3D digital histopathology:a new methodology for the morphological characterization of the human liver

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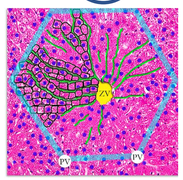
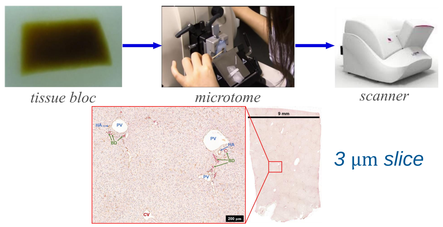
Introduction and Aims

2D histopathology is a common technic for the diagnosis and study of liver diseases as many of them are directly linked to structural disorders at the micro- and mesoscale. However, the complexity of *the liver organization* calls *for richer and more consistent data representation*, hence for *spatially resolved 3D visualization* and *analysis of histological images*. This analysis, called here **3D histopathology**, would enable **better understanding and earlier diagnosis of liver disorders**.

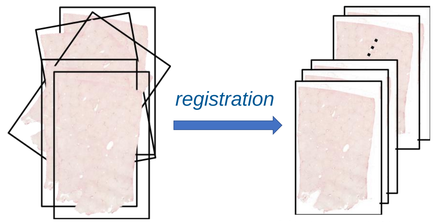


Method

1) Acquisition of 300 histological slices of a normal liver



2) 3D reconstruction using image analysis



Conclusions

1) 3D reconstruction at the micro- and mesoscale of a human liver piece ($14 \times 9 \times 1mm^3$) at high resolution ($0.12 \times 0.12 \times 3\mu m^3$).
2) Morphological and topological quantifications evaluated on a normal case can serve as *benchmark* for*:*
   - *Building a geometrical model of the human liver.*
   - *Linking 3D morphology to liver functions => easier discrimination of pathological cases.*
   - *Study of disease evolution.*

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Results

Main characterization

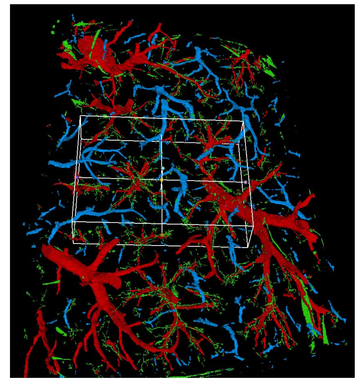
- 3D reconstruction of vessel/biliary networks, and of lobules at high resolution
- Morphological and topological analysis of the vessels
- Morphological analysis of the lobules (not shown here)
- Spatial analysis of the sinusoids

Clinical aspect

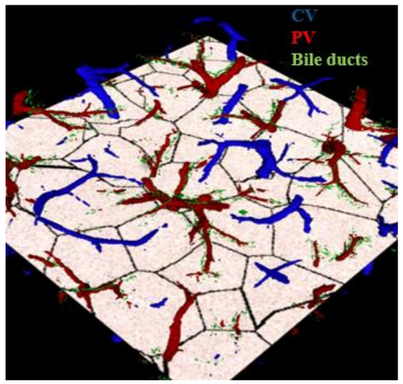
These quantification criteria were evaluated on a **normal tissue** which can serve as benchmark.

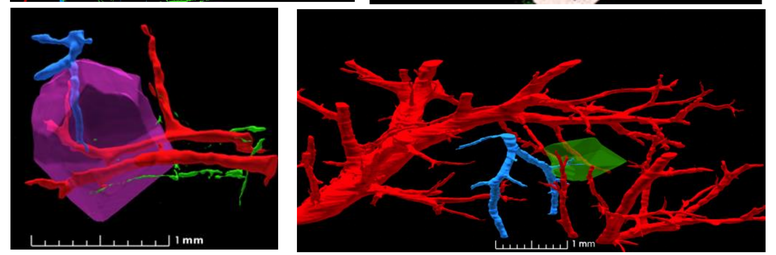
=> application on altered liver would give knowledge on liver diseases and its evolution.

Full volume reconstruction

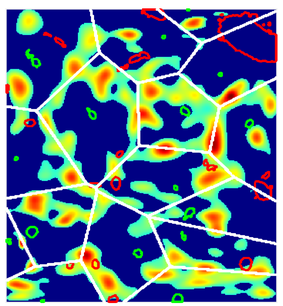


Lobule surface reconstruction on ROI

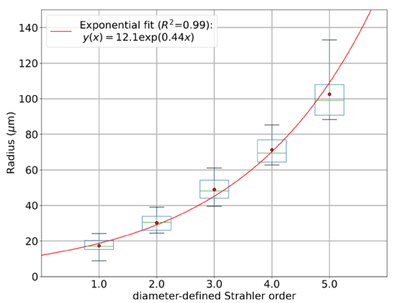




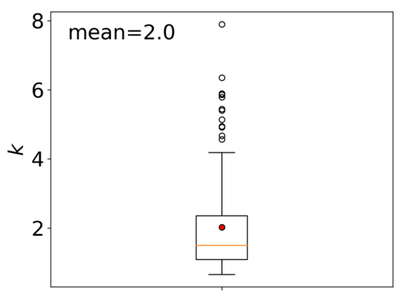
Example of 3D lobules and their surrounding



Spatial analysis of sinusoids orientation



(CV) Radius distribution with respect to ordering



Murray's law: $r_0^k = r_1^k + r_2^k$

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