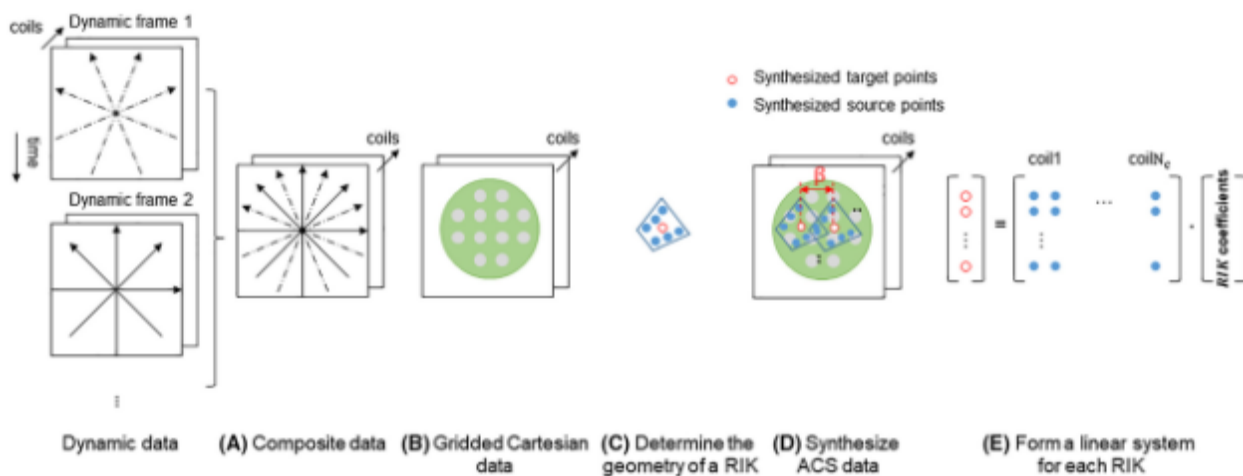




Non-Cartesian k-space reconstruction to improve acquisition efficiency

A non-Cartesian k-space reconstruction method using self-calibrated, region-specific interpolation kernels for highly accelerated acquisitions in MRI.

Technology No. 2019-114



IP Status: US Patent Pending; **Application #:** 16/853,308

Applications

- MRI parallel imaging
 - Non-Cartesian imaging
 - 3D imaging
 - 4D high-resolution imaging using kooshball acquisition

Key Benefits & Differentiators

- Eliminates lengthy reference scans or long reconstruction times
- Determines interpolation kernels based on the data itself rather than requiring an additional reference scan
- Highly accelerated reconstruction with comparable image quality to TT-GRAPPA (currently available non-Cartesian) technique; 3-5 times faster than CG-SENSE technique

- Provides increased temporal resolution without loss of spatial resolution
- Ideal for free-breathing scanning as there is no calibration steps

Overview

In MRI scanning, parallel imaging techniques such as GRAPPA use properties of multicoil receiver arrays to recover missing k-space data points using nearby acquired k-space samples. In conventional non-Cartesian GRAPPA with through-time GRAPPA (TT-GRAPPA), the use of region-specific interpolation kernels has demonstrated improved reconstruction quality in dynamic imaging for highly accelerated acquisitions. However, TT-GRAPPA requires the acquisition of a large number of separate calibration scans, which lengthens overall scan duration; for every ~20 s data acquired, there is a ~3 min calibration data acquisition step.

To eliminate calibration steps and reduce overall scan time, researchers at the University of Minnesota have developed a new reconstruction method named Self-calibrated Interpolation of Non-Cartesian data with GRAPPA (SING) to self-calibrate region-specific interpolation kernels from dynamic undersampled measurements. The SING method synthesizes calibration data to adapt to the distinct shape of each region-specific interpolation kernel geometry, and uses a novel local k-space regularization through an extension of TT-GRAPPA. This calibration approach is used to reconstruct non-Cartesian images at high acceleration rates while mitigating noise amplification. Researchers have shown that SING offers visually and quantitatively similar reconstruction quality to TT-GRAPPA, and provides improved reconstruction quality over conjugate-gradient SENSE in both numerical phantom and in vivo cine data sets. In the SING method, the computational burden is spent up-front and is low for subsequent data; and can be highly parallelized for rapid application such as for free-breathing scans.

Phase of Development

Demonstrated in a 3T clinical field strength scanner for cardiac imaging with radial acquisition.

Desired Partnerships

This technology is now available for:

- License
- Sponsored research
- Co-development

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References

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<https://doi.org/10.1002/mrm.28033>, Magnetic resonance in medicine 83, no. 5 (2020): 1837-1850.

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