

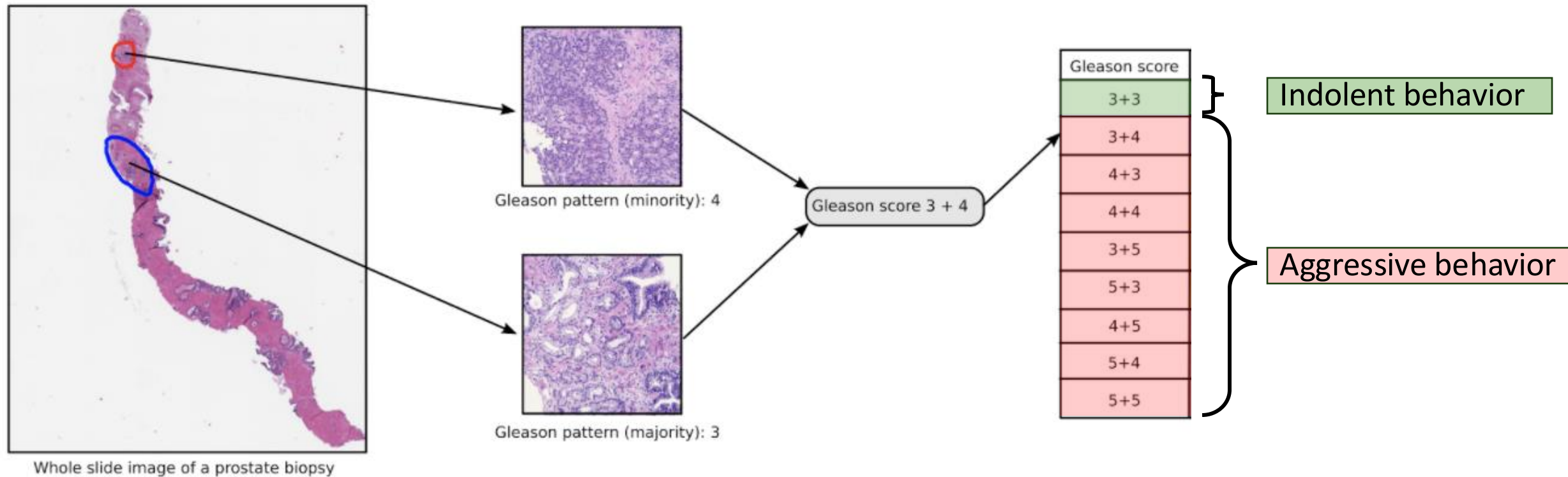
Analysis of Mp-MRI to anticipate Gleason Upgrading in Active Surveillance for Prostate Cancer

Research Project - Applied Statistics, Mathematical Engineering 2025

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Clinical problem – Prostate Cancer (PCa)

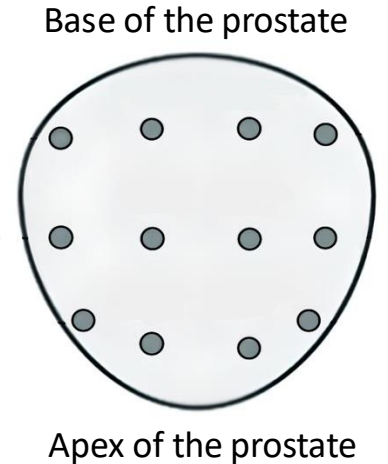
- Fourth in the world by incidence (second considering only the male population)
- Gleason Pattern Score (**GPS**): ranks the aggressiveness of prostate cancer



Potential Misdiagnosis and Active Surveillance

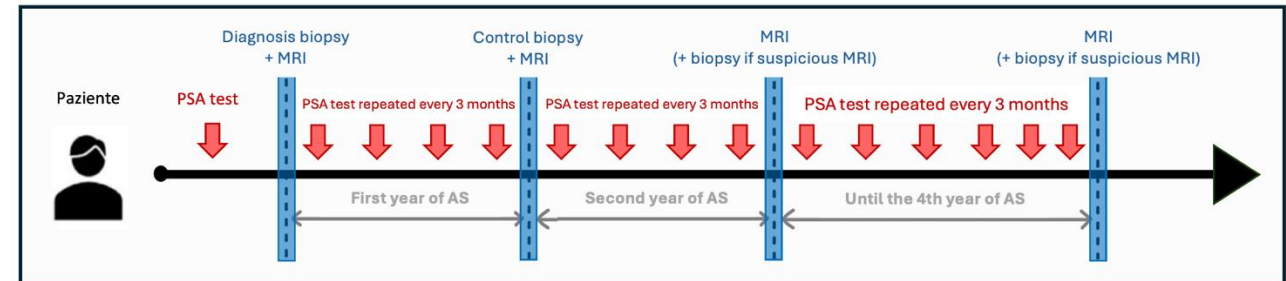
PROBLEM: Due to the tumour heterogeneity, different sub-regions within the prostate volume may display various degrees of aggressiveness, therefore the biopsy sampling may not reflect the actual state of the disease.

