Signal and Image Processing Laboratory (LTSI - INSERM U1099)  
Rennes, FRANCE  
Postdoctoral position:

Image-Guided Adaptive Radiation Therapy (IGART) in prostate and Head-and-Neck cancer

Context:
The goal of highly conformal radiotherapy (such as intensity modulated RT, IMRT) is to deliver a high dose to the tumor to increase the local control, while limiting strongly the irradiation of the organs at risk (OAR), to minimize the toxicity. The treatment is classically planned using a unique CT scan, then is typically fractionated into 30 to 40 daily treatment for 7 to 8 weeks, using the same pre-treatment irradiation plan. In prostate cancer IMRT, the OARs, namely the rectum and bladder, are, however, subject to large deformations, leading to, in one hand displacements of the prostate and therefore a risk of overdose of the tumor and, in other hand, discrepancies between the planned dose distribution and that which is actually received and therefore a risk of overdose. This may consequently expose the patient to an increased risk of recurrence and toxicity. In the context of locally advanced head and neck tumor IMRT, the main anatomical variations occurring during the 7 weeks of treatment are tumor shrinkage, decreasing of the parotid gland volume and weight loss, leading to overdose the parotid glands and increasing the risk of xerostomia.

Recently-developed concepts of image-guided adaptive radiotherapy (IGART) could lead to improved matching between planning and treatment by considering a possible treatment replanning, prior to a new fraction delivery. In a personalized adaptive treatment, the key is then to determine which criteria should trigger a replanning. For example, to determine if replanning is required, the dose actually received by the tissues could be monitored during the treatment course. This is a critical issue, relying on the capability of tracking the tissues appearing on the planning CT on each CBCT scan, in order to estimate the actual dose distribution in the frame of reference of the planning CT. This tissue tracking can be performed by nonrigid image registration. The LTSI has proposed and evaluated a dose monitoring method in the context of prostate treatment [1]. However, other criteria may be considered, such as anatomical variations.

Goals:
In the context of Image-Guided Adaptive Radiation Therapy (IGART) of prostate and head-and-neck cancer, the main goals of this postdoctoral position are:
(i) to adapt the dose accumulation method proposed in [1] to Head-and-Neck images and to perform its evaluation;
(ii) to propose and to evaluate methods to help for the decision in an adaptive RT workflow (decision based on accumulated dose, geometrical features...).
The methodological aspects of this work will be related to image registration of deformable organs, geometric features extraction and decision-making aid.
The Postdoctoral fellow to be recruited will integrate the IMPACT team of the LTSI and will work in close collaboration with the clinical centre “Centre Eugène Marquis”. The LTSI (ltsi.univ-rennes1.fr) is conducting research in biomedical engineering at the interface of Health, ICT and Integrative Physiology. A large number of data will be used from prospective randomized studies, for both prostate (STIC-IGRT P) and head and neck cancer (ARTIX).
**Required skills:**
PhD. in Computer Science, Applied Mathematics, Medical Imaging, Biomedical Engineering or related areas
Main areas: Image processing, image registration
Good programming skills: C/C++, ITK/VTK
Good communication skills (English)

**Applications and more information:**
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**References:**