 # 2593

Towards A Clinical Prostate MR Fingerprinting Protocol

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Declaration of
Financial Interests or Relationships

Speaker Name: Manuel Baumann & Mariya Doneva

I have the following financial interest or relationship to disclose with regard to the subject matter of this presentation:

Company Name: Philips Research Europe
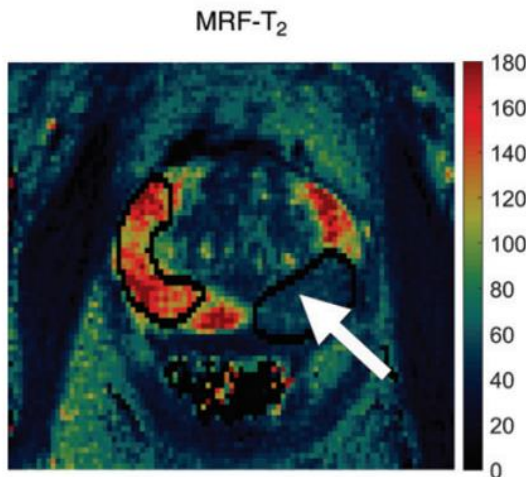Type of Relationship: Employee

Introduction

Prostate MRI

- mpMRI: reliable lesion detection in peripheral zone (PZ)
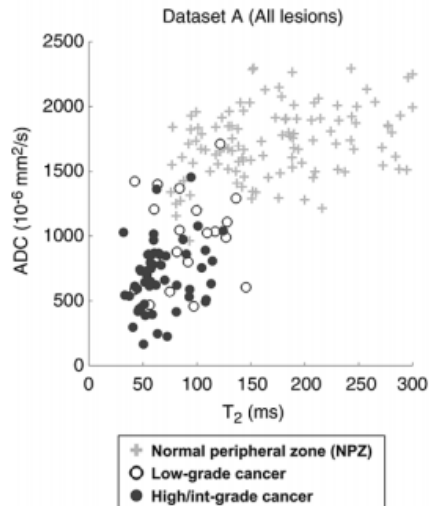- Goal: A quantitative and reproducible technique.

Peripheral zone (PZ) of the prostate[1]
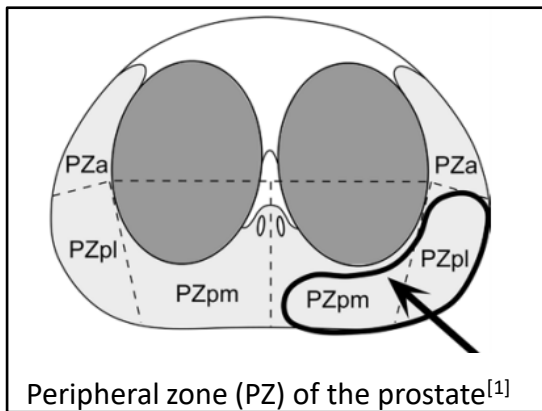
Challenges in Prostate-MRF

- Fat-induced blurring
- B_1^+ inhomogeneities
- Long reconstruction times

MRF-T_2

Classification:
Separate NPZ from cancer region based on T2 and ADC values.[2]

[1] A. Yu et al. *Radiology* 2017
[2] A. Panda et al. *Radiology* 2019

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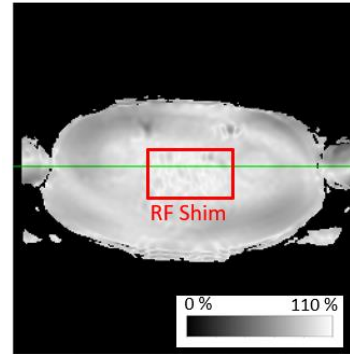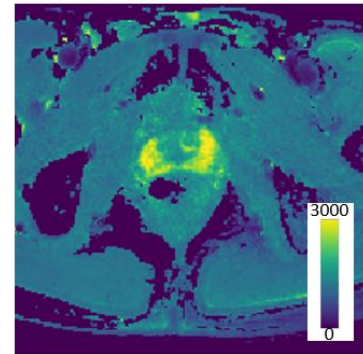
Methods

Prostate MR Fingerprinting in less than 5 minutes.