➔ Need for a tool that can detect the presence of a more aggressive type of cancer, despite the histological result.



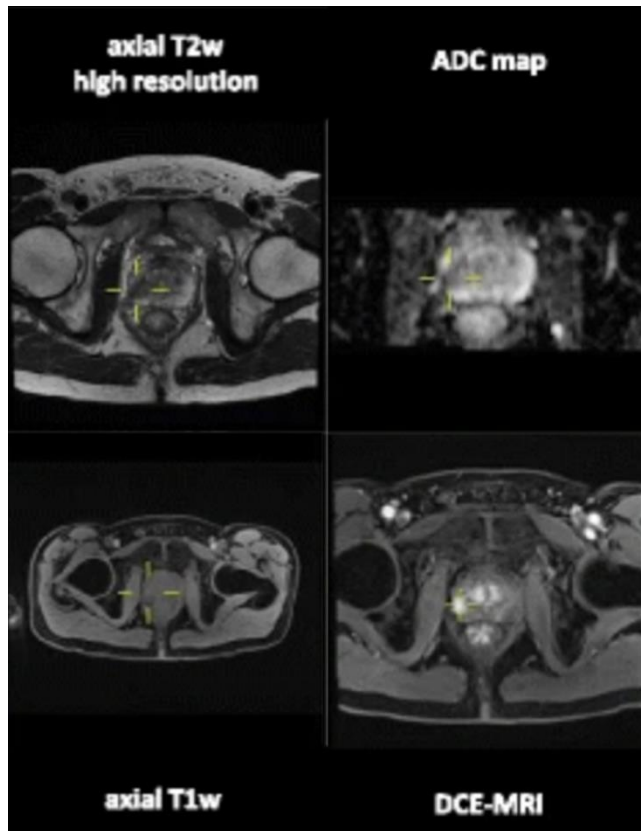
Active Surveillance (AS)

- Proposed strategy for patients with a non-aggressive Form of Cancer (GPS=3+3)
- Involves **monitoring tumor progression** through repeated exams over time: PSA tests, prostate biopsies and Magnetic Resonance Imaging.



The Research Question

Can radiomic features of the prostate, extracted from multiparametric Magnetic Resonance Images, predict the presence of aggressive PCa not seen by biopsy?



T1w, T1-weighted -> Lower signal for more content water (edema, tumor, inflammation), high signal for fat

T2w, T2-weighted -> Higher signal for more water content. Standard because is faster

DWI, Diffusion Weighted Imaging -> measures the apparent diffusion of water

ADC, Apparent Diffusion Coefficient -> derived from DWI. Used to assess infarct, tumors, and ischemic lesions

DCE-MRI, Dynamic Contrast-Enhanced MRI → Measures tissue permeability.

Fast uptake & washout → malignancy, Gradual uptake → benign lesions.

The population and the data

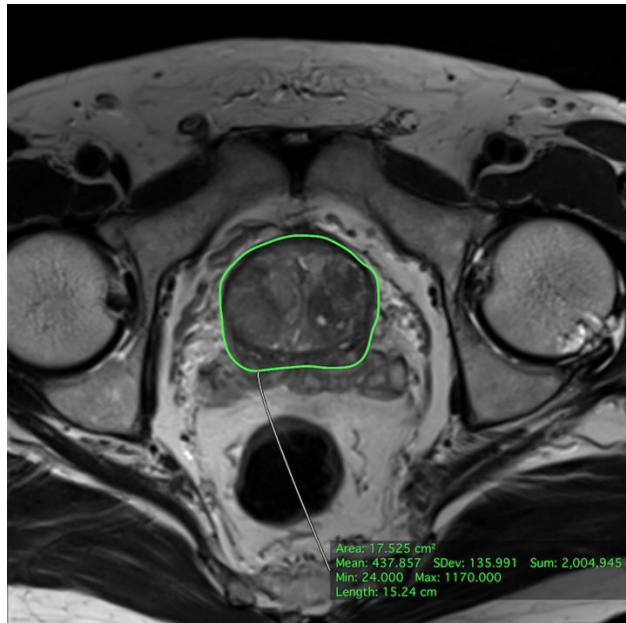
A retrospective population consisting of ~130 PCa patients monitored in Active Surveillance at INT with the SPRINT protocol:

