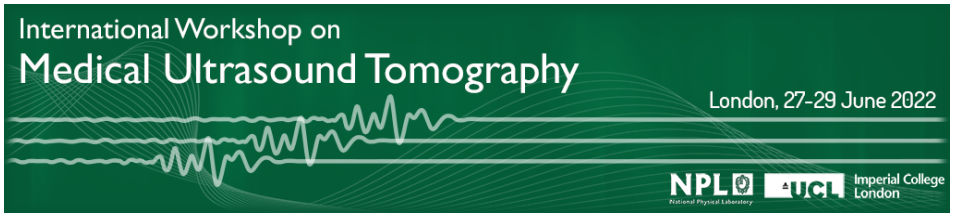

Contribution ID: **34** Type: **not specified**

Multimodality imaging for preclinical oncology applications using a PET registered Ultrasonography (PETRUS) device

Tuesday, June 28, 2022 3:20 PM (20 minutes)

PETRUS (Positron Emission Tomography Registered with Ultrasonography) [1-3] is a new hybrid in vivo imaging instrument ideally suited for the development of preclinical oncology applications using laboratory rodents. This device allows for the simultaneous monitoring of several major cancer hallmarks, in particular proliferation, dysregulation of glucose metabolism, changes in tissue composition, and angiogenesis. For this purpose, PETRUS employs Positron Emission Tomography (PET) to study glucose metabolism dysregulation, Computed Tomography (CT) to study tumor morphology, and Ultrafast-Ultrasound-Imaging (UUI) to (i) analyze the vascular architecture by Ultrasensitive Doppler [1], (ii) obtain local sound speed (SS) maps and (iii) elasticity maps to characterize tissue composition by analyzing speckle pattern disparities in ultrafast B-mode multi-angle planar sequences. In this work, we describe the methods developed for the ultrasonic component of PETRUS, applied to the study of a mouse model of paraganglioma tumors (using n=3 mice).
The ultrasound component of PETRUS consists of a clinical UUI scanner (Aixplorer, Supersonic Imagine, France) connected to a a custom-made ultralight probe (Vermon, France) with 15 MHz central frequency, 128 transducer elements and 100 µm pitch. The probe is attached through a 35 cm long hollow carbon arm (Polyplan Composites, France) to a six-degree-of-freedom high-precision micromotor (Hexapod H811, Physik Instrumente, Germany) to operate inside the PET/CT gantry.
To obtain the SS volumes, planar sequences at -5/0/5 degrees were repeated in each transverse plane of the tumor using the robot. Acquisitions were launched during the animal's respiratory pause, using an external monitor. Speckle tracking between the acquired planes was performed using a mixed optical-flow and local-phase algorithm. An iterative algorithm was applied to minimize the disparity between the speckle locations by varying the local SS map during the beamforming algorithm employed, which consisted of a delay and sum method, with heterogeneous SS map. The elasticity maps were obtained using micro-vibrators controlled with a pulse generator and tissue deformation analysis. The Doppler maps were obtained by means of the ultrasensitive Doppler technique using spatiotemporal filtering by singular value decomposition [1].
Fig.1 shows a fusion of Bmode-Ultrasensitive-Doppler-SS in a cross-section of the tumor. All parameters obtained are being analyzed for tumor phenotype characterization. This may be crucial in redefining or confirming treatment or elucidating the best time to combine different precision medicine drugs.
[1]Provost et al., Nat.BE 2018;[2]Pérez-Liva et al.,MIB 2020;[3]Facchin et al.,Theranostics 2020.

Preferred Contribution Type

Presentation

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