Post-doctoral position
Computer vision and machine learning for the classification of colon's wall from fluorescent microscopy imaging

1 year available as soon as possible. Candidate before 15th November 2016.
Funded by LABEX PRIMES (http://primes.universite-lyon.fr/) : 2100 euros per months
Contact : david.rousseau@univ-lyon1.fr

Context: We consider the biomedical problem of the classification of the health state of Colon's wall from fluorescent microscopy. As visible in Fig. 1, these are scenes constituted by underlying structural vascular networks. A strong prior that we propose to investigate is that the inflammation process occurring before and during the development of cancer leads to the progressive opening of the crypts that constitutes these networks. The extraction of information from such networks requires image processing methods specifically designed to preserve the topological structure of the network hidden in the image. In this context, graphs appear as an adapted representation either to guide image processing or to characterize the topology of the underlying structural network.

Keywords: Image processing, Machine learning, Graph theory, Fluorescence microscopy.

Objective: In human technologies, the topology and data produced by networks are mostly directly accessible because they are manmade. By contrast in life science, information concerning structural networks are to be extracted first before being accessible to the analysis. To the best of our knowledge, jointly addressing graph characterization and image segmentation to preserve the extracted graph topology is currently not realized. Among possible original contribution on this subject, we propose to develop a robust joint segmentation and graph-based representation; We will test different segmentation strategies with the integration of a term quantifying the quality of the extracted graph. The proposed method relates, in the closest computer vision literature, to the so-called Maximally Stable Extremal Region that we propose to extend to extremely stable graph. The idea is then to determine either from human expertise selection or from machine learning the optimal graph metrics that optimally address the classification of colon's wall health state.

Data: the classification of colon's wall health state will be considered at various scales and with various imaging modality. This includes fluorescent video endoconfocal microscopy, recent fluorescent multiphoton microscopy, or also standard reflectance chromo endomicroscopy with applications on mice and on human.

Scientific environment: the work will be realized at CREATIS **(https://www.creatis.insa-lyon.fr),** which is a 200 staff lab dedicated to biomedical imaging and image processing**,** under the supervision of David ROUSSEAU, Professor in image processing, Carole FRINDEL, Associate Professor in image processing and in close collaboration with Raphaël SABLONG, Driffa MOUSSATA (specialist in instrumentation and biology of the colon [1], CREATIS, Université de Lyon), Christian WOLF (specialist in graph[2] and machine learning [3] LIRIS, Université de Lyon) and Maximillian WALDNER [(specialist instrumentation and biology of the

colon [4], University Erlangen, Germany).

Candidate: highly motivated PhD scientists with excellent knowledge on image processing, interest in life sciences applications should contact David ROUSSEAU before the 15th of November 2016 with CV and motivation letter. Additional background on graph theory or machine learning would be appreciated.

Developed skills: networks are everywhere in life sciences (think for instance to root systems in plants, neuronal networks in brain, microstructure in bones, …) the methods developed during the project will therefore be of high genericity for the characterization of biological networks via bioimaging.

[1] Publications David ROUSSEAU on Googlescholar :
https://scholar.google.fr/citations?hl=fr&user=33IO_m4AAAAJ&view_op=list_works&sortby=pubdate
[2] H. Dorez, R. Sablong, L. Canaple, H. Saint-Jalmes, S. Gaillard, D. Moussata, and O. Beuf, "Endoluminal high-resolution MR imaging protocol for colon walls analysis in mouse model of colitis", *MAGMA*, In Press (2016).
[3] Oya Celiktutan, Christian Wolf, Bülent Sankur and Eric Lombardi. Fast Exact Hyper-Graph Matching with Dynamic Programming for Spatio-Temporal Data. In Journal on Mathematical Imaging and Vision, pp. 1-21, 2015.
[4] Mingyuan Jiu, Christian Wolf, Graham W. Taylor and Atilla Baskurt. Human body part estimation from depth images via spatially-constrained deep learning. In Pattern Recognition Letters 50(1):122-129, 2014.
[5] Waldner, M. J., Wirtz, S., Neufert, C., Becker, C., & Neurath, M. F. (2011). Confocal laser endomicroscopy and narrow-band imaging-aided endoscopy for in vivo imaging of colitis and colon cancer in mice. *Nature protocols*, *6*(9), 1471-1481.

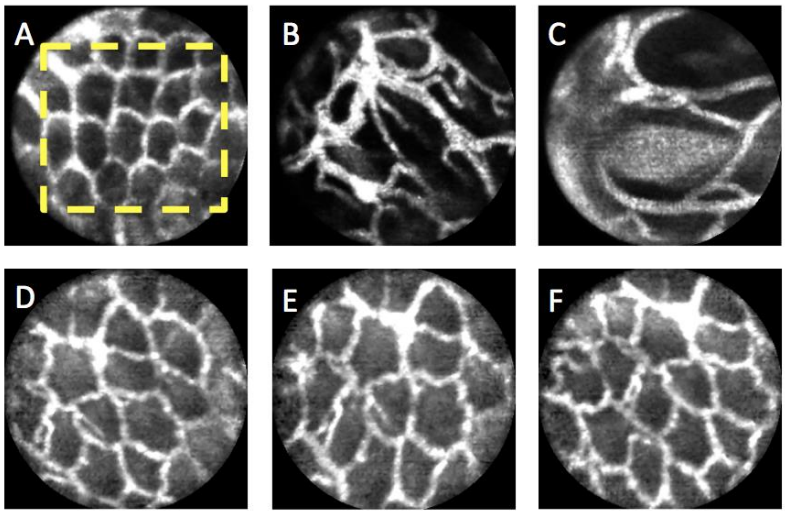

Fig. 1: various images of colon's wall from endoconfocal microscopy acquired at CREATIS following the protocol of [5] A, D, E and F healthy states. B inflammated. C cancer. D, E and F acquired at the same location at different times. The objective is to robustly classify images of type A, B and C.