Addy et al. Journal of Cardiovascular Magnetic Resonance 2014, 16(Suppl 1):P380
http://www.jcmr-online.com/content/16/S1/P380

Journal of Cardiovascular Magnetic Resonance

POSTER PRESENTATION Open Access

Accelerated isotropic resolution 3D image-based navigators for coronary MR angiography

Nii O Addy[1*], Jieying Luo[1], R Reeve Ingle[1], Bob S Hu[1,2], Dwight G Nishimura[1]

From 17th Annual SCMR Scientific Sessions
New Orleans, LA, USA. 16-19 January 2014

Background

Motion remains a primary challenge for MR coronary angiography. In our previous protocol, we performed retrospective 3D motion correction based on a set of orthogonal 2D image-based navigators (iNAV) [1]. Recent work examined the use of anisotropic-resolution 3D Cartesian iNAVs every heartbeat [2]. Capitalizing on the efficiency of non-Cartesian imaging and iterative reconstruction, we sought an improved 3D iNAVs acquisition with isotropic resolution, to facilitate whole-heart motion correction with translational or more advanced models. In this work, we propose a method providing 3D motion correction on a per-heartbeat basis using a variable-density 3D cones iNAV acquisition [3].

Methods

Imaging was performed on a GE Signa 1.5 T Excite scanner with an 8-channel cardiac coil. Scans were acquired over a 28 × 28 × 14 cm3 FOV using an ATR-SSFP sequence and 3D cones trajectory [1]. The pulse sequence was modified by replacing the two 2D iNAVs with a single 3D cones acquisition collected after the last cardiac phase within the ATR-SSFP train. Due to the limited time window for the 3D iNAV, an under-sampled, variable-density trajectory was used. At 4.38 mm isotropic resolution, a fully sampled 3D cones acquisition would require 290 readouts. However, using a variable-density design, decreasing the sampling density from 1.0 at the k-space origin to 0.26 at kmax, a 32-readout trajectory was achieved corresponding to an acceleration factor of 9 and acquisition time of 175 ms. 3D iNAVs were first reconstructed with gridding which served as a starting point for ESPIRiT [4]. ESPIRiT used a single set of coil sensitivities derived from a central calibration region from the fully sampled 3D cones imaging data. 3D motion information was extracted with the Insight Toolkit [5], using mutual information as the metric. Whole-heart images with 1.25 mm isotropic resolution were reconstructed with gridding. To test the feasibility of the 3D iNAVs, translational motion correction was applied using linear phase modulation [1].

Results

Figure 1 shows the initial 3D iNAV reconstruction with gridding and the corresponding reconstruction with ESPIRiT. ESPIRiT significantly reduced the aliasing artifacts, revealing contrast and features useful for motion estimation. Figure 2 shows motion estimates derived from the 3D iNAVs, in this case translational, and the resulting sharpening of the right coronary artery after motion correction.

Conclusions

Acquiring 3D iNAVs every heartbeat, 3D motion of the heart was measured during a free-breathing coronary MRA acquisition to provide 100% respiratory efficiency and retrospective motion correction. Future work includes applying more advanced models based on the 3D iNAVs for improved correction.

Funding

NIH T32 HL007846 NIH R01 HL039297 GE Healthcare.

[1]Electrical Engineering, Stanford University, Stanford, California, USA
Full list of author information is available at the end of the article

