

Functional Decomposition

Needs Statement: There is a need to clearly identify the boundary between the rhabdosphincter and the prostate in patients undergoing radical prostatectomies to reduce the severity of post-procedural urinary incontinence.

Solution: A device to clearly identify the boundary between the sphincter and the prostate to guide surgical incisions during radical prostatectomies using robotic surgery techniques

1. **Measurement** of mechanical stiffness of a medium
 - a. Conversion of force into an electrical signal
 - b. Sensor sensitivity required to detect differences in media with mechanical stiffnesses that correspond to the sphincter and prostate
2. **Differentiation** between the two anatomical structures through detecting differences in mechanical stiffness
 - a. Processing and analysis must translate raw data into measurements representing stiffness
 - b. Robust signal processing required to differentiate small local inhomogeneities and variations from change of medium
3. **Identification and registration** of the location of the boundary between the two structures
 - a. Choice of sensors and configuration must be able to achieve desired spatial resolution
 - b. Processing of raw data originating from multiple measurements taken by the probe along the surface
 - c. Analysis of raw sensor data must be able to provide the spatial location of the boundary
 - d. Provision of a notification for when a boundary has been definitively identified
4. **Detection** of the position of a surgical tool relative to the boundary
 - a. Processing must successfully triangulate the surgical tool's relative position to the boundary
 - b. Real-time measurements and processing is necessary
 - c. Choice of sensors and configuration must be able to match the spatial resolution of the boundary
5. **Provision** of visual feedback to guide surgical incisions towards the boundary
 - a. Real-time processing of data relating to the relative position between the surgical tool and the boundary
 - b. Integration with robotic surgery unit
 - c. Easy for surgeon to view and understand

