MASTER Research Internship
2019-2020

Period : February 2020 until end of July 2020.

Laboratory : CREATIS

Team : NMR and Optics

Supervisors : Kevin TSE VE KOON (kevin.tsevekoon@creatis.univ-lyon1.fr)

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Title : **Evaluation of optical and mechanical properties of tissues by multimodal MRE and Optical imaging.**

Context: The team MRI and Optics in CREATIS laboratory has a long expertise in the evaluation of optical and mechanical properties of tissues. We develop magnetic resonance elastography (MRE) to assess mechanical properties of tissues. We also develop optical diffuse imaging to assess optical properties of tissues in vivo. The team has an experience in multimodality imaging in particular for photoacoustic and MRI/optics methods.

Summary: Assessing optical and mechanical properties of tissue in vivo is a hot topic in medical imaging community. Indeed the multiscale understanding of cell to tissue links is a key point to define robust quantitative imaging biomarkers. This is mandatory to develop new clinical medical imaging devices. The mechanical and optical behaviors of tissue are very rich and yield intrinsic imaging contrast. Moreover, they are intricated in numerous multimodal-imaging techniques. Mechanical properties assessed by optical means has been recently proposed in particular applications in ophthalmology and oncology [1]. However imaging deeper the tissue is still an open issue and acousto-optics [2] which combines optical imaging and ultrasonic ‘tagging’ is a promising technique with this respect. Studies have also been devoted to the effect of transient shear waves on the measured optical speckle pattern [3]. The shear wave resulted from the acoustic radiation force during a short burst of focused high intensity ultrasound.

The present work is focused on reproducing numerical results of the above-mentioned experiment and to explore the feasibility of using continuous unfocused shear waves in view of measuring mechanical and optical parameters of tissues.
The candidate will work on the development of Monte-Carlo simulations of light propagation in an optically diffusive medium while integrating continuous shear waves propagating within while exploring the potential added-value.

[1] : B.F. Kennedy, P Wijesinghe, DD Sampson, Nature Photonics 11, 2017
[2] : D.S. Elson et al., Interface Focus 1, 632–648, 2011
[3] : E. Bossy et al., App. Phys. Lett. 90, 174111, 2007