**Introduction**

The algorithm used in this code is the implementation of our paper [1] which was fulfilled in the Lab of Vision Engineering at the University of Lincoln (UK). It is a modification of the method Simple Linear Iterative Clustering (SLIC) which was proposed by Achanta *et al.* [2].

Our method is optimized for medical images such as MRI, CT, etc. The contributions of our codes compared to conventional 2D and 3D superpixel are as follows:

* Multi-modal input (works for single-modal, as well)
* Taking the spatial resolution of the medical images into account, i.e. the voxel resolution in X and Y directions and the slice thickness.

**Algorithms**

The algorithm has an iterative approach. In the first iteration, the geometrical centres of the initial grids are considered as supervoxel region centres. The mean value of the voxel coordinates inside the supervoxel provides the centre of gravity of that supervoxel.

In the consequent iterations, the locations of the centres of gravity are updated. The distance between each voxel in the dataset to the bounded cluster centres are calculated and then a label of the closest cluster centre is assigned to that target voxel. The final distance is comprised of both intensity and location distances.

The intensity distance, *dc*, is calculated by defining the intensity difference between the *i*th and the *j*th voxel according to the following formula:

|  |  |
| --- | --- |
| , | (1) |

where, *Ii* and *Ij* are the normalized intensity values of the *i*th and the *j*th voxel, respectively. The location distance, *ds*, between the two voxels is calculated as follows,

|  |  |
| --- | --- |
| , | (2) |

where (*,* , ) is the coordinate of voxel *I* and *Rx*, *Ry* and *Rz* are the voxel resolutions.

The distance measure [34] is then defined as,

|  |  |
| --- | --- |
| , | (3) |

where, *m*, is the compactness coefficient. A higher value of *m* results in more compact segments and a lower value creates more flexible boundaries.

The details of the algorithm are explained fully in our paper [1].

You can download a sample Multi-modal MRI file, which we used in the paper, from the following GitHub link:

If you are using this code please cite our paper which is the reference [1].

**References**

[1] Soltaninejad, M., Yang, G., Lambrou, T., Allinson, N., Jones, T.L., Barrick, T.R., Howe, F.A. and Ye, X., 2018. Supervised learning based multimodal MRI brain tumour segmentation using texture features from supervoxels. Computer methods and programs in biomedicine, 157, pp.69-84.

[2] Achanta, R., Shaji, A., Smith, K., Lucchi, A., Fua, P. and Süsstrunk, S., 2012. SLIC superpixels compared to state-of-the-art superpixel methods. IEEE transactions on pattern analysis and machine intelligence, 34(11), pp.2274-2282.