- Fully-integrated B_1^+ *'pre-scan'* using iDREAM[3]
- Integration of **Dixon-based water/fat separation** with MRF
- Flow compensation to suppress signal from artery blood flow
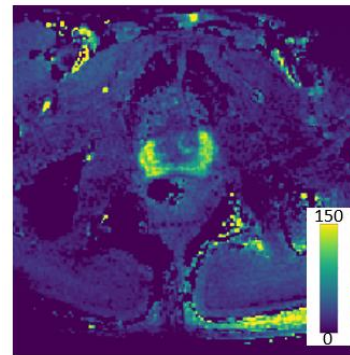- Fast GPU-based reconstruction for direct visualization on the scanner
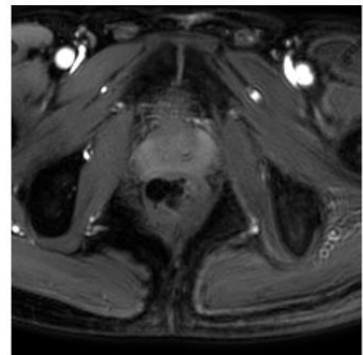

(a) B1 from iDREAM

RF Shim

0 %   110 %

(b) T1 water-only MRF

3000

0

(c) T2 water-only MRF

150

0

(d) Water-only MRF

[3] K. Nehrke et al. *ISMRM 2022*, #3314
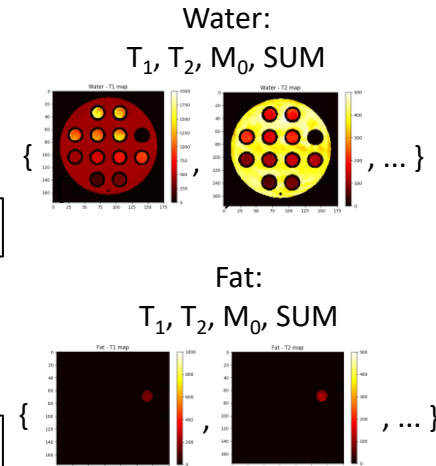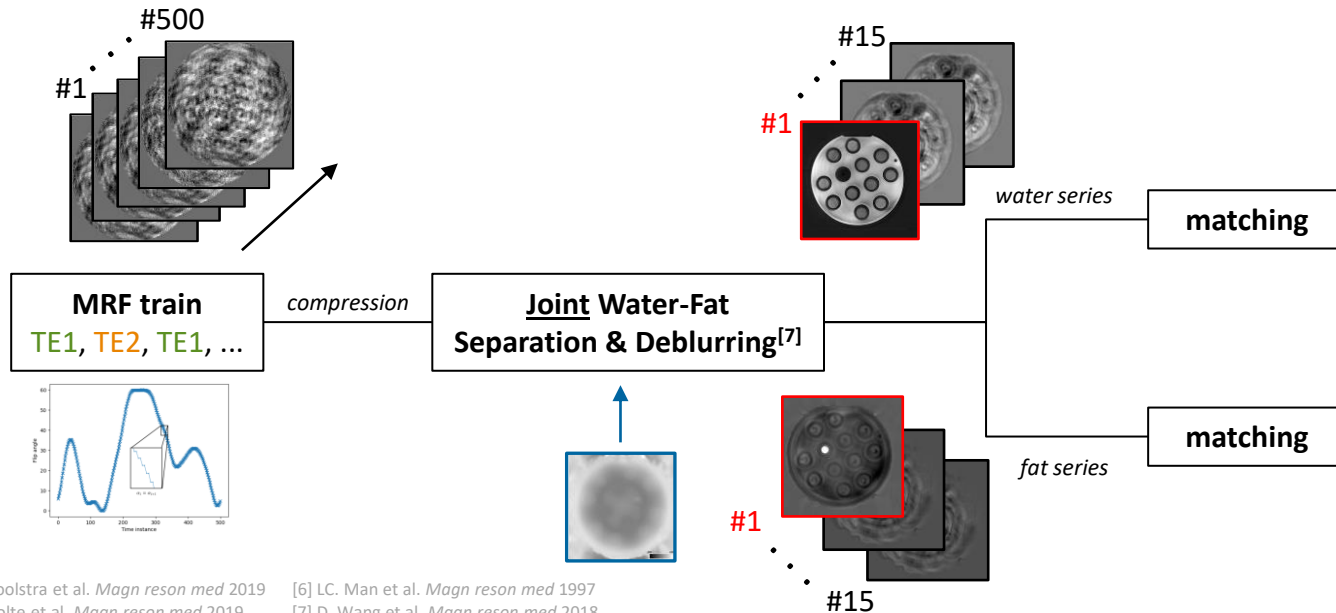
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MRF & water-fat separation

