Segmentation of pulmonary lobe from CT-Scan with medial/skeleton geometric data structure

Thomas Laporte and André Galligo
Université Côte d'Azur, CNRS, LJAD, Centre VADER, Nice, France
and Inria Sophia Antipolis - Méditerranée, Université Côte d'Azur, Sophia Antipolis, France
thomas.laporte@unice.fr,andre.galligo@univ-cotedazur.fr

For medical purposes, it is important to obtain an accurate geometry of the human lungs and more precisely of the lung lobes, which are subdivisions of the lungs by the fissures. Deep Learning methods already exist, generally using 3D segmentation algorithms, which are very demanding in terms of computing resources. It is, moreover, a rather complex task, as two lung lobes are very similar when looking at their signal emitted on CT-Scans, see the left figure below.

The lungs, as a whole, being easier to obtain, we based our work on this morphological structure which we combined with a medial/skeleton structure process. We then started by extracting the lung structures from the images, using a U-Net architecture method, which requires less computational resources. We have exploited this architecture on the 3 CT-Scan planes (axial, coronal and sagittal), to create a 2.5D segmentation algorithm.

The next step is to generate a lung skeleton database from these morphological structures, using a package from the CGAL library, and then train a classification algorithm to separate the lung skeleton into lobar skeletons.

From these lobar skeletons and the lung geometry, we can then reconstruct the morphological structures associated with the lobes.

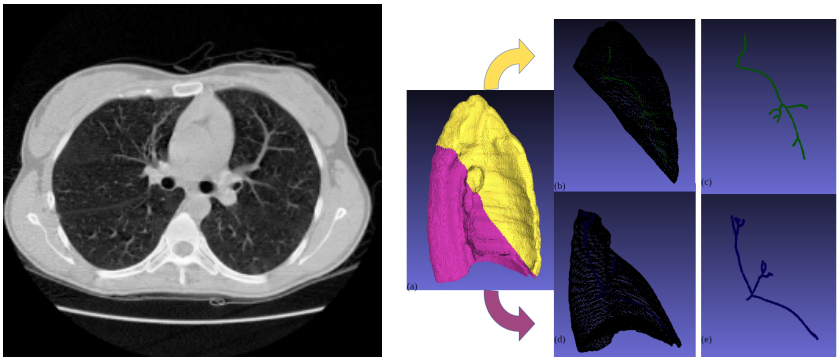

Figure 1: Left to Right : Axial slice of a CT-Scan, Method to extract skeleton from lobar meshes

References

[1] J. Damon. *Determining the boundaries of objects from medial data.* International Journal of Computer Vision, 63,2005, 45–64.

[2] Hao Tang and Chupeng Zhang and Xiaohui Xie *Automatic Pulmonary Lobe Segmentation Using Deep Learning.*, arXiv:1903.09879 (2019).

[3] Andrea Tagliasacchi, Ibraheem Alhashim, Matt Olson, and Hao Zhang *Mean curvature skeletons.* Computer Graphics Forum (Proceedings of the Symposium on Geometry Processing), 31(5):1735– 1744, 2012.