Signal Relationship Analysis of Prostate mpMRI T2w, DCE, DWI Sequences for Cancer Localization

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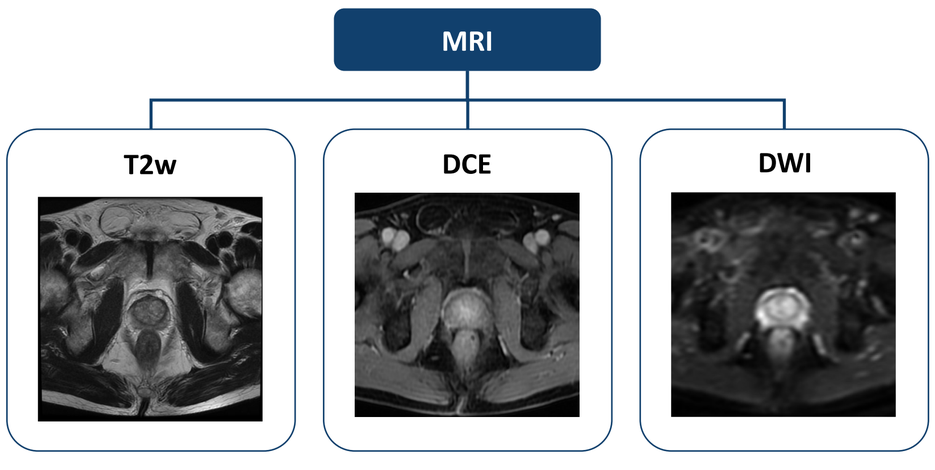
Introduction

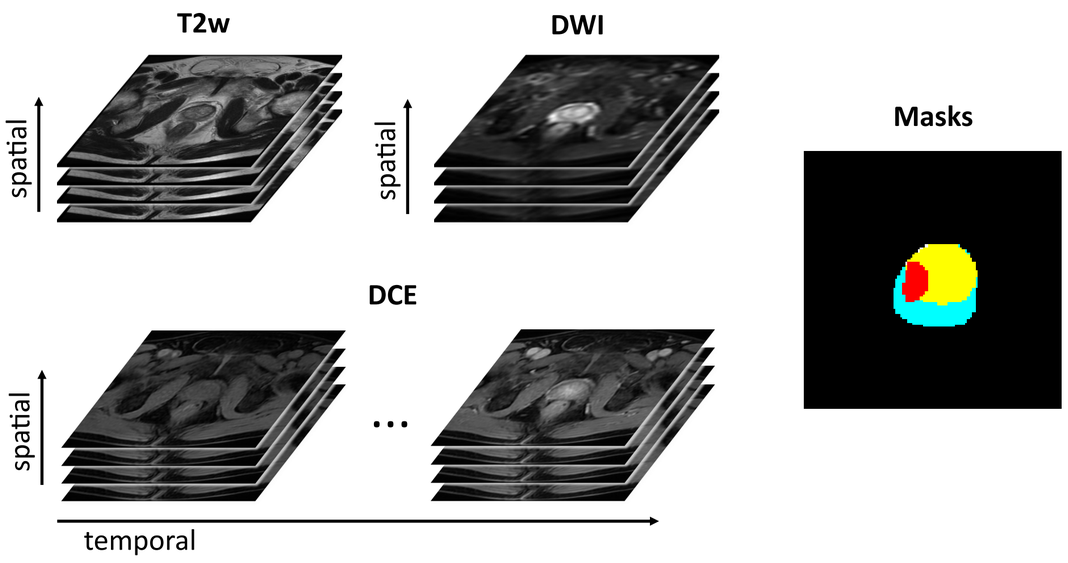
Currently, prostate cancer diagnostics is based on multi-parametric MRI containing several imaging sequences: T2-weighted (T2w), Diffusion Weighted Imaging (DWI), and Dynamic Contrast Enhancement (DCE). Prostate Imaging-Reporting and Data System (PI-RADS), a structured scheme for cancer classification, further separates peripheral (PZ) and transition (TZ) zones for interpretation. This research is focused on signal relationship among T2w, DWI, and DCE sequences in each of the zones.



Data

T2w and DWI imaging produces a 2-dimensional grayscale signal matrix for each of patient's spatial coordinates representing body's axial cross-sections (or slices). DCE sequence is more complex by having an additional temporal dimension representing signal dynamic over time.

