Prostate-Checker: Prostate cancer assessment by multi-parametric MRI studies

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Outline

- Clinical context
- Prostate-Checker: A multi-parametric tool
- Analysis modules

  - Texture Analysis
  - Pharmacokinetic modelling
  - Apparent Diffusion Coefficient

- Prostate-Checker

  - User Interface
  - Nosologic images generation
  - Structured report

- Conclusion

Prostate Cancer: Some Relevant facts

Prostate cancer (PC) is the second most diagnosed type of cancer

PC It is the fifth leading cause of cancer-related death in men worldwide (most frequent cause of cancer death in men in developed countries)

Guidelines about prostate magnetic resonance (MR) imaging published by the European Society of Urogenital Radiology (ESUR) in 2012 recommended a multi-parametric approach for a better characterization of PC

Prostate-Checker: a multi-parametric approach

Prostate-Checker performs voxelwise multi-parametric analysis from T2W, DW and DCE MR images
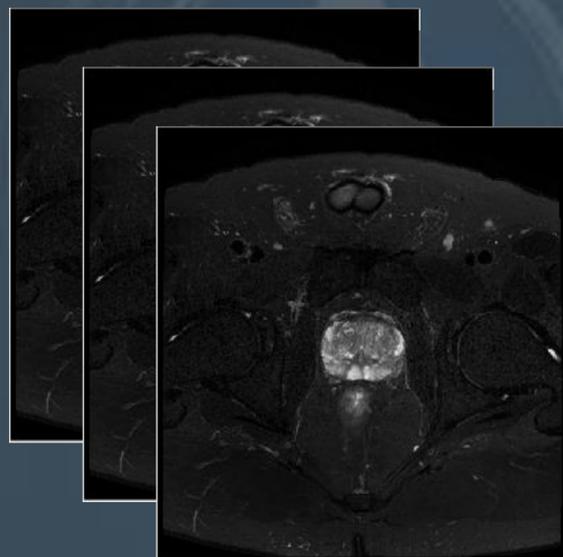
Texture
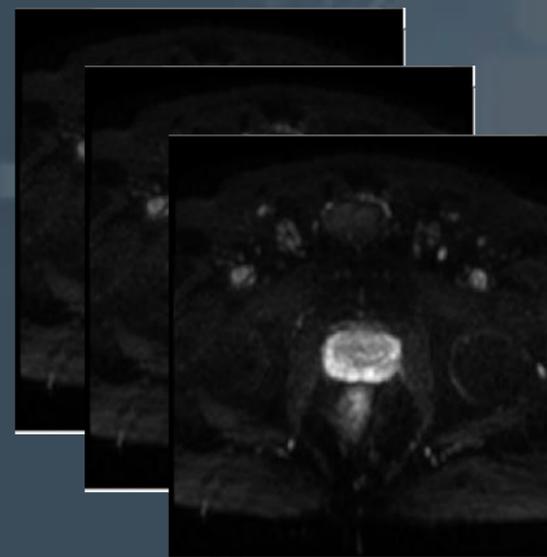
Cellularity
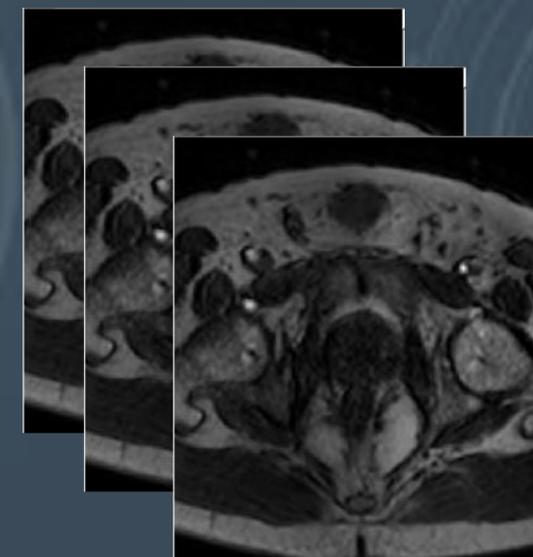
Micro-vascularity

# TexRAD® module texture analysis
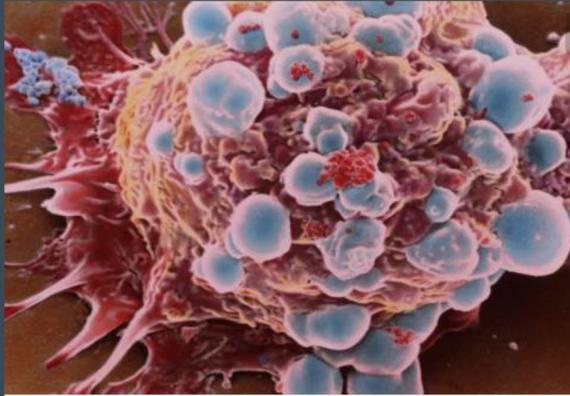
- Tumor is a heteregeneous structure in its morphological and vascular structure.

