Imaging with **less data** by tailoring the **acquisition** to the **reconstruction** and including prior information

Precision reconstruction for vessel-encoded ASL angiography.

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INTRO

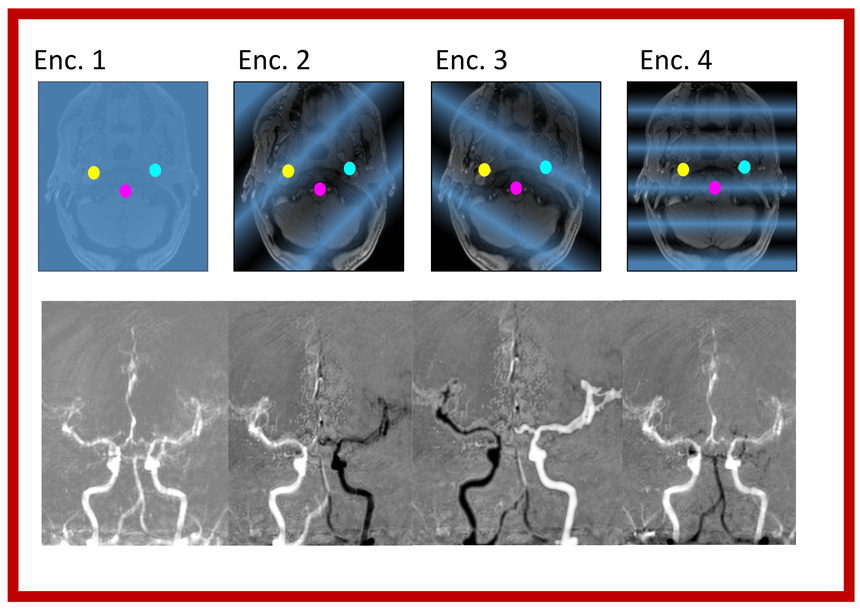
- Traditional image reconstruction (Fourier transform) is limited by the Nyquist Limit.
- Modern methods like Parallel Imaging[1,2] (PI) and Compressed Sensing[3,4] (CS) allows for breaking the Nyquist limit **BUT** are generally designed as recipes for diverse types of MR data.
- Vessel-Encoded Arterial Spin Labelling (VE-ASL)[5] angiography is a promising technique for studying vessel selective blood flow in the brain, but it is a time consuming technique.
- To improve image quality and reduce imaging time of VE-ASL angiography, the acquisition and reconstruction methods can and should be jointly optimised.

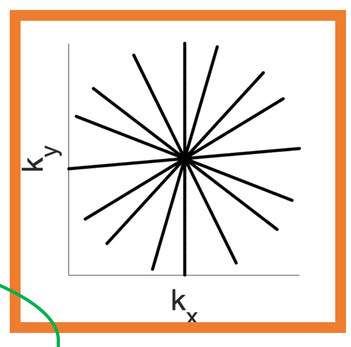
METHODS

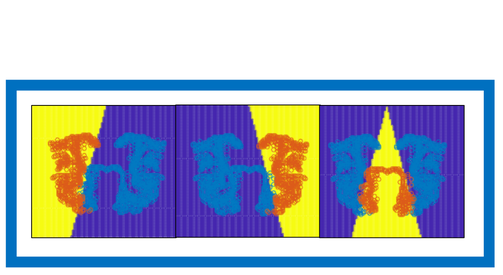
- Simulations on numerical phantom.
- 3 blood + 1 static tissue images.
- 2D golden angle radial acquisition[6,7].
- 8 orthogonal receive coils
- **Optimised acquisition** for improved incoherence – vary spoke trajectories between encodings
- **Optimised reconstruction** taking into account likely spatial distribution of signal.

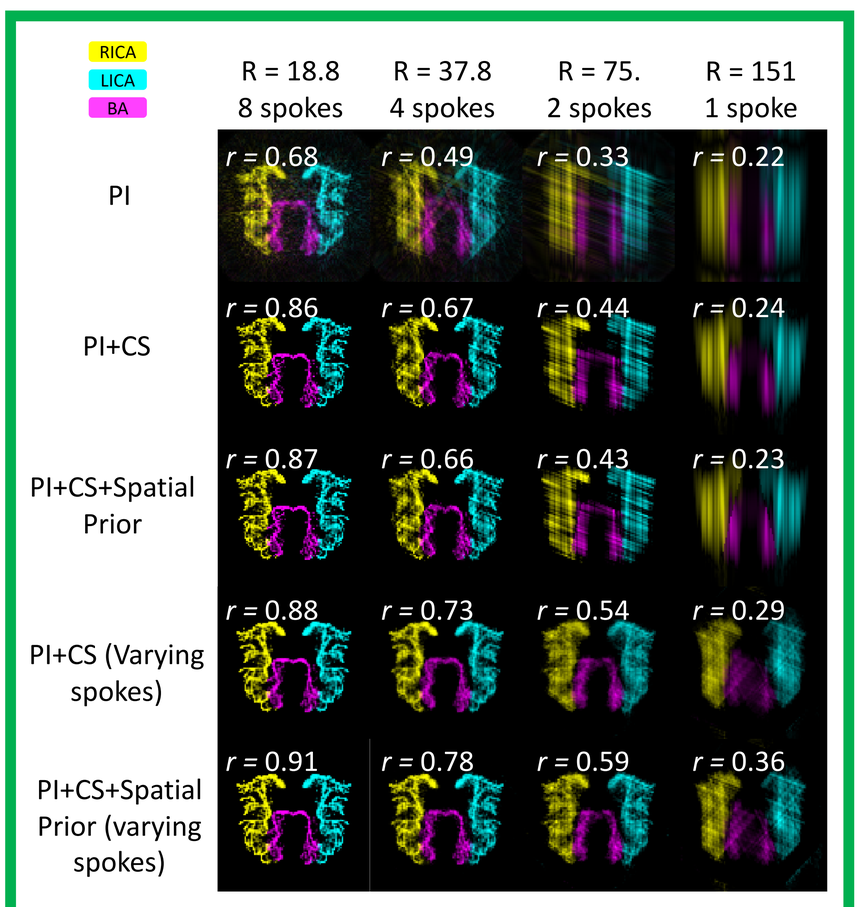
RESULTS

- High correlation coefficients (*r)* between reconstructions and ground truth at high acceleration factors (R = 18.8, 37.8, 75.5, 151) when acquisition and reconstruction is optimised.
- Both optimising the acquisition and the reconstruction protocol improves image quality, but varying the spokes has a larger positive effect.









DISCUSSION

- Spatial priors were generated from ground truth (but can be generated from low-resolution or temporal average image).
- Strong static tissue signal can disrupt reconstruction with varying spokes (can be mitigated with background suppression or sparsifying the static tissue).
- The observations made in these simulations will need to be validated in vivo.

References:
[1] Pruessmann KP, et al. Magn. Reson. Med. 42: 952-962 (1999). [2] Griswold MA, et al. Magn. Reson. Med. 47: 1202-1210 (2002). [3] Donoho DL. IEEE Trans. Inf. Theory. 52: 1289-1306 (2006). [4] Lustig M, et al. Magn. Reson. Med. 58: 1182-1195 (2007). [5] Wong EC. Magn. Reson. Med. 58: 1086-1091 (2007). [6] Okell TW. Magn. Reson. Med. 81: 182-194 (2019). [7] Schauman SS, et al. BioRXiv. 673475 (2019).

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