Journal of Cardiovascular Magnetic Resonance

BioMed Central

Meeting abstract

Open Access

1110 Improved real-time cine with the use of a 32-channel cardiac array and Karhunen-Loeve Transform filter

Yu Ding*[1], Yiucho Chung[2], Titus Lanz[3], Subha V Raman[4] and Orlando P Simonetti[5]

Address: [1]The Dorothy M. Davis Heart and Lung Research Institute, The Ohio Sate University, Columbus, OH, USA, [2]Siemens Medical Solutions, Chicago, IL, USA, [3]RAPID MR International, Columbus, OH, USA, [4]The Dorothy M. Davis Heart and Lung Research Institute, Department of Internal Medicine, The Ohio State University, Columbus, OH, USA and [5]The Dorothy M. Davis Heart and Lung Research Institute, Department of Internal Medicine, Department of Radiology, The Ohio Sate University, Columbus, OH, USA

* Corresponding author

from 11th Annual SCMR Scientific Sessions
Los Angeles, CA, USA. 1–3 February 2008

Published: 22 October 2008

Journal of Cardiovascular Magnetic Resonance 2008, **10**(Suppl 1):A235 doi:10.1186/1532-429X-10-S1-A235

This abstract is available from: http://jcmr-online.com/content/10/S1/A235

Introduction

Real-time cine MRI can be accelerated with parallel acquisition techniques at the expense of signal-to-noise ratio (SNR). 32-channel coil arrays can reduce the SNR loss at high acceleration rates [1]. The Karhunen-Loeve Transform (KLT) filter can enhance SNR in dynamic images without compromising image information [2]. In this work, we investigate the combination of a 32-channel cardiac array with KLT filtering to maintain SNR at high parallel acceleration rates.

Purpose

Our standard clinical real-time SSFP cine method [3] utilizes a 12-channel array and TSENSE parallel acceleration rate R3. The purpose of this study is to demonstrate that the combination of a 32-channel array and KLT filter permits higher acceleration rates while maintaining sufficient SNR. Higher acceleration can in turn be used to improve the temporal or spatial resolution of real-time cine.

Methods

The study was performed on a 1.5 T MRI system (Avanto, Siemens Medical Solutions, Inc). Five normal volunteers (age range from 25 to 54 with mean age 34) were imaged after giving written informed consent. Eight 256-frame real-time SSFP cines in the same mid-ventricular short axis view were acquired in each volunteer. Four cines with TSENSE rates R1, R3, R4 and R5 were acquired using a standard 12-channel array, and four additional cines with the same imaging parameters were acquired using a 32-channel coil (RAPID International, LLC). Other imaging parameters were: 192 × 144 matrix, 8.0 mm thick slice, flip angle 68 degrees, TE = 1.02 ms, TR = 1.62 ms, pixel bandwidth = 1370 Hz/pixel. The SNR was defined as the ratio of mean signal in the left ventricular blood pool to the noise standard deviation (SD) in the heart region. The noise in the heart region was evaluated using a modified temporal subtraction method [4]. All images were KLT filtered and the SNR compared between filtered and unfiltered images, and between 12-channel and 32-channel acquisitions. The KLT filter cutoff was set at 40/256 eigenimages based on an evaluation of the autocorrelation of the eigenimages. No significant spatial structure was evident beyond the 40th eigenimage, so this cutoff was expected to have no significant impact on image information content while providing an expected reduction in image noise of 60%.

Results

Table I compares the SNR (mean ± SD) of the 12- and 32-channel coils without KLT filtering, and the 32-channel coil with KLT filter. Without filtering, no significant difference was observed between the coils at R1 or R3, but SNR improvement with the 32-channel coil alone nearly reached significance at R4 and R5. SNR was significantly improved with the KLT filter at all acceleration rates. A

direct comparison of images acquired using 12- and 32-channel coils with R3 before filtering, and R5 before and after KLT filtering is shown in Figure 1. Comparable SNR was observed using the 12-channel coil with R3 (our current standard method) and the 32-channel coil with R5 acceleration after KLT filtering.

Conclusion

Equivalent or better SNR is achieved at R5 with the combination of the 32-channel array and KLT filter compared to the standard coil without filter at R3. This results in a 67% improvement in imaging speed, which in this study was used to improve temporal resolution from 78 msec at R3, to 47 msec at R5. This gain in temporal resolution is important for the application of real-time cine in dobutamine and exercise stress CMR.

References

1. Wintersperger BJ, *et al.*: *JMRI* 2006, **23:**222.
2. Ding Y, *et al.*: *Proceedings of the 15th Annual Meeting of the ISMRM* 2007:3608.
3. Simonetti OP, *et al.*: *Proceedings of the 14th Annual Meeting of the ISMRM* :3598.
4. Schoenberg SO, *et al.*: *Parallel imaging in clinical applications Springer*; 2007.