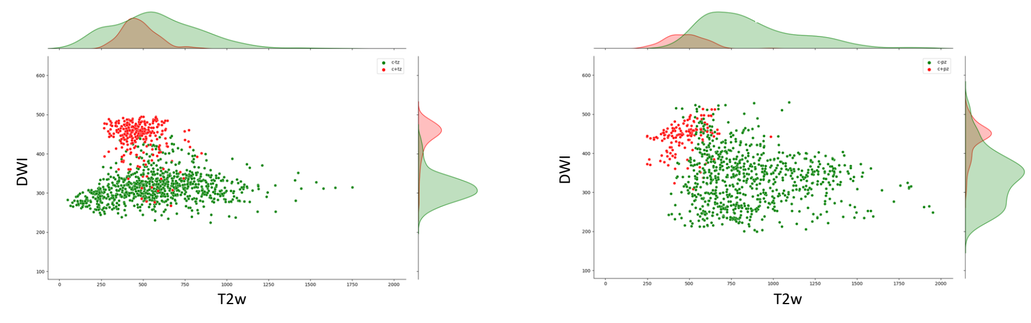
Imaging sequence data is supported by prostate, cancer, peripheral zone, and transition zone masks denoting regions of interest in each slice.



Experimentation

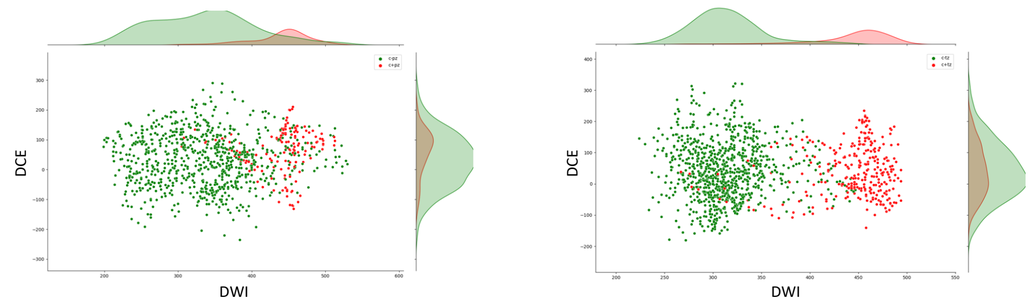
T2w-DWI

T2w and DWI sequences are compared by constructing scatterplots depicting relationship between signal strength for each pixel of a slice. Some patients displayed visible separation of cancerous and non-cancerous clusters of points—in both peripheral (left) and transition (right) zones higher DWI values are associated with malignant tumors with some overlap with healthy tissue.



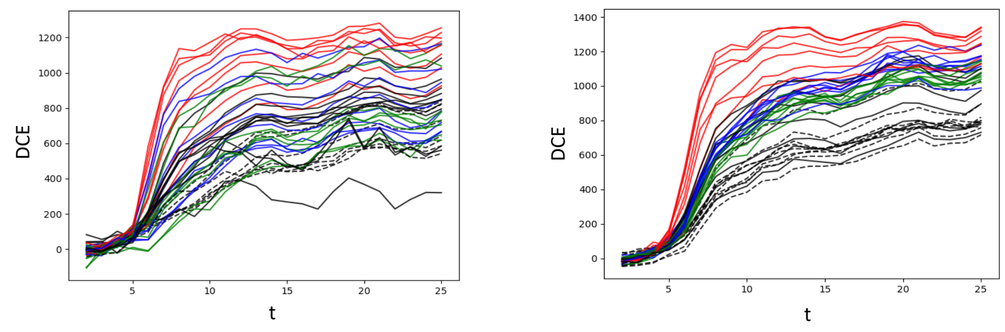
DCE-DWI

DCE sequence is reduced from 2D+temporal dimension to 2D by creating a difference matrix between two time points—16th and 50th temporal percentile. Similarly, for a subset of patients a visible cluster of malignant points in transition zone (right) is separated. For peripheral zone the segregation is less clear.



Aggregated DCE

A separate analysis was done on DCE imaging by defining 3 additional zones around the cancer ROI—close-proximity, far-proximity, and the rest of the prostate. Signal inside each zone is mean-aggregated and a set of time series curves are constructed for every slice. Dashed black curves represent average signal in whole prostate for slices only containing benign tissue.



Conclusion

Findings:

- There is significant variation in point distributions among different patients, possibly due to physiological factors
- For the selected patients there is segregation between cancerous and benign data points

Further research:

- This case analysis was conducted on a subsample of patients; the scope will be increased to cover all available subjects
- To conduct data-specific evaluation on variability between patients