- Texture analysis can reveal changes in apparently disease-free areas.

- Histogram-derived parameters such as kurtosis, skewness and standard-deviation as quantitative biomarkers.

Galleshan et al. Texture analysis in non-contrast enhanced CT: impact of malignancy on texture in apparently disease-free areas of the liver. European Journal of Radiology. 2009

Pharmacokinetic modeling

$$C_{ROI}(t) = v_p \cdot C_{AIF}(t) + K^{trans} \int_0^t C_{AIF}(u) e^{-k_{ep}(t-u)} du$$
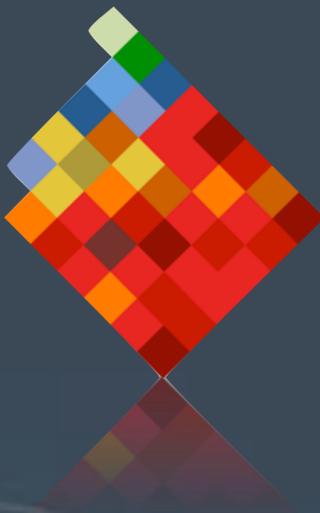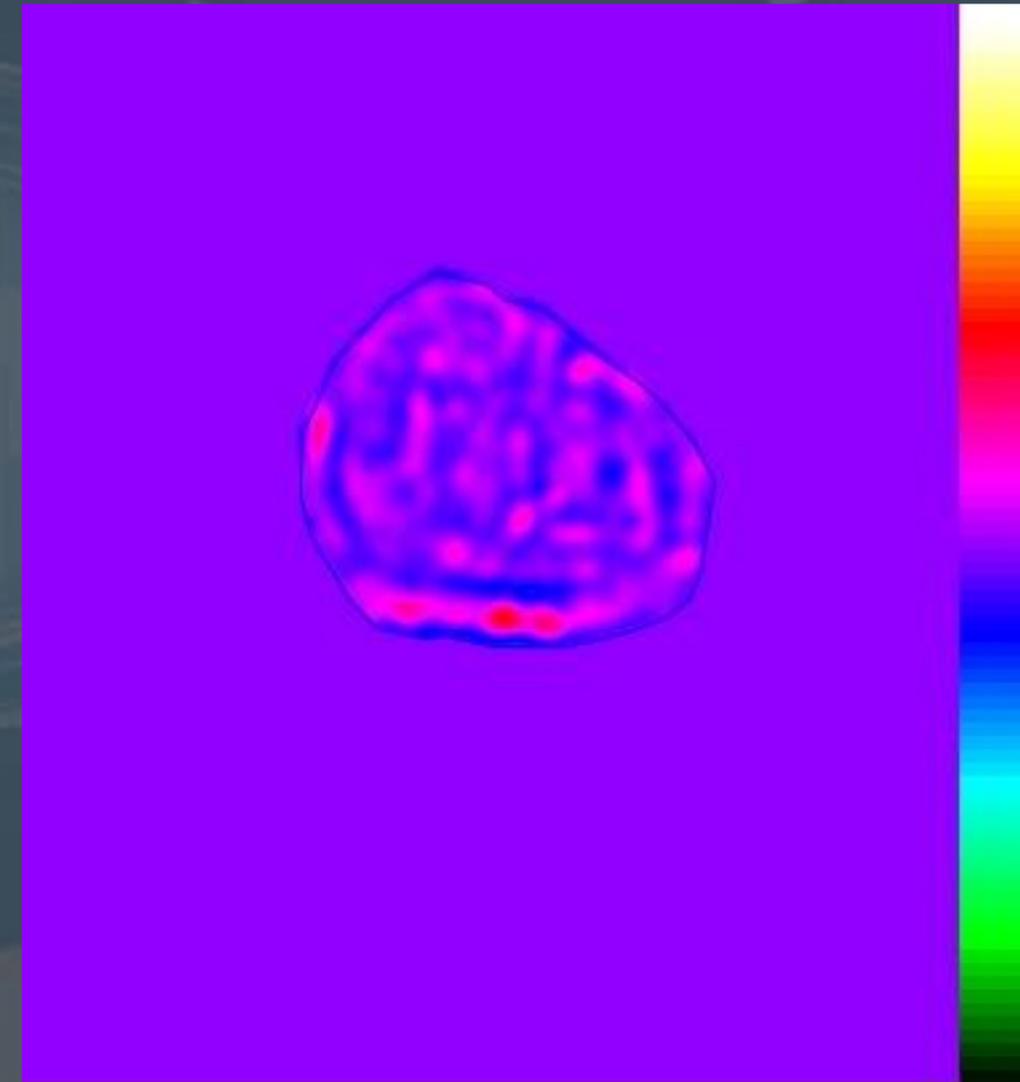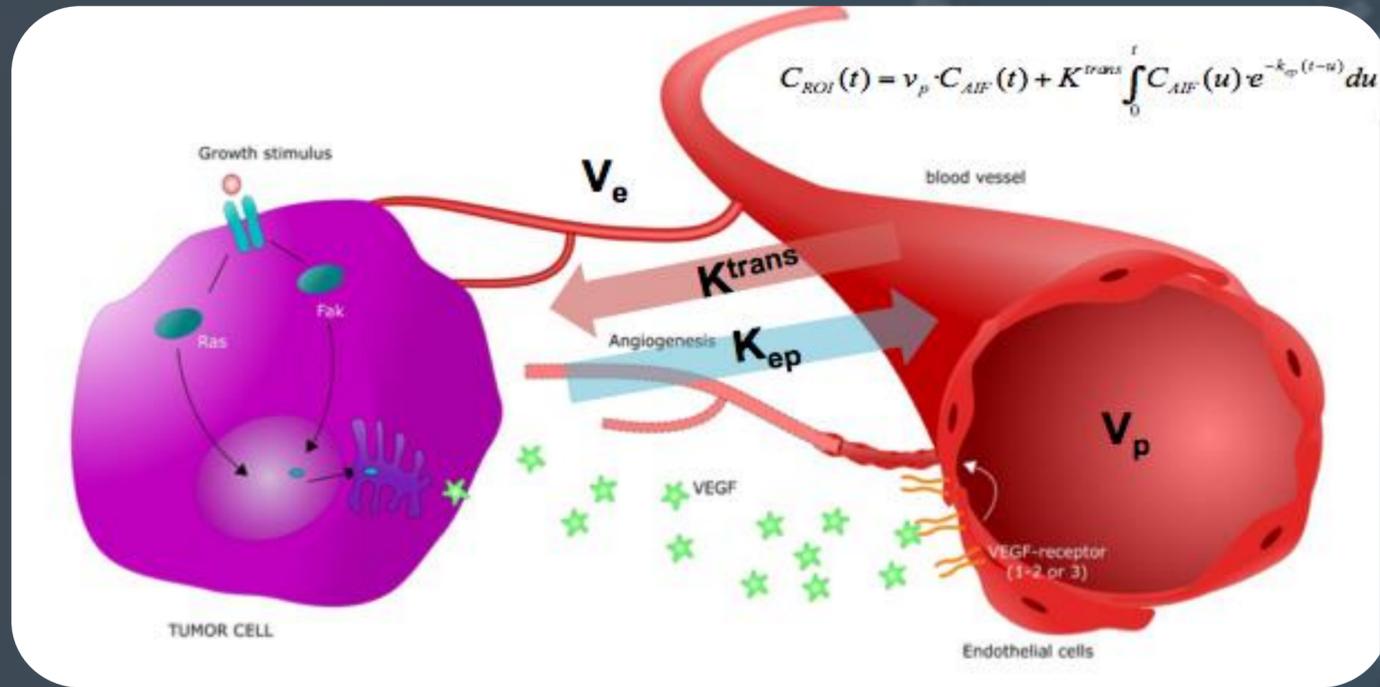
- 2-compartment 1-input model for the analysis of pharmacokinetic properties of the tissues (K^{trans}, k_{ep}, v_e).

