

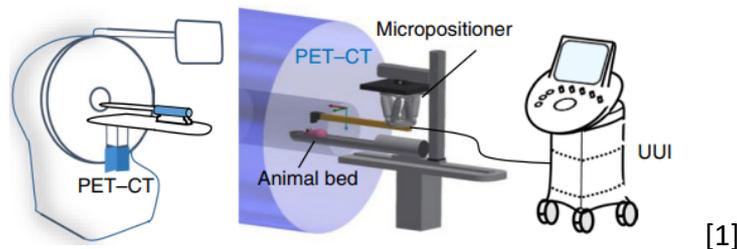
## High-precision Ultrasonic probe positioning in PETRUS multimodal imaging

**Professional domain:** In vivo Imaging / Computer Science

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**State of the art & rationale:** PETRUS is the first implementation of simultaneous multimodal analysis to explore the topographic relationship between tumor vascularization and metabolism by Positron Emission Tomography–Computed Tomography– Ultrafast Ultrasound Imaging examinations on animal models [1, 2]. However, the examination of smaller microstructures requires a faster acquisition and higher precision probe positioning obtainable through the optimization of the coupling positioning elements [2]. The expected design is centered around a Hexapod 6-Axis Parallel Robot with a 40 nm actuator resolution, a nanoScan PET/CT scanner and a Verasonics Vantage Research Ultrasonic System.



### Methods and tools:

The selected candidate will oversee two major tasks with emphasis on the first one: (i) The optimization of the probe positioning and ultrasound acquisition system. Particularly in the discrete control and redesign of the coupling and supporting parts of the positioning structure and (ii) the acquisition and register pipeline implementation with the Verasonics system using high frequency ultrafast probes.

### Role of the student / Main tasks:

- DESIGN AND MANUFACTURING: CAD utilities; additive manufacturing.
- ROBOTICS: Inverse and forward robot kinematics, structural analysis and simulation.
- PROGRAMMING: MATLAB
- ULTRASONIC IMAGING: Ultrafast ultrasonic imaging, MATLAB.
- COMPUTER VISION: Multimodal registration.

### Anticipated outcomes and potentials:

- Positioning system load and kinematic analysis.
- Revised conception of the ultrasonic positioning system.
- CT-based probe position tracking.
- Ultrafast ultrasonic acquisition and registration to the PET/CT data

### References:

- [1] Provost, Jean, et al. "Simultaneous positron emission tomography and ultrafast ultrasound for hybrid molecular, anatomical and functional imaging." *Nature biomedical engineering* 2.2 (2018): 85-94.
- [2] Perez-Liva M, Viel T, Yoganathan T, et al. Performance evaluation of the PET component of a hybrid PET/CT-ultrafast ultrasound imaging instrument. *Physics in Medicine & Biology*. 2018; 63: 19NT01.