SLIC（Simple Linear Iterative Clustering）

Simple Linear Iterative Clustering method, the so-called SLIC, is a state of the art algorithm to segment superpixels which doesn’t require much computational power. This algorithm clusters pixels by measuring the distance in the combined five-dimensional space, which involves L, a, b values from the CIELAB color-space and x, y coordinated of the pixels, to efficiently generate compact, nearly uniform superpixels. It has a different distance measurement which enforces compactness and regularity in the superpixel shapes, and can be used on grayscale images as well as color images.

**How this algorithm works**

SLIC takes a desired number of approximately equally-sized superpixels K as input, so each superpixel will have approximately N/K pixels. Hence, for equally sized superpixel, there would be a superpixel center at every grid interval K superpixel cluster centers with k = [1, K] at regular grid intervals S are chosen. Since the spatial extent of any cluster is approximately , it can be assumed that pixels associated with this cluster lie within 2S x 2S area around the superpixel center in the x-y plane.

Euclidean distances in CIELAB color-space are meaningful for small distances. If spatial pixel distances exceed this perceptual color distance limit, then they begin to outweigh pixel color similarities.

Distance measure Ds is defined as follows:

where is the sum of the lab distance and the xy plane distance normalized by the grid interval S. A variable m is introduced in Ds allowing us to control the compactness of superpixel. The greater the value of m, the more spatial proximity is emphasized and the more compact the cluster.

**Algorithm**

It begins by sampling K regularly spaced cluster centers and moving them to seed locations corresponding to the lowest gradient position in a 3 × 3 neighborhood. Image gradients are computed as:

Where is the lab vector corresponding to the pixel at position (x, y), and ||.|| is the L2 norm. This takes into account both color and intensity information.

Each pixel in the image is associated with the nearest cluster center whose search area overlaps this pixel. After all the pixels are associated with the nearest cluster center, a new center is computed as the average labxy vector of all the pixels belonging to the cluster. At the end of this process, it enforces connectivity by relabeling disjoint segments with the labels of the largest neighboring cluster.