Table 1: SNR comparison. The combination of a 32-channel cardiac array and Karhunen-Loeve image filter is utilized to maintain SNR in highly accelerated real-time cine imaging.

	12-channel unfiltered	32-channel unfiltered	p value 2-channel vs. 32-channel unfiltered	32-channel KLT-filtered	p value 32-channel unfiltered vs. KLT filtered
No TSENSE	97.8 ± 20.7	90.6 ± 26.3	0.4775	n/a	n/a
TSENSE Rate 3	31.9 ± 2.4	28.6 ± 4.3	0.1151	61.9 ± 10.3	0.0011
TSENSE Rate 4	20.4 ± 3.7	22.2 ± 3.8	0.0605	48.8 ± 6.5	< 0.001
TSENSE Rate 5	10.9 ± 3.3	15.2 ± 4.7	0.0556	38.6 ± 9.3	< 0.001

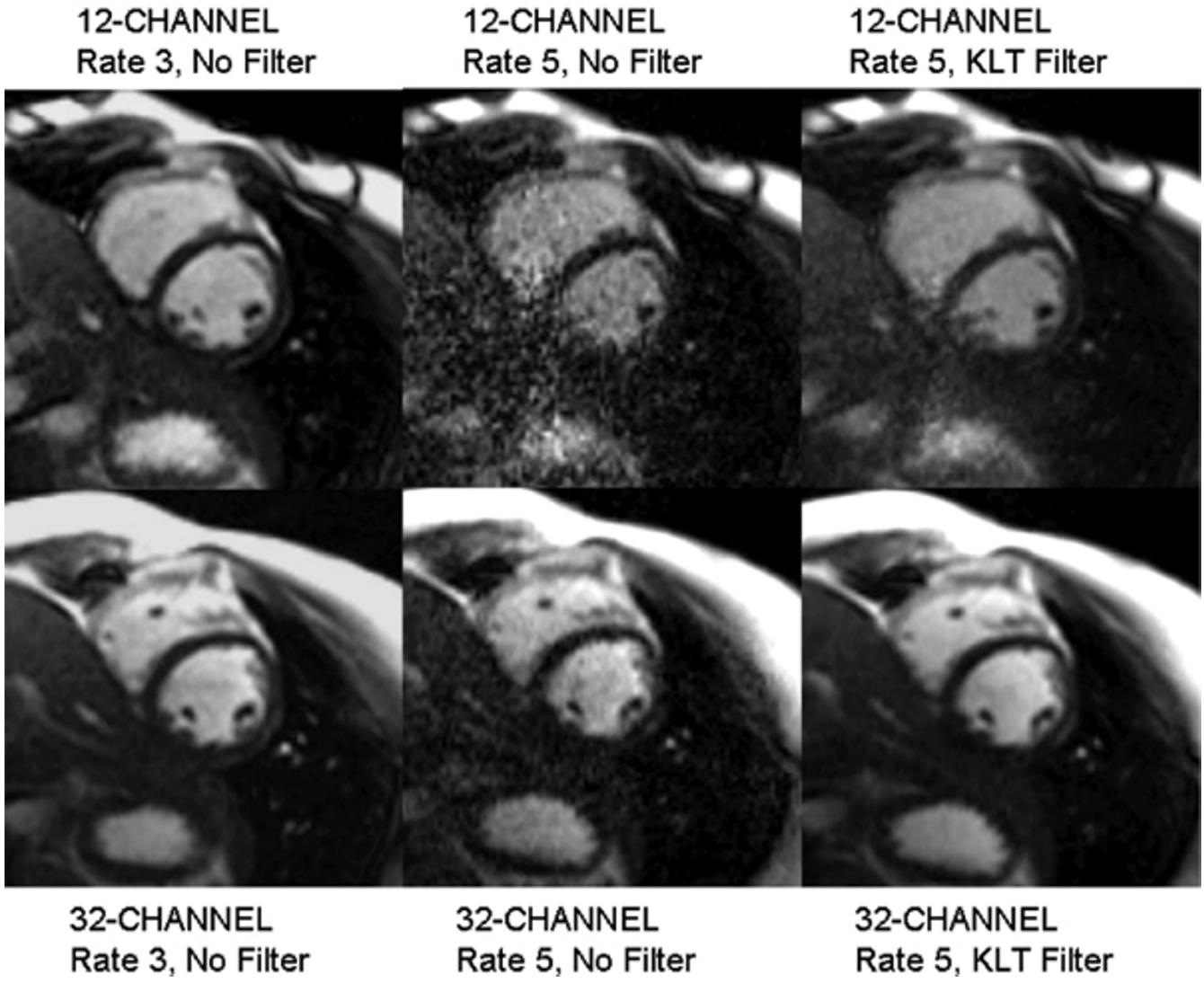

Figure 1
Comparison of 12-channel and 32-channel coil results, with and without KLT filtering.