# Cell-rad: towards histology-driven radiation oncology from multi-parametric MRI

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## What was your motivation for initiating this study?

The assessment of tumour volume and its contouring for treatment planning is a very hard task and suffers from high variation between observers and modalities. Biopsies help a lot in understanding biological aggressiveness of the tumour but do not provide a full characterisation of its volume. Only whole slide histological images give the gold standard assessment but are de facto unavailable prior to surgery. Our motivation is to tackle deep-learning-based generative models to infer virtual whole-slide histology from images that are acquired at diagnosis, such as computed tomography (CT) or magnetic resonance imaging (MRI).

## What is the most important finding of your study?

The objective is complex and challenging since these two modalities are extremely different (tissue shrinkage, out-of-plane deformation, etc). Nevertheless, we managed to build a pipeline that generated virtual histology of the prostate based on pre-operative MRIs. We used the cycleGAN framework (Zhu et al., 2017), which learns characteristic features of both modalities and is able, once trained, to transfer style in real time. Our synthetic images are realistic and remain faithful to anatomical areas of the prostate such as the urethra.

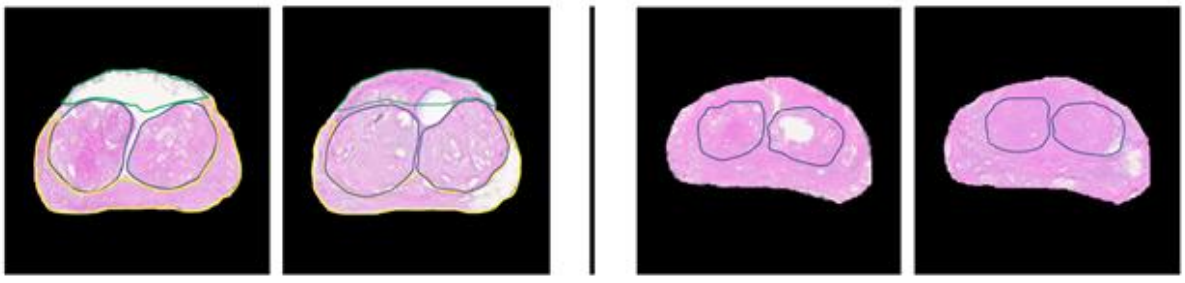

*Figure 1. Two samples of prostate histology, real (left) and synthetic (right), with characteristic areas to be conserved*

## What are the implications of this research?

This study represents a proof-of-concept that validates the clinical potential of generative models to make new, meaningful sources of data available for better diagnosis/treatment planning. Our images are at MR resolution, and we cannot catch cellular environments of the tumour yet, but resolution enhancement and generalisation to new locations are ongoing. The final goal is to

have access to precise biology from a scanner. Thereafter, new possibilities will be unlocked for radiotherapy, with direct consequences for dose painting, adaptive treatment, and response to immunotherapy.

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