MRF-Dixon methods:

- Acquire data at multiple echo times (while varying MRF sequence)
- Field inhomogeneity ΔB_0 either from pre-scan[4] or estimation[5]
- Spiral deblurring using CPR[6]
- Applications: Fat suppression or separation (e.g. fat images in MR-HIFU)

[4] K. Koolstra et al. *Magn reson med* 2019   [6] LC. Man et al. *Magn reson med* 1997
[5] T. Nolte et al. *Magn reson med* 2019   [7] D. Wang et al. *Magn reson med* 2018

Experiments @ 3T

Set-up

- Evaluated on six healthy volunteers
- Comparison with MESE T2 mapping
- Flow compensation evaluation

MRF protocol details
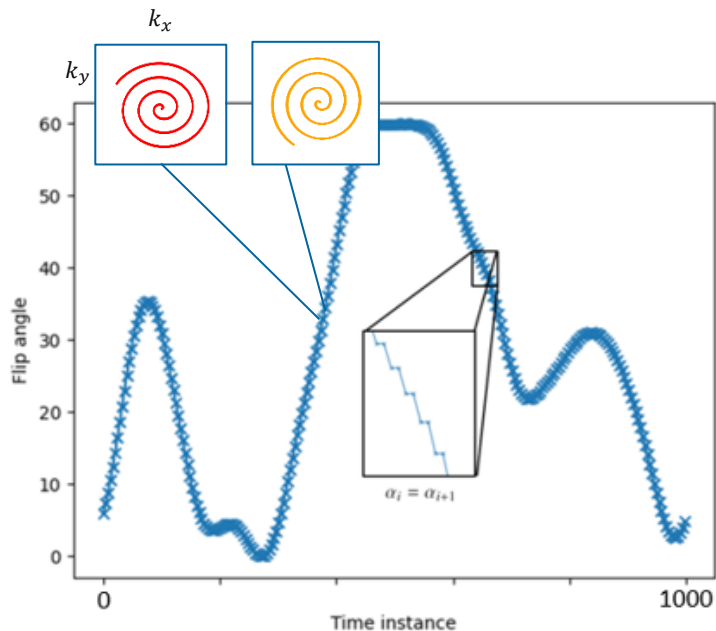
- 15 slices in 04:25 mins

| Parameter	Value
TE1	3.45 ms
TE2	4.60 ms
TR	17 ms
Acq. window	9.3 ms
Interleaves	1 / 29
Resolution	1.1 x 1.1 x 5
FoV	$(80 + 200 + 80)^2$

