A novel deep-learning framework applies to analysis the image characteristics of uveal melanoma tissue in MRI

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Purpose: To evaluate an automated segmentation of UM in MRI using an end-to-end deep learning segmentation *without the need of expert's annotations for training*. Towards a precise tumors characterisation to support in prognosis and patient-specific treatment plan, thereby contributing to precision medicine.

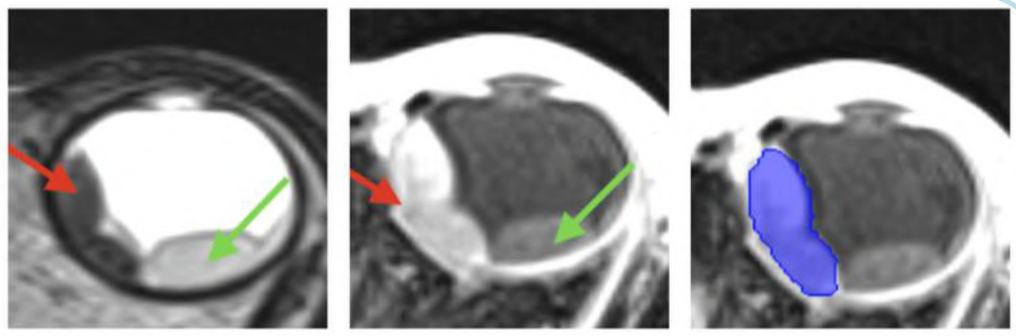
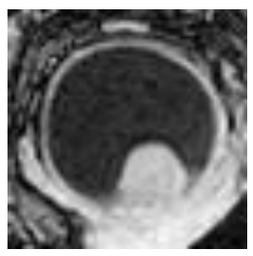


Figure 1: Example of UM in MRI: (left) T2-w; (center) T1-w; (right) manual tumor segmentation. Red & green arrows indicate the tumor & retinal detachment respectively.

Method:

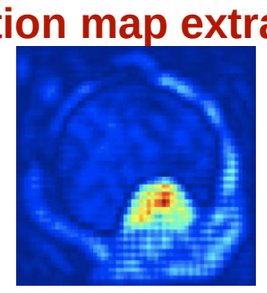
1. Pre-processing

- Eye cropping
- Anisotropic diffusion filtering
- Intensity normalisation



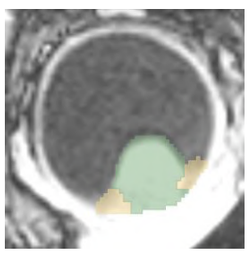
2.1 Statistical shape analysis for prior information

2.2 Attention map extraction



3. Tumor & retinal detachment differentiation

- Unet
- Gabor textural separation



Material: MR acquisitions are performed by a 1.5T Siemens scanner with surface coil for both T1w and T2w contrasts at the Paul Scherrer Institute. The study was approved by the Ethics Committee of the involved institutions and all subjects (anonymized and de-identified) provided written informed consent prior to participation.

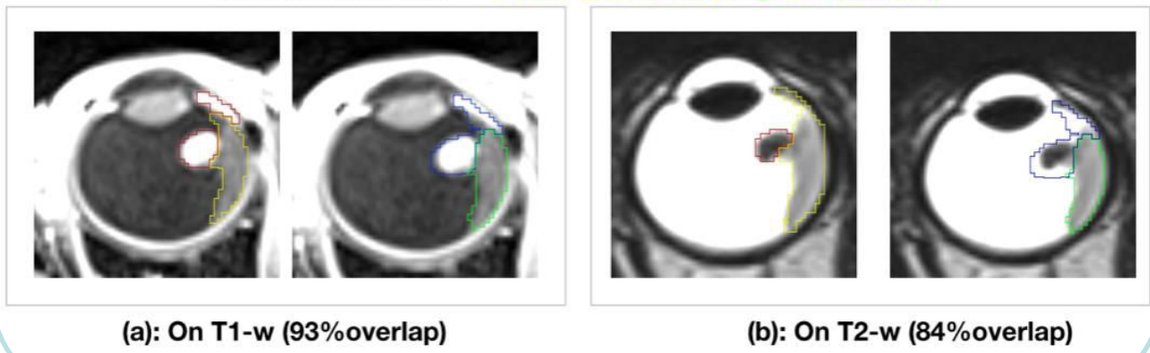
	Repetition time(ms)	Echo time (ms)	Flip Angle	Voxel size (mm^3)	FOV (Voxels)	Healthy	UM
T1-VIBE	6.55	2.39	12°	0.5x0.5x0.5	256x256x80	28 eyes	24 eyes
T2-SPACE	1400	185	150°	0.5x0.5x0.5 and 0.82x0.82x0.8	256x256x80	25 eyes	22 eyes

Table 1: MR imaging acquisition parameters at 1.5T with a surface coil.

Result:

Dice overlap coefficient of proposed method are 83.4±4.5% for T1W and 82.7±5.1% for T2W.

Tumor : red (prediction) & blue (manual)
Retinal detachment : yellow (prediction) & green (manual)



(a): On T1-w (93%overlap) (b): On T2-w (84%overlap)

Conclusion:

- Allowing the UM tumor quantitative from image analysis could further support clinicians to tailor the proton therapy.
- An accurate segmentation without manual segmentation for training.

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