What other methods of edge detection are there besides derivate based methods?

Advanced Boundary Detection

This not lonely looks at intensity, it also looks at other features such as texture and combines them together into one framework to form an edge group.

Boundary Detection

For every pixel in the image, we draw a circular disc and the radius of the disk is split into half along 6 directions. Calculate the three scales for the regions. The size of the disk and multiple scales are also considered along with multiple orientations.

Region Based Segmentation

Unlike edge-based region directly tries to detect regions

Active Contour Models(snake)

Edged based and region don’t work when dealing with objects of actively changing shapes such as live cells

It looks for any shape in the image that is smooth and forms a closed contour.

This becomes an optimisation problem

In order to find an object boundary, we initialise our curve close to the object boundary and then shape the curve to fit the shape of the object.

Modelling

Internal energy function. This does not relate to the image, they simply try to make the curve smooth. You want the minimal energy, the minimal derivative produces a smooth curve. The smoother a curve, the closer the fit would de to the object.

external energy function is derived from the image. It tries to push the image boundary towards the object boundary to make the curve fit the object.

K-means segmentation

The problem with this is that it can often get stuck in a local minimum

Mean shift segmentation

With mean shift you do not need to define the number of K clusters, this is automatically done.