MRF acquisition details

- Single-spiral with a pseudo-golden-angle rotation
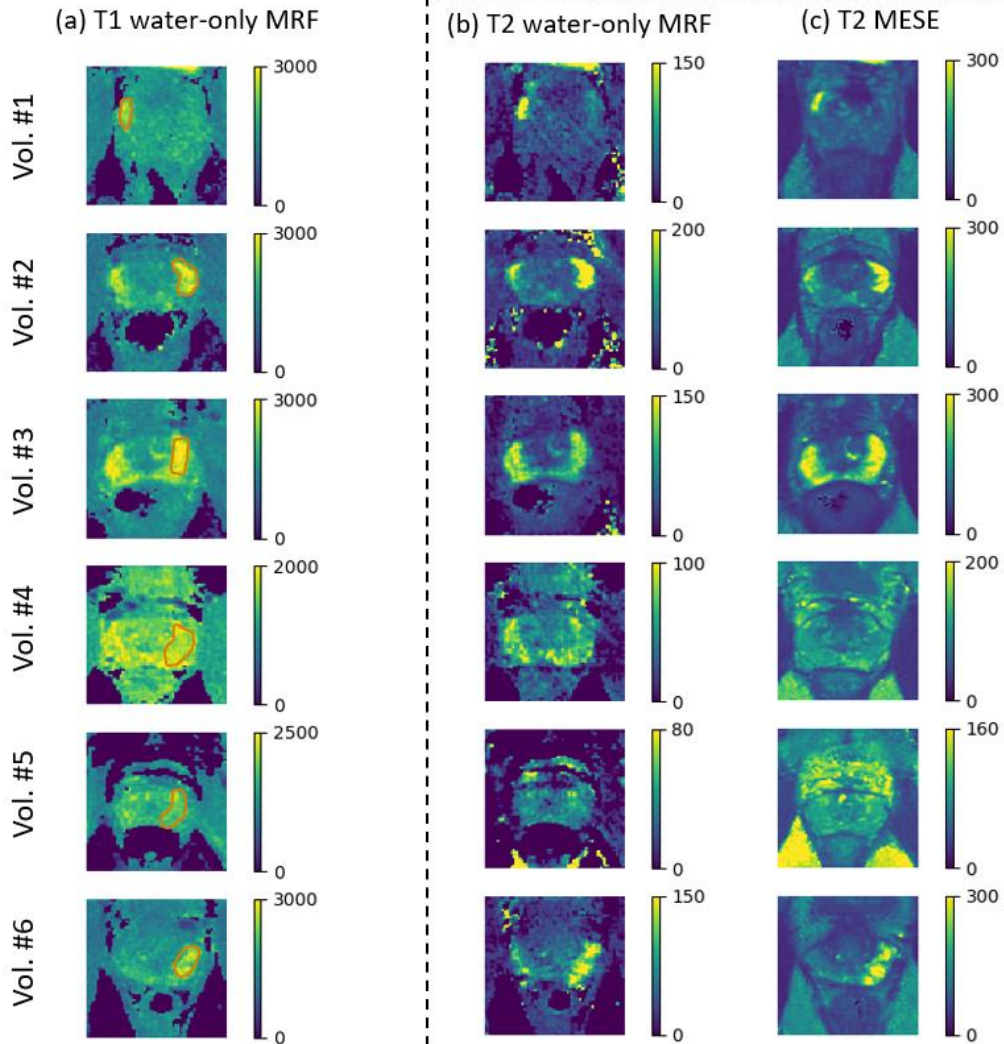- Two TEs alternating along the MRF train

Results I

ROI analysis of NPZ:

- MRF + T2 MESE reference[*]
- Observed strong variations wrt. volunteers; good agreement in T2

