Title: Development of a new classification algorithm for hyperspectral imaging of skin erythema following radiotherapy

Research team: Ayin

Abstract:

Radiotherapy is one of the most common treatments for malignant tumors. The diagnosis and tumor location are usually defined by MRI or CT, while high energy photons are delivered, from multiple directions, to the targeted volume to damage the tumor cells. The radiation doses should be optimally chosen to maximize the radiation response of the tumor, while minimize damage to collateral normal tissue. A wide intra- and inter-patients variation in radiotherapy response has been observed for the same dose due to a number of factors including: tumor size, disease stage, oxygenation, interstitial fluid pressure, etc. Since many of these factors cannot be accurately estimated, current radiation treatment is not optimized for individual patients. Tumor morphology change and blood tests are used to determine radiation response in individual patients. However, these are long term (a few weeks to months) physiological changes hence usually not sufficient for effective treatment optimization.

Radiation exposure to skin causes a reaction know as erythema, which displays as skin redness change within a few days after radiation. Skin erythema has been reported to correlate to individual patient response to radiation. Upon visual examination, a qualitative score can be assigned by the oncologists to characterize this erythema which then being used for assessing radiation response. Nevertheless, the clinical assessment of redness is not a quantitative measure and subjective.

In the past decade, significant progresses have been made in optical imaging instrumentation and image pattern recognition and classification.

The aim of this Master internship is to develop one hyperspectral image processing algorithm that can precisely quantify skin erythema and identify optical features that closely correlate to radiation response. The intern will compare MAD algorithm from Sylvain Prigent at al. [1,2] with PLS algo [3,4] or a variant of it to be able to select the best method according to some criterion to be chosen.

Bibliography:

1 - Estimation of an optimal spectral band combination to evaluate skin disease treatment efficacy using multi-spectral images.

S. Prigent, D. Zugaj, X. Descombes, P. Martel and J. Zerubia. In Proc. IEEE International Conference on Image Processing (ICIP), Brussels, Belgium, September 2011.

2 - Multi-spectral Image Analysis for Skin Pigmentation Classification.
S. Prigent, X. Descombes, D. Zugaj, P. Martel and J. Zerubia. In Proc. IEEE International Conference on Image Processing (ICIP), Hong-Kong, China, September 2010.

3 - Partial Least Squares (PLS) methods for neuroimaging: A tutorial and review. A. Krishnan, L. J. Williams, A. R. McIntosh and H. Abdia, in NeuroImage, Vol 56, Issue 2, pp 455-475, 2011.

4 - Simultaneous dimensionality reduction and human age estimation via kernel partial least squares regression. G. Guodong and G. Mu. In Proc. IEEE Conference on Computer Vision and Pattern Recognition (CVPR), pp 657-664, 2011.

Profile of the candidate: The ideal candidate should have knowledge of image processing, computer science or bio engineering, and applied mathematics, and be able to program in C++ and Matlab. He or she should speak English quite fluently, French is not necessary but will be appreciated.

Duration: The duration of the internship will be six months.

Place of work: AYIN Team at INRIA-SAM in France (near Antibes) with a short stay at McMaster University, Hamilton, Ontario, Canada.

Amount: around 440 euros per month (according to INRIA rules)

PhD continuation: possible if good results are obtained.

Contact person:

Dr. Josiane Zerubia
Head of Ayin research group
Josiane.Zerubia@inria.fr
http://www-sop.inria.fr/members/Josiane.Zerubia/index-eng.html
Phone: +33 (0)4 92 38 78 65
Fax: +33 (0) 4 92 38 7643

Web-page of the team:
see https://team.inria.fr/ayin/