CLINICAL DATA <ul style="list-style-type: none">• Baseline PSA• Prostate Volume V_p• PSA Density (PSA/V_p)• Biopsy information	MRI and DCE-MRI <ul style="list-style-type: none">• Standard sequences (T1w, T2w, DWI)<ul style="list-style-type: none">• Radiomics analysis (160 features)• Dynamic Contrast-Enhanced images<ul style="list-style-type: none">• Wash-in and wash-out maps	ENDPOINT <ul style="list-style-type: none">• Upgrading<ul style="list-style-type: none">• Undetected more aggressive type of cancer: <div><div>YES 35%</div><div>NO 65%</div></div>
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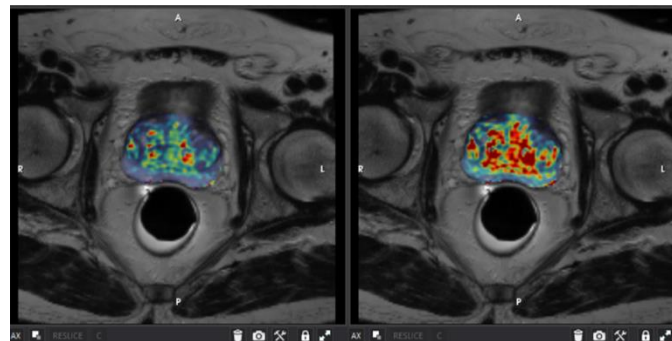
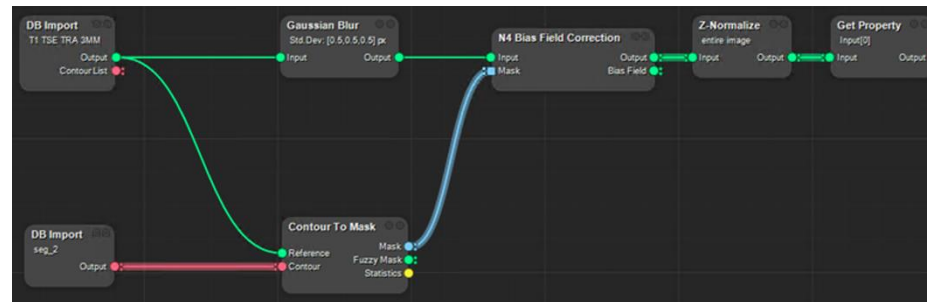
Tools used in the analysis

During the project different software will be used for different aims:

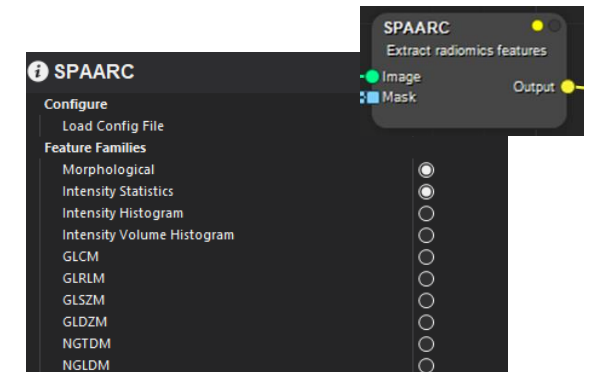
Software for prostate auto-segmentation

DOI: [10.1109/ACCESS.2021.3090825](https://doi.org/10.1109/ACCESS.2021.3090825)

Hero Imaging for MRI pre-processing and computation of wash-in wash-out maps from DCE-MRI analysis



SPAARC (plugin in Hero) for Radiomic analysis



	E	F	G	H	I	J	K	L
1	4.	5	6	7	8	9	10	
2	stat_lqr	ih_mean	ih_good	cm_infor_corr2_3D_comb	szm_xsmu_norm_3D	ngl_dc_energy_3D	dzm_dsmu_norm_3D	
3	stat_rmad	ih_skew	rim_srige_3D_comb				dzm_dmr_3D	
4	stat_rmad	ih_median	ngl_hdidge_3D	cm_infor_corr1_3D_comb	szm_sze_3D	szm_sx_intr_3D	dzm_sde_3D	
5	stat_rmad	ih_mode	rim_lgze_3D_comb					
6	stat_var	stat_kurt	rim_lgze_3D_comb					
7		cm_joint_avg_3D_comb	szm_lgze_3D					
8		cm_ssm_avg_3D_comb	dzm_lgze_3D					
9		cm_auto_corr_3D_comb	ngl_lgze_3D					
10		cm_clust_shade_3D_comb	ngl_sdige_3D					
11		ih_kurt	szm_sdige_3D					
12		ih_rmad	dzm_sdige_3D					
13		ih_rmad	ih_cov					
14		ih_rmad	ihw_v10					
15		ih_entropy	ihw_diff_v10_y90					
16		ih_uniformity						
17		ihw_diff_v10_j90						
18		cm_joint_var_3D_comb						
19		cm_ssm_var_3D_comb						
20		cm_ssm_intr_3D_comb						
21		cm_emergy_3D_comb						
22		cm_clust_tend_3D_comb						
23		rim_glnu_norm_3D_comb						
24		ed_qlen_norm_3D						

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