

Accelerated spiral Fourier velocity encoded imaging



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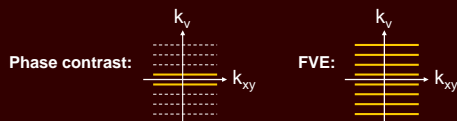
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Accelerated spiral FVE

- SSFP? Nope.
- T1 or T2 weighted imaging? Not really.
- Magnetization preparation? Don't think so.
- This talk is about:
 - Flow quantitation
 - Reconstruction from undersampled k-space

Motivation

- Peak velocity in flow jets
 - Stenosis, regurgitation, atherosclerosis
- Phase contrast is not appropriate for flow jets (partial volume) Tang et al. JMRI 1993;3:377
- Fourier velocity encoding (FVE) is robust to partial volume

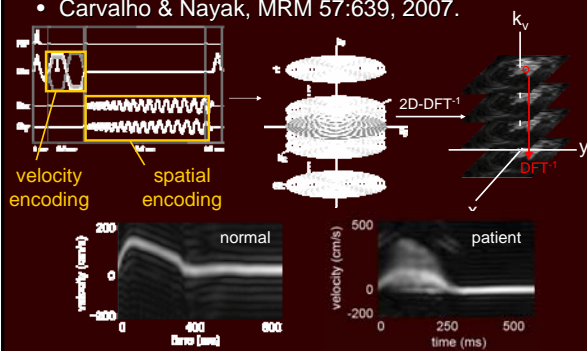


Spiral FVE

- Carvalho & Nayak, MRM 57:639, 2007.
- Fully-localized velocity distribution in a single breath-hold

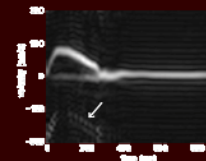
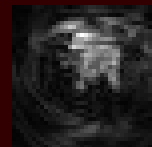
Spiral FVE

- Carvalho & Nayak, MRM 57:639, 2007.



Spiral FVE: limitations

- Low spatial resolution
- Off-resonance
- Insufficient velocity FOV
- Moderate temporal resolution



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Accelerated spiral FVE

- Exploits sparseness and symmetries
- Techniques:
 - Variable-density spirals
 - Temporal acceleration (UNFOLD)
 - Partial Fourier reconstruction

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Variable-density spirals

Tsai et al. MRM 2000;43:452

- Shorter readouts
 - Less off-resonance
 - Higher temporal resolution
- Higher spatial resolution
 - Better spatial localization of flow

2-fold acceleration

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V-D spirals: results

U-D	V-D	V-D	V-D	V-D
7 mm	4.7 mm	7 mm	4.7 mm	3.6 mm
8 ms	8 ms	4 ms	4 ms	4 ms
1 interleaf	1 interleaf	1 interleaf	2 interleaves	3 interleaves

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Madore et al. MRM 1999;42:81
Tsao. MRM 2002;47:202

