Mid-Term Report Summary - CU-ANGIO (Prostate cancer localization by contrast-ultrasound angiogenesis imaging)

The CU-Angio project focuses on the diagnosis and localization of prostate cancer by dynamic contrast enhanced (DCE) ultrasound (US) imaging. To this end, novel contrast ultrasound dispersion imaging (CUDI) has been developed. The dispersion kinetics of ultrasound contrast agents (UCAs) transported by the blood stream through the microvascular bed reflects the underlying microvascular architecture, highlighting those structural changes due to cancer angiogenic processes. CUDI was originally implemented in 2D estimating UCA dispersion by fitting a solution of the convective dispersion equation, the modified local density random walk model, to the time intensity curves (TIC) measured by DCE-US imaging at each pixel in the prostate.

In this first half of the project, the fitting algorithm has initially been improved by use of a maximum likelihood approach based on a probabilistic characterization of the measured signals and noise, then the method has been revolutionized by exploiting the available spatiotemporal information through assessment of the similarity between neighboring TICs as a novel estimator of dispersion. Linear and nonlinear similarity measures have been investigated with promising results for prostate cancer localization in 24 patients as compared to histological results following radical prostatectomy. In order to enable accurate validation, a dedicated algorithm was developed to perform automated 3D registration of histological and 2D DCE-US data. More recently, based on two initial acquisitions, extension of CUDI to full 3D DCE-US data has been demonstrated, and preliminary results on 3D linear and nonlinear similarity presented.

The innovative option of replacing transrectal with transabdominal DCE-US imaging has also been successfully investigated. Moreover, dispersion imaging has been extended to DCE-MRI, confirming the model validity and providing new models that will help describing the binding kinetics of novel UCAs that are targeted to angiogenic expressions.

New ethical approvals have permitted extending our network to three hospitals, which have already collected an extensive CUDI dataset for future validation.

Here a link to our website where you can find detailed information about our research:

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