- Tumor development increases the blood supply and changes the morphology of the microvascular environment
- Accurate methods to evaluate pharmacokinetics properties and angiogenesis are a growing need

$$C_t(t) = v_p C_a(t) + K^{trans} \int_0^t C_a(\tau) e^{-k_{ep}(t-\tau)} d\tau$$

- Oostendorp M et a.. Vessel Growth and Function: Depiction with Contrast-enhanced MR Imaging. Radiology 2009.
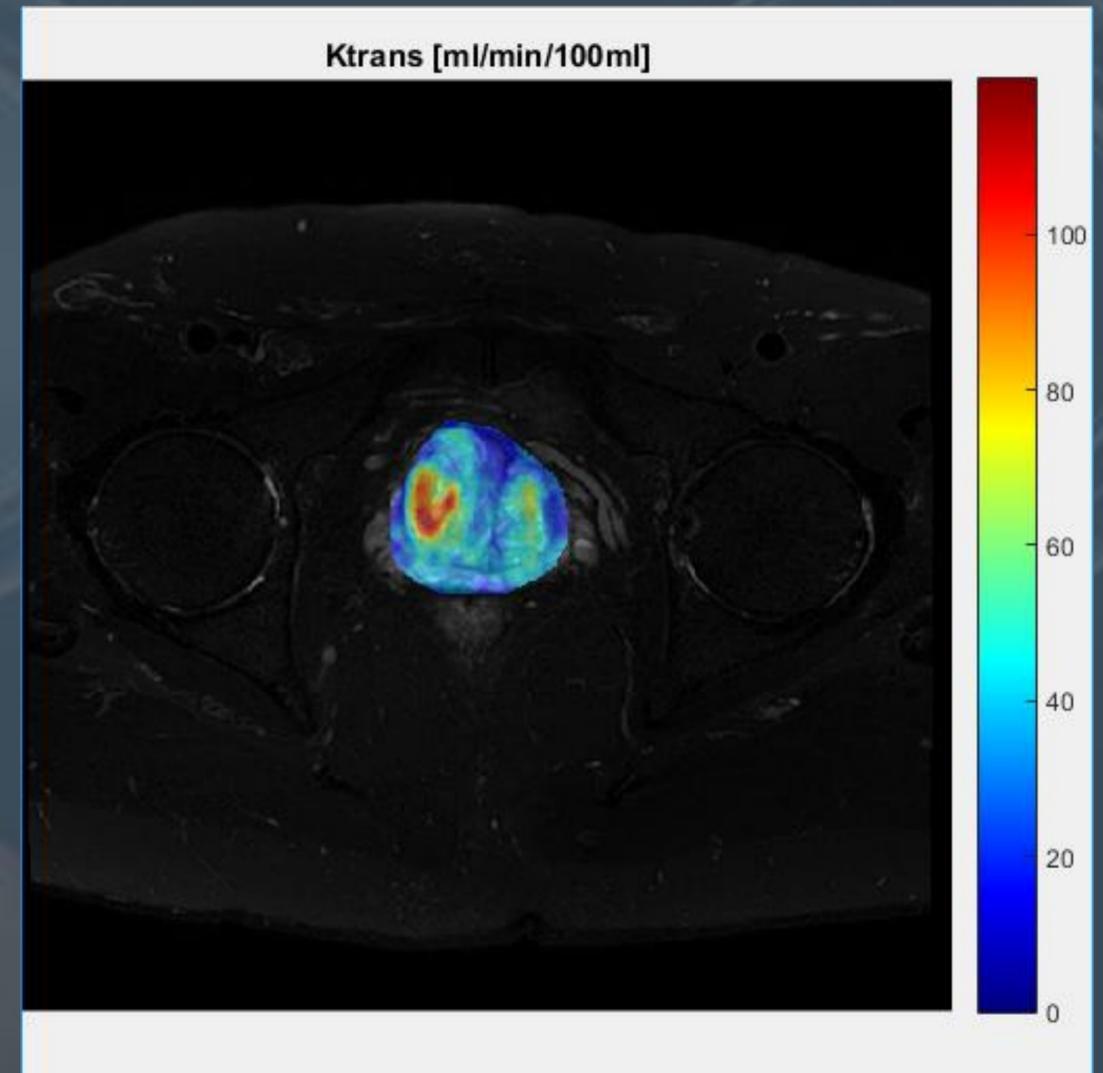
Diffusion studies
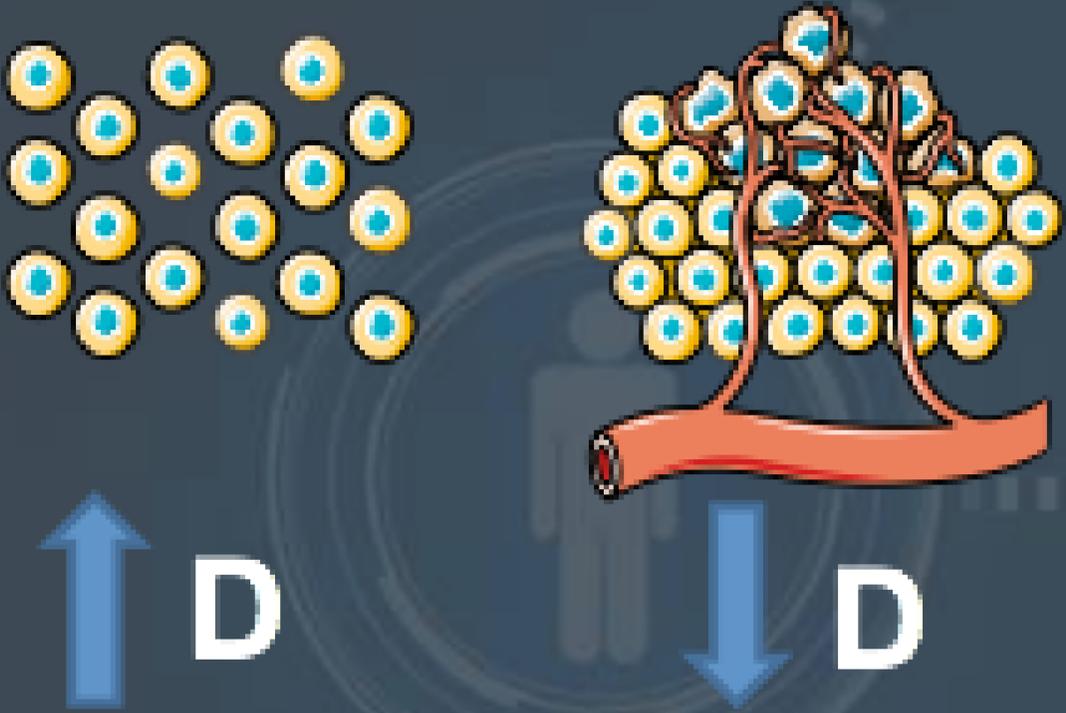
- Pathological processes produce an alteration in cells distribution in tissues modifying the water diffusion properties in the interstitial space.
