

# COMPARING LEARNED VARIATIONAL NETWORKS AND COMPRESSED SENSING FOR $T_1\rho$ MAPPING OF KNEE CARTILAGE – PRELIMINARY RESULTS

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## Introduction

• To compare the use of Learned Variational Networks (VN) [1] and Compressed Sensing (CS) [2] for accelerating 3D- $T_1\rho$  mapping of the human knee cartilage.

## Methods

- 3D- $T_1\rho$  mapping was performed at 3T in 7 healthy volunteers [2].
- CS methods [2]: a) Spatial finite difference (SFD) transform and spatiotemporal FD (STFD); b) FISTA-FGP algorithm, 150 iterations; c) Regularization parameter from training set.
- VN [1]: a) parameters trained using 5000 iterations of Inertial Incremental Proximal Gradient; b) 24 filters of size 11x11.
- Training dataset from 3 volunteers (7680 images), and testing dataset from 4 volunteers (10240 images).
- Fitting using nonlinear least squares using pre-filtering with 3x3 average filter.
- Evaluation using normalized root mean square error (nRMSE) and median normalized absolute difference (MNAD).

## Results and Discussion

- Fig.1 (a)-(b) show image reconstruction quality (nRMSE) where VN performed as good as CS-STFD but superior to CS-SFD.
- Fig.1 (c)-(d) show  $T_1\rho$  mapping quality (MNAD).
- Fig.2 (a)-(h) show comparison of VN and CS spatial  $T_1\rho$  results with zoom into details of the maps.

## References

- [1] Hammernik et.al. "Learning a variational network for reconstruction of accelerated MRI data" Magn. Reson. Med. 2018;79:3055–3071. doi: 10.1002/mrm.26977..
- [2] Zibetti et al. "Accelerating 3D-T 1p mapping of cartilage using compressed sensing with different sparse and low rank models" Magn. Reson. Med. 2018; 80:1475-1491. doi: 10.1002/mrm.27138.

