



Development of an automatic approach for biomarker scoring : application to breast cancer

Contract : Post doctoral position for 1 year

Project : EUR EIPHI (<https://gradschool.eiphi.ubfc.fr>)

Location : FEMTO-ST institute (UMR CNRS 6174), AS2M departement, PHM team,
Besançon, France

Starting date : 01/10/2020

Grant : Region Bourgogne Franche-Comté & EIPHI

About FEMTO-ST

FEMTO-ST Institute specialty is to associate "Science and Technologies of Information and Communication" with "Sciences for the Engineer". FEMTO-ST's research can be fundamental or applied, and regularly produces a socio-economic impact in sectors of activity such as energy, transportation, health, telecommunications, space, instrumentation and metrology, clock and watch making and luxury goods. The institute is supported by high-level technologies, equipment and platforms, particularly the micro-/nanotechnology center MIMENTO (micro-fabrication for mechanics, nano-sciences, energy and optics) which is included in the national network CNRS RENATECH.

About PHM team

The scientific corpus of the Prognostics and Health Management (PHM) team is the development of advanced algorithms for diagnosis, prognosis and decision-making. The team's three themes rest upon what are, in fact, the main pillars of the PHM domain : pre-processing of data, diagnosis and prognostics guided by data and the decision process. Applications are related to industrial and medical fields.

Context of the work

Breast cancer is the first woman cancer with 2.1 million new cases in 2018 worldwide and with 58,968 new cases diagnosed in France in 2017. Early detection leads to a cure in more than 90% of cases. Decisions concerning the choice of the treatment for a patient are sometimes complex. This decision may differ from one practitioner to another depending on the diagnosis approach, which is based on a set of data (information and measurement). These data may be subjected to uncertainty.

We are interested in studying the biomarker Ki-67, which seems to be a potential prognostic factor. The Ki-67 measurement is a continuous variable, expressed as the ratio of the number of positive nuclei over the total number of nuclei. The Ki-67 is counted manually by pathologists using the scanned whole slide image. The scoring is based on at least three different region of intersets representing the area of highest density of Ki-67 positive tumor cells (hot-spots) and two areas of medium density of Ki-67 positive tumor cells for a total of more than 1000 malignant cells. The reliability of the Ki-67 scoring depends on the quality of the sampling process and the biopsy digitization.

Objectives

The goal of the postdoctoral position is to (i) develop a counting approach based on on deep neural networks and machine learning tools in order to improve the accuracy of Ki-67 labeling score, (ii) include expertise in the development process, (iii) deal with the problem of data quality, (iv) automate the counting process to help pathologists at HNFC in the diagnosis process.

References

- [1] SAHA, Monjoy, CHAKRABORTY, Chandan, ARUN, Indu, et al. An advanced deep learning approach for Ki-67 stained hotspot detection and proliferation rate scoring for prognostic evaluation of breast cancer. *Scientific reports*, 2017, vol. 7, no 1, p. 3213.
- [2] CIREAZAN, Dan C., GIUSTI, Alessandro, GAMBARDELLA, Luca M., et al. Mitosis detection in breast cancer histology images with deep neural networks. In : *International Conference on Medical Image Computing and Computer-assisted Intervention*. Springer, Berlin, Heidelberg, 2013. p.411-418.
- [3] Thakur SS, Li H, Chan AM, Tudor R, Bigras G, Morris D, Enwere EK, Yang H. The use of automated Ki67 analysis to predict Oncotype DX risk-of-recurrence categories in early-stage breast cancer. *PLoS one*. 2018 Jan 5 ;13(1) :e0188983.

Keywords

Diagnosis, Breast cancer, Decision-making, Digital pathology, Artificial intelligence.

Candidates profile and skills

- PhD degree in applied mathematics, machine learning, computer vision or related field ;
- Solid programming skills (Python, C++, Matlab) ;
- Autonomous and motivated ;
- Good communication skills (spoken and written) in English.

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