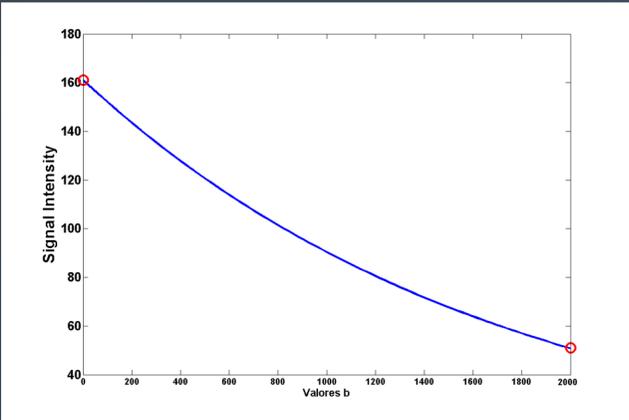
- Monoexponential modeling of the MR signal decay to calculate the apparent diffusion coefficient (ADC).
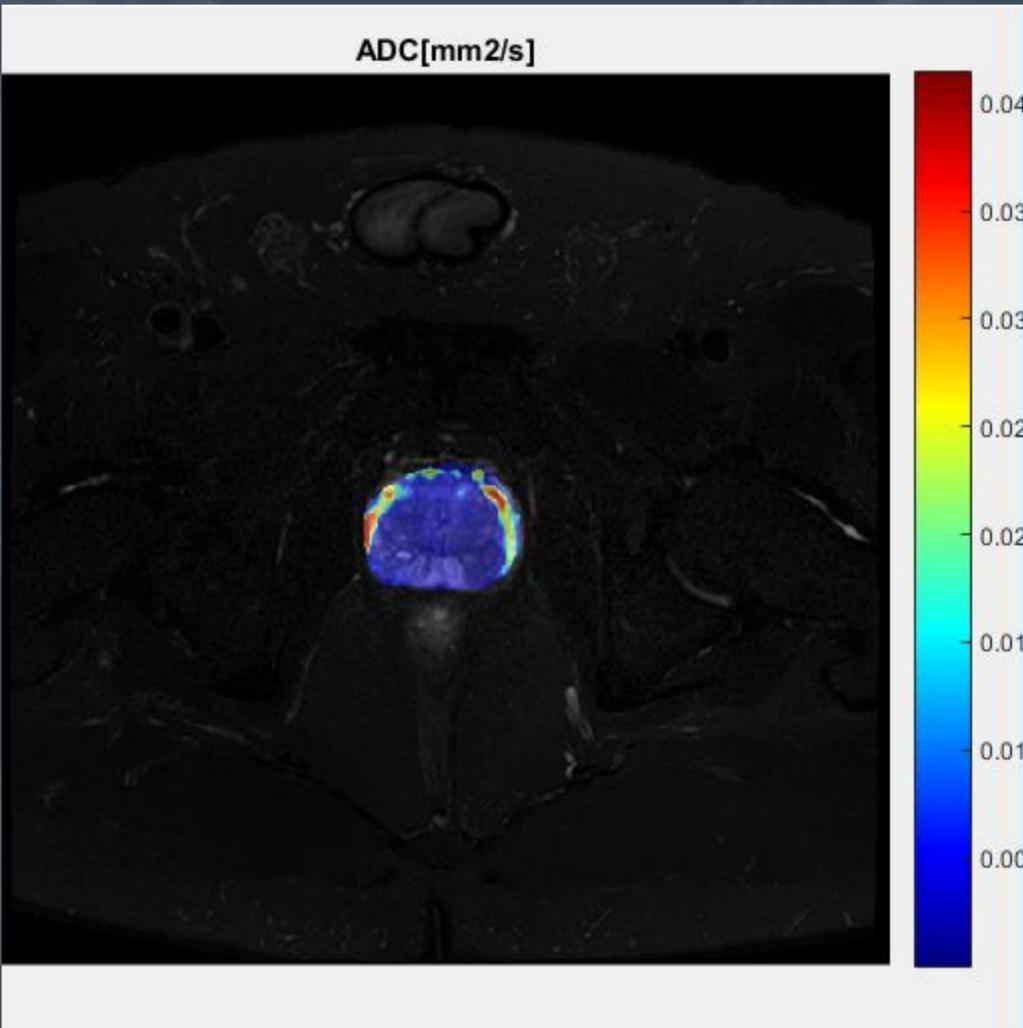
Prostate Checker GUI
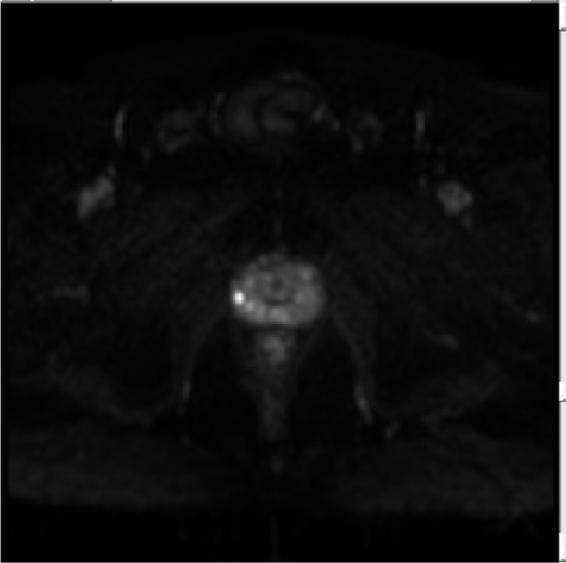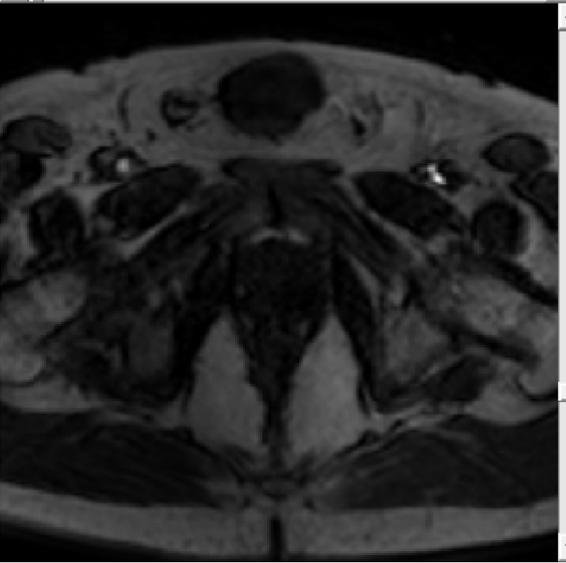
Re-slicing and co-registration

