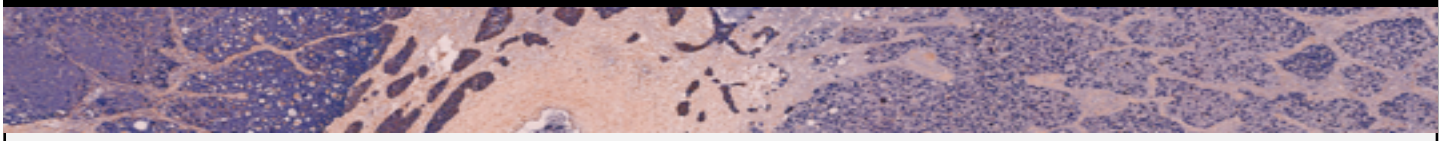
Student Project

Modeling the 3D Micro-Architecture of Lung Carcinoma

University of Zurich[UZH]



Topic

Lung squamous cell carcinoma (SCC) is the second most frequent histologic subtype of lung cancer displaying a frequency of 25% among all lung cancers. This subtype is morphologically characterized by cohesive tumor sheets showing various degrees of necrosis which are surrounded by a supportive matrix so-called stroma. Studying the 3D microarchitecture of such tumors is of great interest to investigate invasion modes and could be highly relevant to improve the current tumor classification system.

The aim of this project is to help model the 3D architecture and shape of human lung squamous cell carcinoma, as imaged by Propagation-Based Phase Contrast X-ray microscopy. For this purpose, two data sets consisting of more than 2000 consecutive 8 bits images along the z-axis are available. The most relevant tissue structures such as vital cells, necrotic cells and stroma are expected to be identified and segmented for visual morphological analysis. This would allow modeling the tumor invasion patterns.

Assignment

First, the data should be read slice-wise and preprocessed for noise and artifact removal. Next, relevant 3D descriptors will be investigated and tested. This can lead to a segmentation-based approach (where each pixel belongs to one category), or to a transformation where each voxel is mapped to one or few scalar values that provide an easy and direct illustration of the distribution of each category across the region (e.g. RGB values). The student will then help evaluate the perceptual quality of the results by performing a 3D visualization where relevant region morphology should be easily observable. A quantitative evaluation of the descriptors is also possible, if ground-truth data is manually annotated. Interesting software choices for the project include ImageJ, Fiji, MATLAB and its image processing toolbox, etc.

Requirements

Experience on image or volume processing techniques. Having notions on pattern recognition and/or machine learning and related software packages would be beneficial.

Work Load

- 20% theory
- 50% implementation
- 30% testing

Project Type

Varying the focus of methodical analysis, implementation and testing, this project can fit into a Vertiefung, Facharbeit, SW Project or Thesis work. Goals will be adjusted depending on the project type.

Supervision

Prof. Dr. Renato Pajarola
Prof. Dr. Alex Soltermann
Rafael Ballester (Assistant)
Ruben Casanova (Assistant)

Contact

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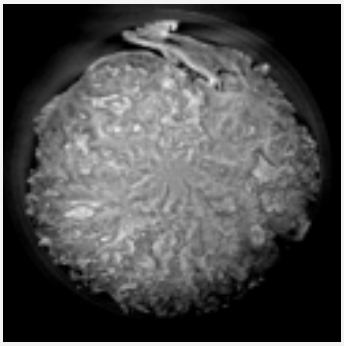
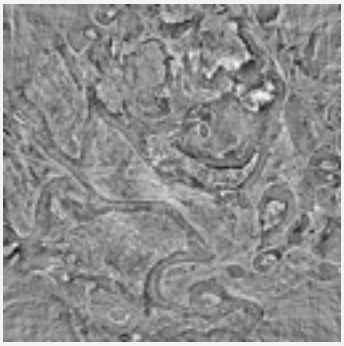
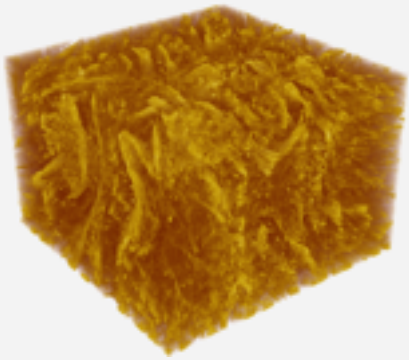




Two sample slices from lung SCC



Tumoral zone 3D visualization

Images are courtesy of Paul Scherrer Institute (Prof. Stampanoni)

VISUALIZATION AND MULTIMEDIA LAB

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