Multimodal Medical Image Registration for Fusion

Research group
The internship will be done in collaboration of two groups: SIMO (LISSI, UPEC) and A3SI (LIGM, UPEM). The SIMO group is particularly working on image analysis, segmentation, characterization, registration and optimization problems for biomedical applications. The A3SI group is working on mathematical morphology, data analysis and convex optimization methods. Moreover, the radiologists will provide medical and clinical expertise.

Research context
Recent advances in medical image acquisition, processing and data analysis have resulted in an explosion of the use of multi-modal images (PET, CT, MRI) in the clinical context. Information contained in such data is of high importance for many tasks, such as tumour heterogeneity analysis [1]. Moreover, the integration of images from multiple sources and/or protocols provides complementary information and thus increase the accuracy of the overall decision making process in tumour imaging. For overall patient management, PET provides functional information, while MRI and CT provide anatomical information with MRI providing opportunities for different modalities complementary to PET. The main challenge consists of learning and visualizing representations from the multi-modal data [2].

Proposed research topics
In this internship, we will address the co-registration of multi-modal images for their further fusion. See Fig.1 for an illustration of multi-modal image fusion. Secondly, the registered multi-modal data will serve for anatomical and tumour segmentation [3]. Finally, the image fusion will be investigated for its clinical value in tumour diagnosis to reduce uncertainty and minimize redundancy while preserving all the useful information from the source images.

The registration will be performed with the library Elastix (http://elastix.bigr.nl/wiki). The segmentation.

![Image](image_url)

*Figure 1. a) PET-CT fusion. b) CT. c) PET-MRI. d) MRI.*

Required Skills
- Background in image and signal analysis
- Programming skills (MATLAB, Python, C++)
- Proficiency in English or French (oral and written)
Supervisors
Olena Tanchyevych (LISSI, UPEC), Giovanni Chierchia (LIGM, ESIEE Paris), Hugues Talbot (LIGM, ESIEE Paris).

Additional information
The duration of the internship is 6 months, possible start is between February and April 2017. The salary is around 500 euros.

Applicants should send their CV to: giovanni.chierchia@esiee.fr and olena.tankyevych@u-pec.fr.

References