Re-slicing and elastic co-registration to share same reference space and resolution
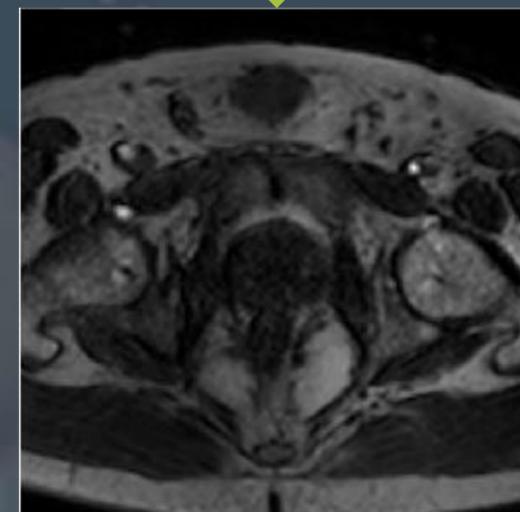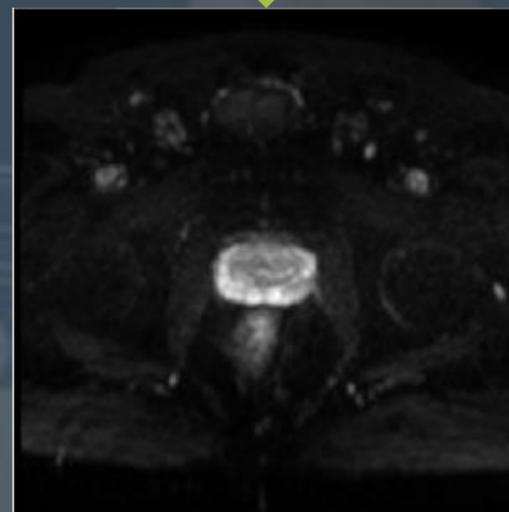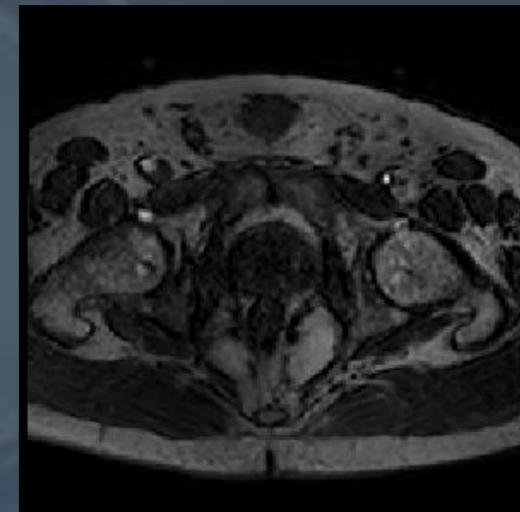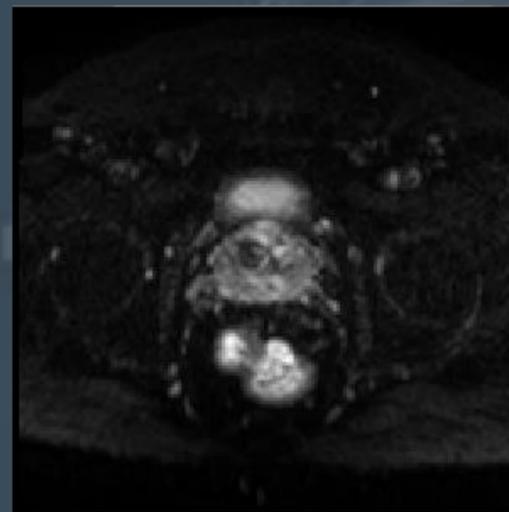