Numerical Results: VN vs CS

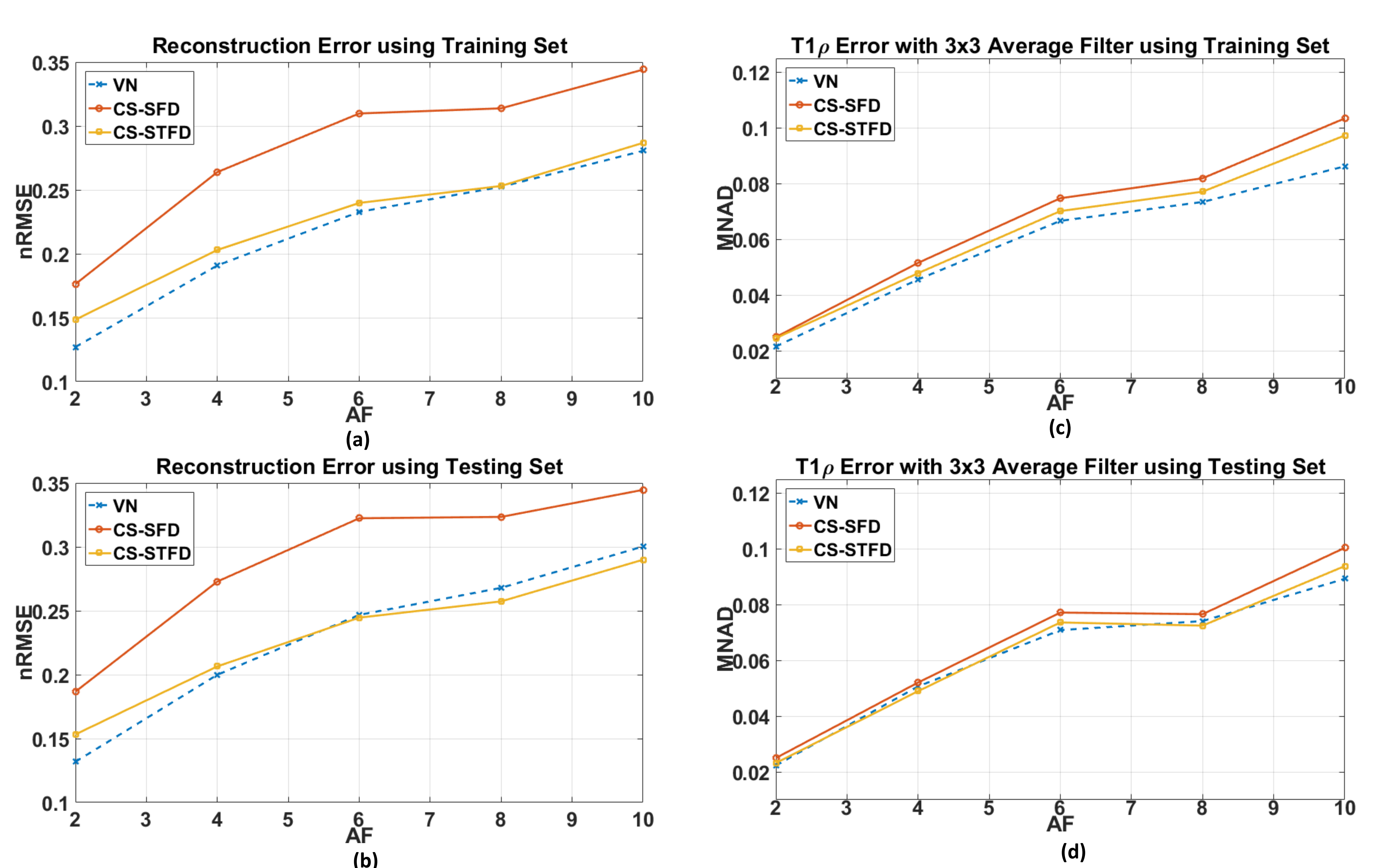


Fig.1 (a) shows image reconstruction error (nRMSE) for the training set and (b) for the testing set for different acceleration factors (AF). Fig (c) shows the  $T_1\rho$  mapping error (MNAD) for the training set and (d) for the testing set.

Accelerated  $T_1\rho$  Maps: VN vs CS

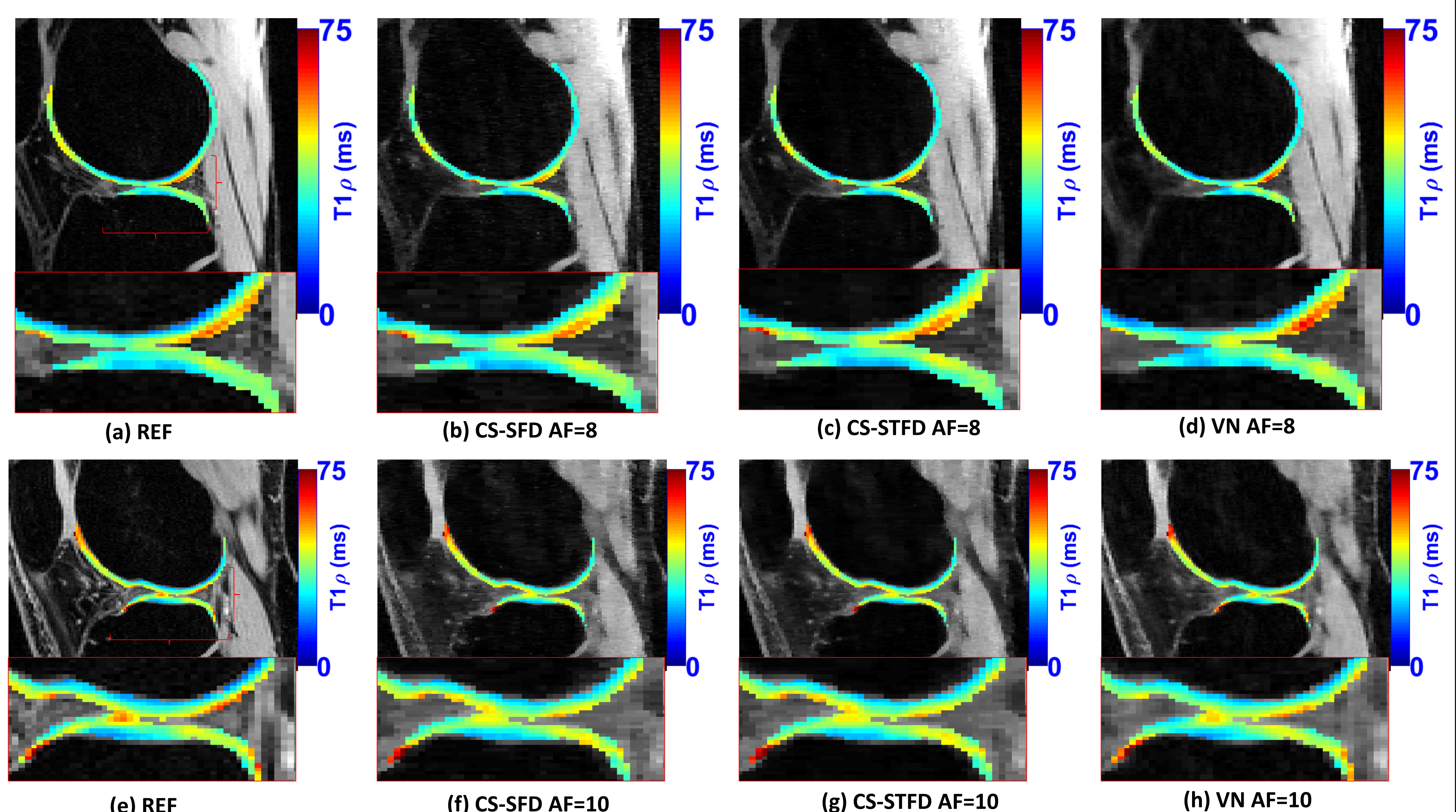


Fig.2 (a)-(d) shows images and  $T_1\rho$  maps obtained from the training set, at 8-fold acceleration factor (AF). Some detailed zoom in maps are also provided. Fig.2 (e)-(h) images and  $T_1\rho$  maps obtained from the testing set, at 10-fold AF, and some detailed zoom in maps.

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