(a) T1 water-only MRF (b) T2 water-only MRF (c) T2 MESE

Vol. #1 Vol. #2 Vol. #3 Vol. #4 Vol. #5 Vol. #6
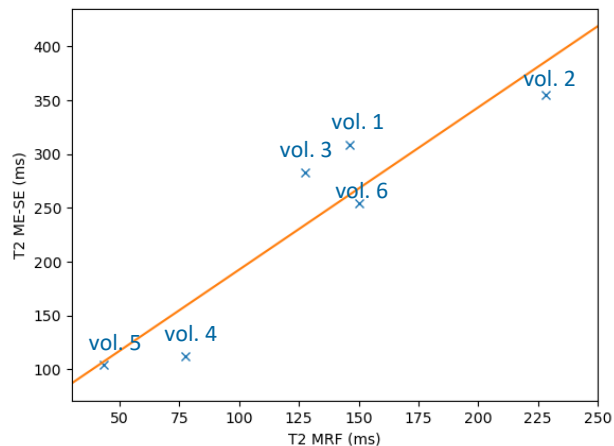
[*] TR = 5 s, 14 echoes, TEn = n*16 ms, 160° const. refocusing, 0.96 x 0.96 x 3 mm^3, SENSE R=7, scan time = 06:00min
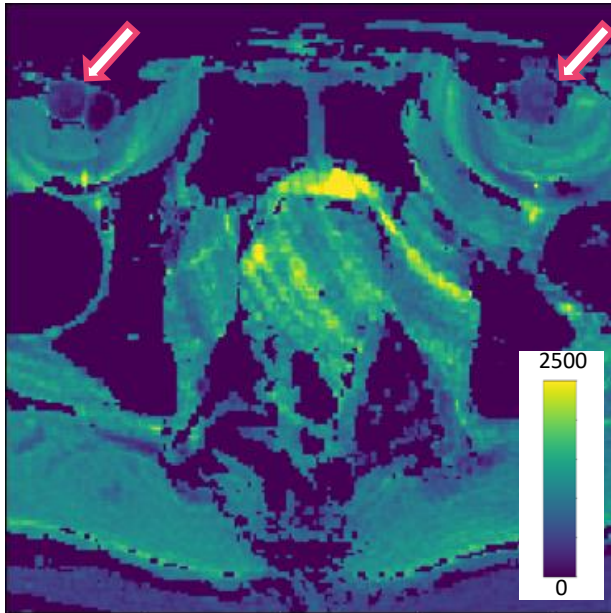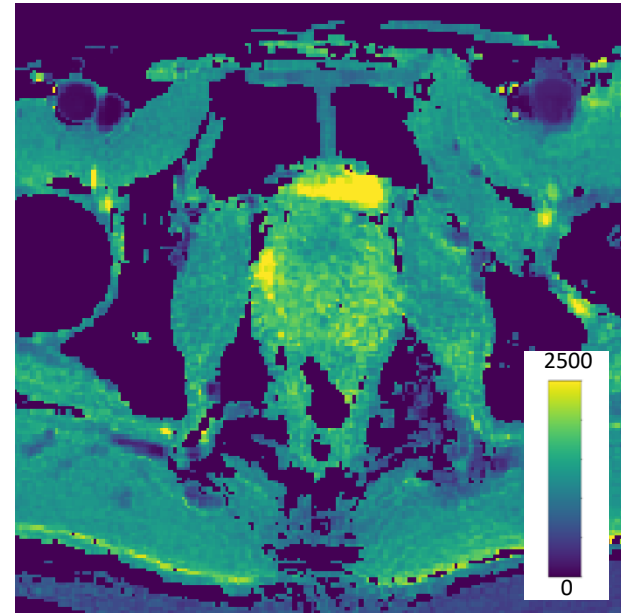
Results II

Flow compensation:

- Spiral artifacts from both arteries (✎) can be suppressed.

(a) T1 water-only wo/ flow compensation   (b) T1 water-only w/ flow compensation

Summary & discussion

Main achievements

- Development of MRF prostate protocol at clinically relevant resolution and acquisition time.
- Extension by water/fat separation and B_1^+ correction.
- Fully-integrated workflow without reconstruction latency.

Related work

- Radial Prostate-MRF[8]

Outlook

- Further improvement of flow suppression using REST slabs
- Improvement of spatial resolution
- Clinical investigations ongoing

Thank you! Questions?

[8] V. Yu et al. *ISMRM 2022*, #2600