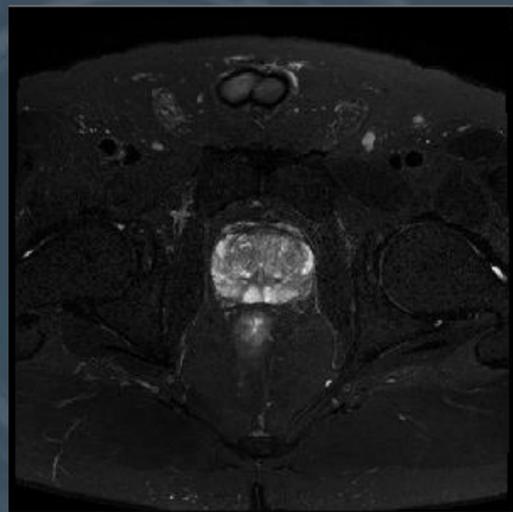
Re-slicing and co-registration
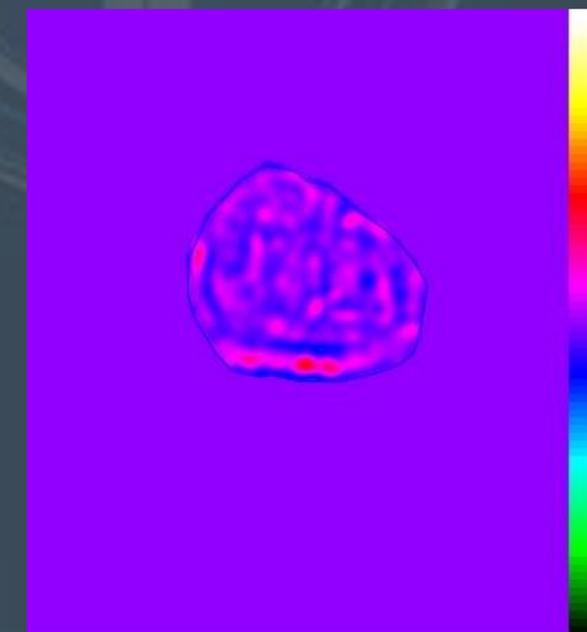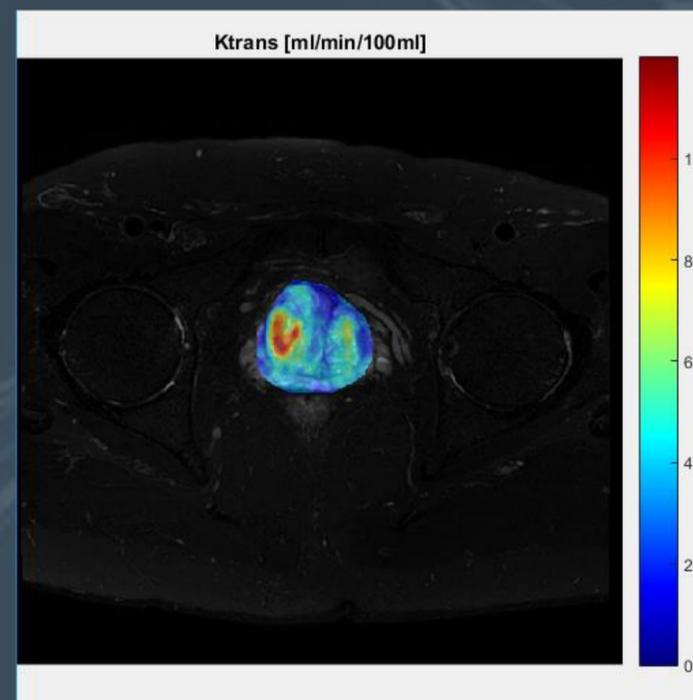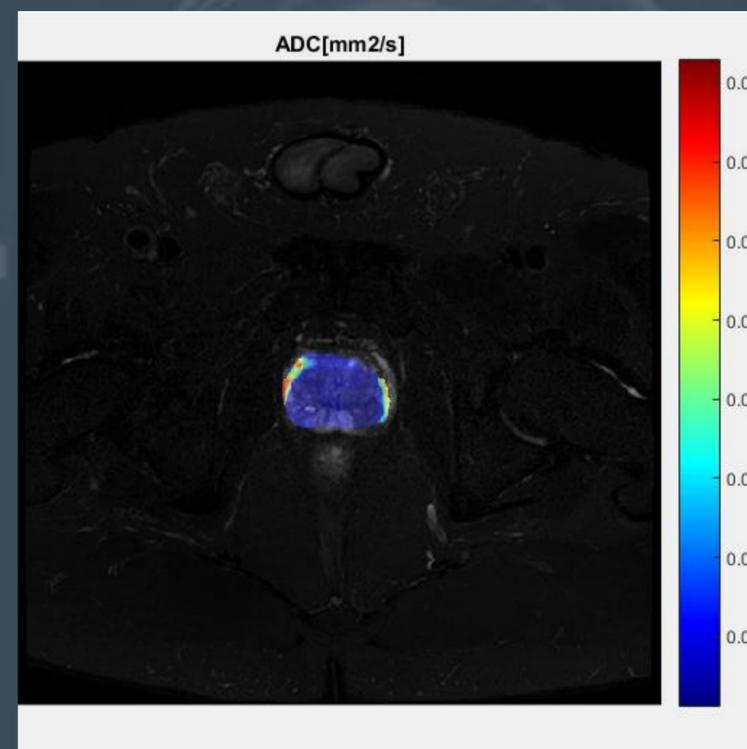
Generation of Nosologic images