UNFOLD

- k - t space

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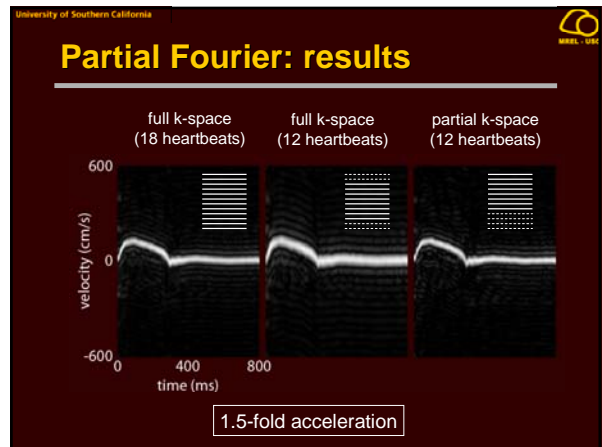
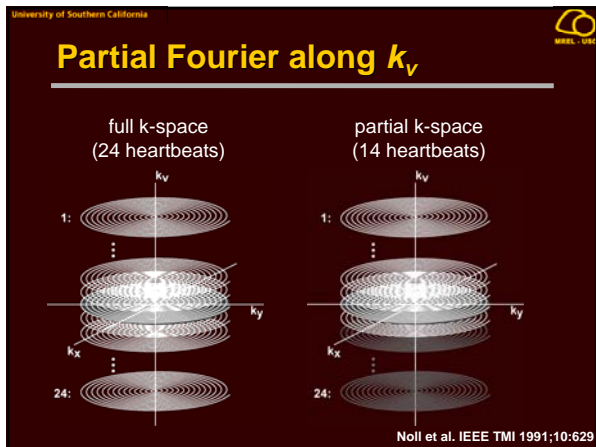
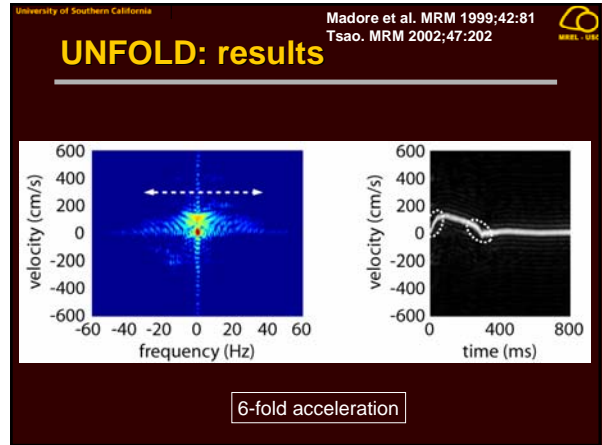
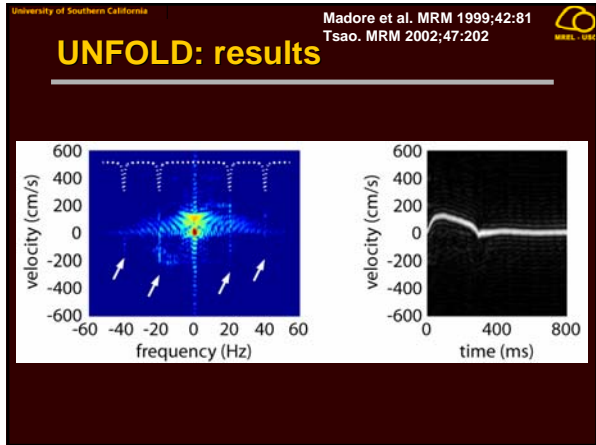
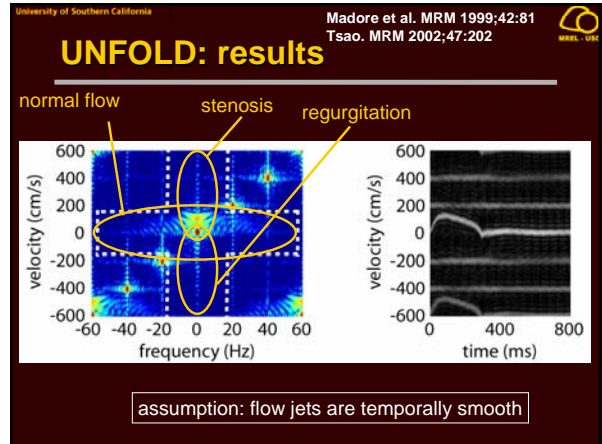
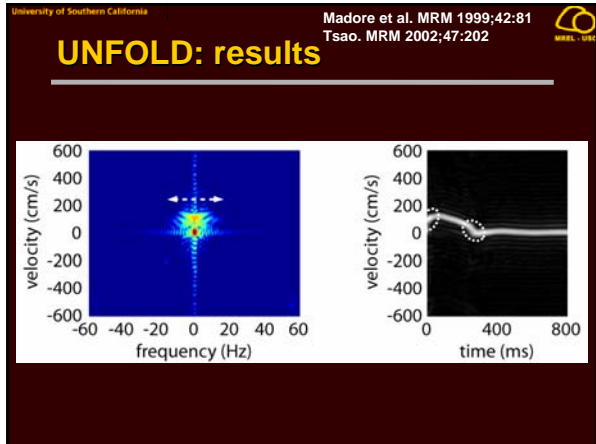
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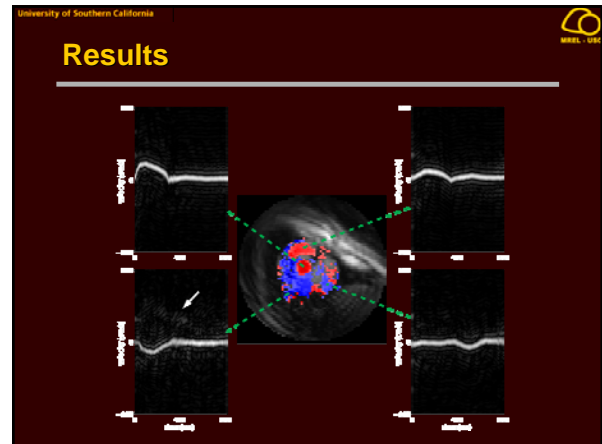
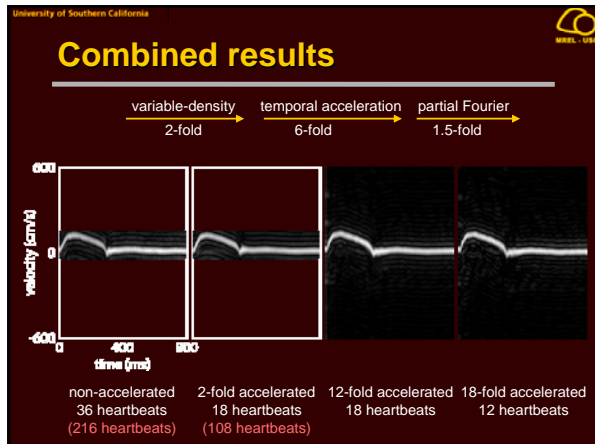
UNFOLD: results

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Madore et al. MRM 1999;42:81
Tsao. MRM 2002;47:202

UNFOLD: results





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- Improvements**
- Spatial resolution
 - Improved from 7 mm to 3.6 mm
 - Reduced off-resonance effects
 - Velocity FOV
 - Expanded from 8 m/s to 12 m/s
 - Temporal resolution
 - Originally 26 ms
 - Now: 9 ms (33 ms for high velocities)

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- Conclusions**
- Spiral FVE is a recently proposed method for rapid quantitation of flow jets
 - The method was considerably improved using three different techniques
 - 18-fold acceleration
 - Several improvements
 - No increase in scan time
 - No significant artifacts
 - Patient validation is planned

Acknowledgement

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<http://mrel.usc.edu>