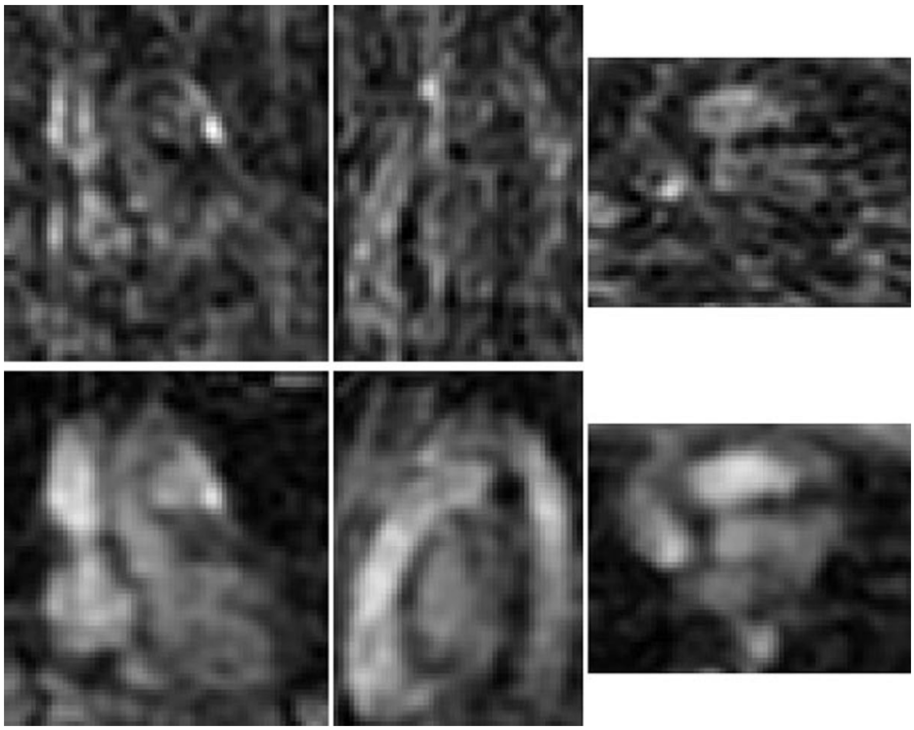

Figure 1 A single heartbeat 3D iNAV reconstructed with gridding (top) and ESPIRiT (bottom) displayed in coronal (left), sagittal (middle), and axial (right) planes.

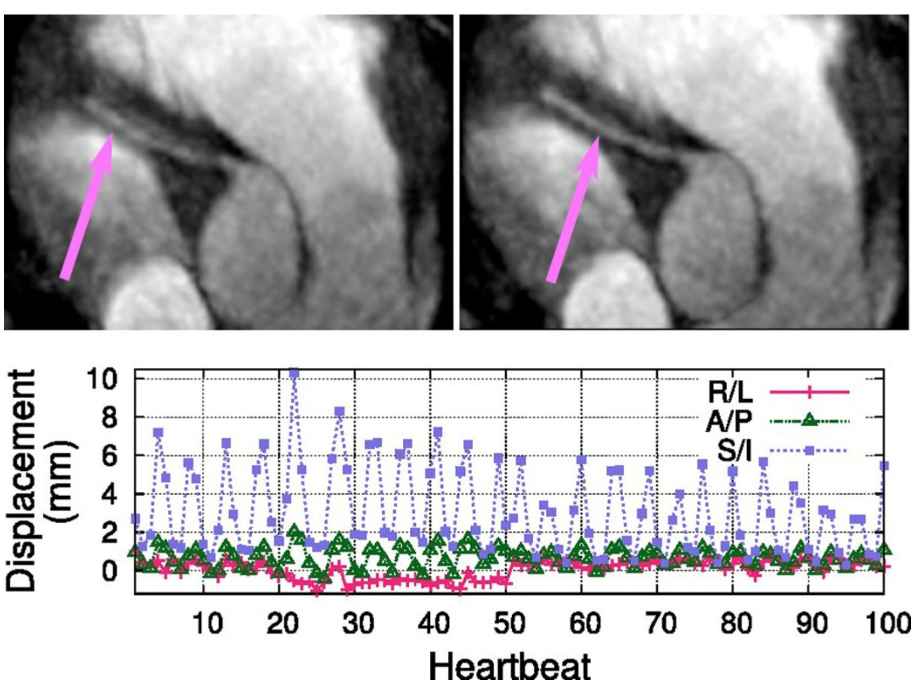

Figure 2 Uncorrected (left) and corrected images (right) images of the right coronary artery. Translation motion information from the first 100 heartbeats shown on bottom.

Authors' details
[1]Electrical Engineering, Stanford University, Stanford, California, USA. [2]Palo Alto Medical Foundation, Palo Alto, California, USA.

Published: 16 January 2014

References

1. Wu HH, *et al*: *MRM* 2012, **69**:1083-1093.
2. Moghari M, *et al*: *MRM* 2013, Early View.
3. Addy NO, *et al*: *Proc. 20th ISMRM* 2012, 4178.
4. Uecker M, *et al*: *MRM* 2013, Early View.
5. Luis I, *et al*: *The ITK Software Guide, 2nd ed. Updated for ITK version 2.4* 2005.

doi:10.1186/1532-429X-16-S1-P380
Cite this article as: Addy *et al.*: Accelerated isotropic resolution 3D image-based navigators for coronary MR angiography. *Journal of Cardiovascular Magnetic Resonance* 2014 **16**(Suppl 1):P380.