

Targeted Prostate Biopsy Using Mathematical Optimization

Drs. Christos Davatzikos and Dinggang Shen, and their colleagues, have constructed a statistical atlas of prostate cancer distribution, to significantly improve the determination of optimal biopsy sites.

Prostate cancer is one of the leading causes of death among American men. Current imaging modalities have very poor performance in detecting prostate cancer, with MRI having only 50% detection rate. Therefore, prostate cancer diagnosis is currently performed rather blindly, under various protocols for needle placement. The most widely used protocol is the six-needle biopsy, performed under very approximate guidelines. Success rate of diagnosis and staging of prostate cancer can be greatly improved by developing statistical methods for sampling, provided that the statistics of the population can be determined.

Using histological sections from about 300 radical prostatectomy specimens, along with deformable registration methodologies, CISST and its partners – the University of Pennsylvania, Brigham and Women's Hospital, Georgetown University (currently Howard University), and the Center for Prostate Disease Research (currently Duke University) – have developed a multivariate statistical model for determining optimized biopsy plans based on the spatial distribution of prostate cancer. This statistical atlas can be warped to the individual patient's space, under guidance from ultrasound images, for performing optimal biopsy for the particular patient (Figure 1). By applying this optimized biopsy protocol to a database of prostatectomy specimens, our detection rates, estimated from whole-mount histological stains, reached over 90% levels for 6-7 biopsy cores after applying cross-validation, which represents a significant improvement over standard random-systematic biopsy protocols that can only reach about 70% in the same patients.

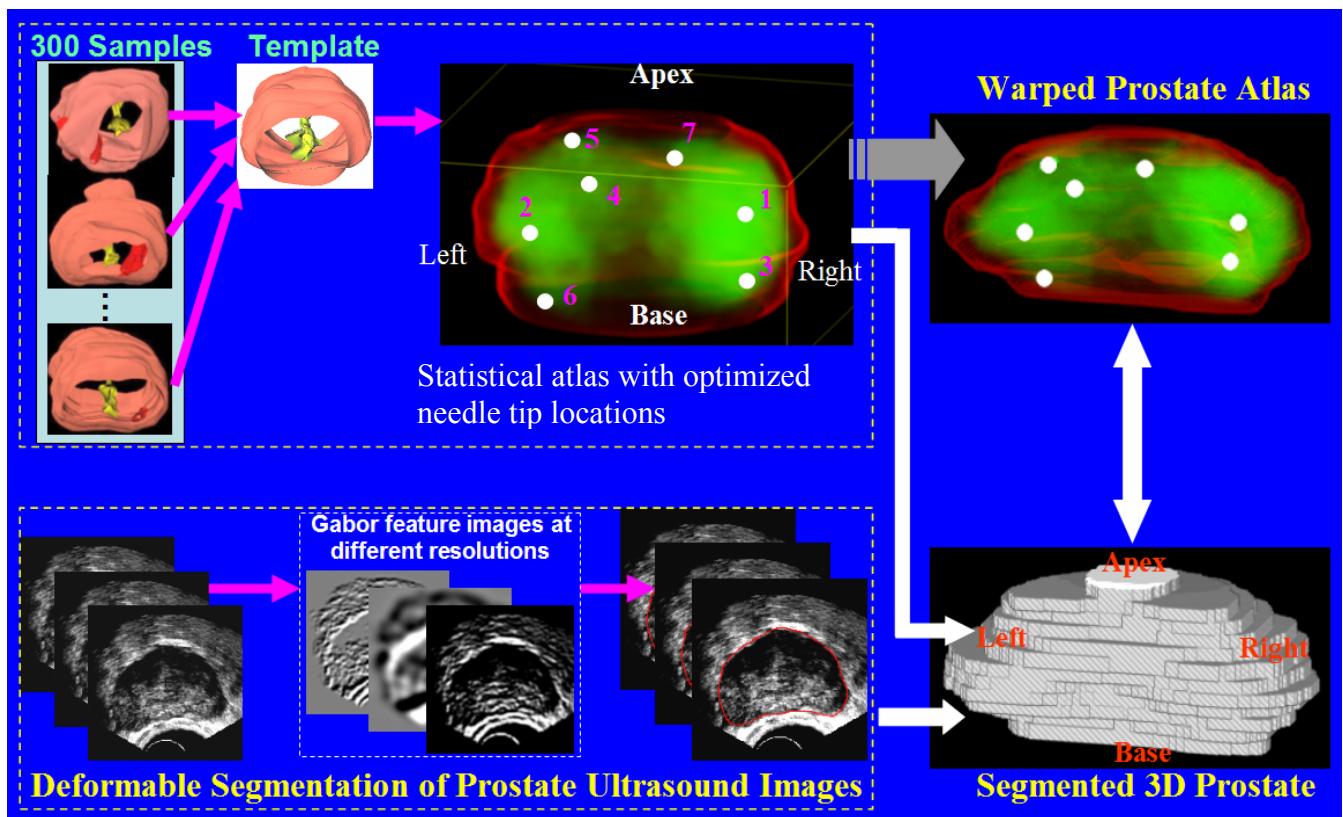


Figure 1: Atlas-based prostate biopsy strategies.