Selective cell nuclei detection from histopathological images and deployment on many-core architectures

D. Béréziat, P. Fortin, J.-L. Lamotte

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Context

This research is concerned by the grading of the breast cancer from histopathological images. These images are acquired by a microscope coupled with a CCD sensor from histological slices and have a very high resolution. The first step of a grading process is to segment the nuclei cells, in order to detect and enumerate the ill cells. As these images are very large (more than 25×10^8 pixels), the computational cost of segmentation methods used becomes critical. Moreover, the final objective being the breast cancer grading, the retained segmentation algorithm has to give accurate and robust results. In collaboration with IPAL[1], one algorithm has been selected as a possible good candidate to perform the segmentation task. This method is based on active contours associated to a marked point process to determine the initial contours. A stochastic death and birth process is also introduced to deal with the variable number of regions to segment.

Objectives

The main objective of this research is an effective and operational implementation of the segmentation algorithm on many-core architectures. The first step is probably a direct implementation of the algorithm on GPUs and/or on multicore CPUs. As explained below, the quantity of data to process is very large and the first implementation will probably not reach real time processing. The challenge is then to propose an algorithm which respects the segmentation objectives, and which can be efficiently deployed on the massively parallel and (partially) vectorized architectures of GPUs and/or multicore CPUs, in order to reach a real time execution.

Several strategies should be examined.

1. To reduce the quantity of data to be processed: only a small part of image data is relevant for the cell nuclei segmentation issue. A pre-processing should be applied to eliminate irrelevant areas.
2. One stage of the proposed algorithm makes use of active contours (snakes): we propose to investigate the choice of geodesic contours in order to have coarse grain, parallel and regular computations.

Desired skills

- basic image processing,
- skills in parallel algorithmics and parallel programming (on GPU and/or on CPU) will be considered as assets,
- numerical analysis (approximation of PDEs in finite difference),
- knowledge in probabilities.

[1] `http://ipal.i2r.a-star.edu.sg/`

Among the desired skills enumerated above, strong skills are required in image processing or in parallel computing.

Conditions

This post-doctoral research will be led in the PEQUAN[2] team (LIP6/UPMC) during **12 months** and is supported by the ANR MICO (TecSan 2010 program). Net salary is 1800 euros per month. Starting date is expected in Autumn 2011.

Applicants are invited to send a full curriculum vitæ (including list of publications, title and summary of PhD Thesis, PhD referee reports, and eventually post-doctoral researches), a cover letter, and a contact information of two possible references to:

- Dominique.Bereziat@lip6.fr
- Pierre.Fortin@lip6.fr
- Jean-Luc.Lamotte@lip6.fr

Candidatures will be examined after mid-August.

[2] http://www-pequan.lip6.fr