PIMA project M1 : Unsupervised segmentation on spinal and paraspinal regions

The lower part of the vertebrae is constituted by five interlocked bones and its referenced as lumbar spine. Due to its location, this part bears all the top part of the body weight and can be damaged. One of this damage is called the spinal stenosis which causes claudications and touch around 20% of elderly people. Half of these patients are disturbed in their daily routine and, some outcomes include a surgical intervention.

To characterize stenosis clinicians observe a deformation, nerve compression, obliteration degree of epidural fat, cross section area under 130mm^3, or texture alterations in muscular regions. Spinal and paraspinal region of interest annotations are still manual or supervised, which avoid to propose a fully automated characterization tool on these regions for stenosis.

However, plenty of unsupervised segmentation tools are existing in other domains In this project we will implement an unsupervised traditional segmentation approach which is called SLIC : simple linear iterative clustering superpixels [1] and compare with metrics its segmentation results on spinal and paraspinal regions on same images see [2, 3], with those from the use of a chosen unsupervised deep learning approach [4, 5].

If you are interested in this project please contact : clara.bremond@inserm.fr

References

[1] R. Achanta, A. Shaji, K. Smith, A. Lucchi, P. Fua, and S. Süsstrunk, "Slic superpixels compared to state-of-the-art superpixel methods," *IEEE transactions on pattern analysis and machine intelligence*, vol. 34, no. 11, pp. 2274–2282, 2012.

[2] R. Casey, B. Combès, F. Cotton, M. Dojat, M. Kain, A. Kerbrat, and S. Pop, "Multiple sclerosis spinal cord lesions detection from multisequence mris challenge (ms-multi-spine)," *International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI)*, 2025. [Online]. Available: https://doi.org/10.5281/zenodo.14051168

[3] F. Natalia, H. Meidia, N. Afriliana, A. S. Al-Kafri, S. Sudirman, A. Simpson, A. Sophian, M. Al-Jumaily, W. Al-Rashdan, and M. Bashtawi, "Development of ground truth data for automatic lumbar spine mri image segmentation," in *2018 IEEE 20th International Conference on High Performance Computing and Communications; IEEE 16th International Conference on Smart City; IEEE 4th International Conference on Data Science and Systems (HPCC/SmartCity/DSS)*, 2018, pp. 1449–1454.

[4] X. Mu, H. Qi, and X. Li, "Automatic segmentation of images with superpixel similarity combined with deep learning," *Circuits, Systems, and Signal Processing*, vol. 39, no. 2, pp. 884–899, 2020.

[5] X. Wang, J. Yang, and T. Darrell, "Segment anything without supervision," *Advances in Neural Information Processing Systems*, vol. 37, pp. 138 731–138 755, 2024.