- Prostate segmentation
- Volumetric visualization of information

Prostate Geometry Reconstruction
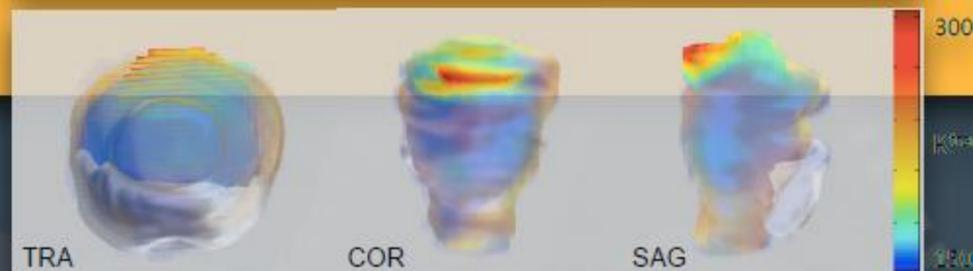
Diffusion & Perfusion 3D volumetric visualization

Suspicious regions 3D representation

Structured Report

Conclusions

Prostate Checker provides an unique imaging tool in the early detection and diagnosis of prostate cancer by using a multi-parametric analysis of magnetic resonance imaging.

Prostate Checker software development is currently at the proof of concept stage

The prototype will be further evaluated in a pilot clinical study to assess initial performance and capabilities and the results will be published in a high-impact scientific peer reviewed journal.

A last hint

Questions ?

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