Next Generation MRI Systems: High Resolution, Real-time Imaging

(OTT ID 1188)

Inventor: Lei (Leslie) Ying, Ph.D. Department of Electrical Engineering and Computer Science

For further information please contact:

Jessica Silvaggi
Licensing Manager
1440 East North Ave.
Milwaukee, WI 53202
Tel: 414-906-4654
jsilvaggi@uwmfdn.org

MRI: Problems and Approaches

Problems:

- Slow acquisition speed
- Poor image quality and many artifacts with accelerated acquisition
- Lack of gating-free dynamic imaging capabilities

Solution: Compressed Sensing in Parallel MRI:

- Better image resolution and fewer artifacts
- Faster acquisition speed
- Easy to implement into current MRI systems
- Lasting market – a large market already exists for MRI
- Larger market – improved speed will likely create new opportunities for advanced imaging applications

Market and Intellectual Property

Market and Opportunities

- The MRI global market is about $4.1 billion and is expected to reach $5.2 billion by 2018
- Functional imaging capabilities are expected to drive the future market
- High speed MRI has the potential to revolutionize the field making real-time, high resolution imaging possible for breast imaging, cardiology, brain surgery, cancer detection, and stroke diagnosis
- Faster MRI will also advance dynamic contrast-enhanced imaging, especially in three-dimensional imaging

Intellectual Property

- US Notice of Allowance for application 12/833,355
- This technology is available for licensing under exclusive or non-exclusive terms.

Compressed Sensing in Parallel MRI

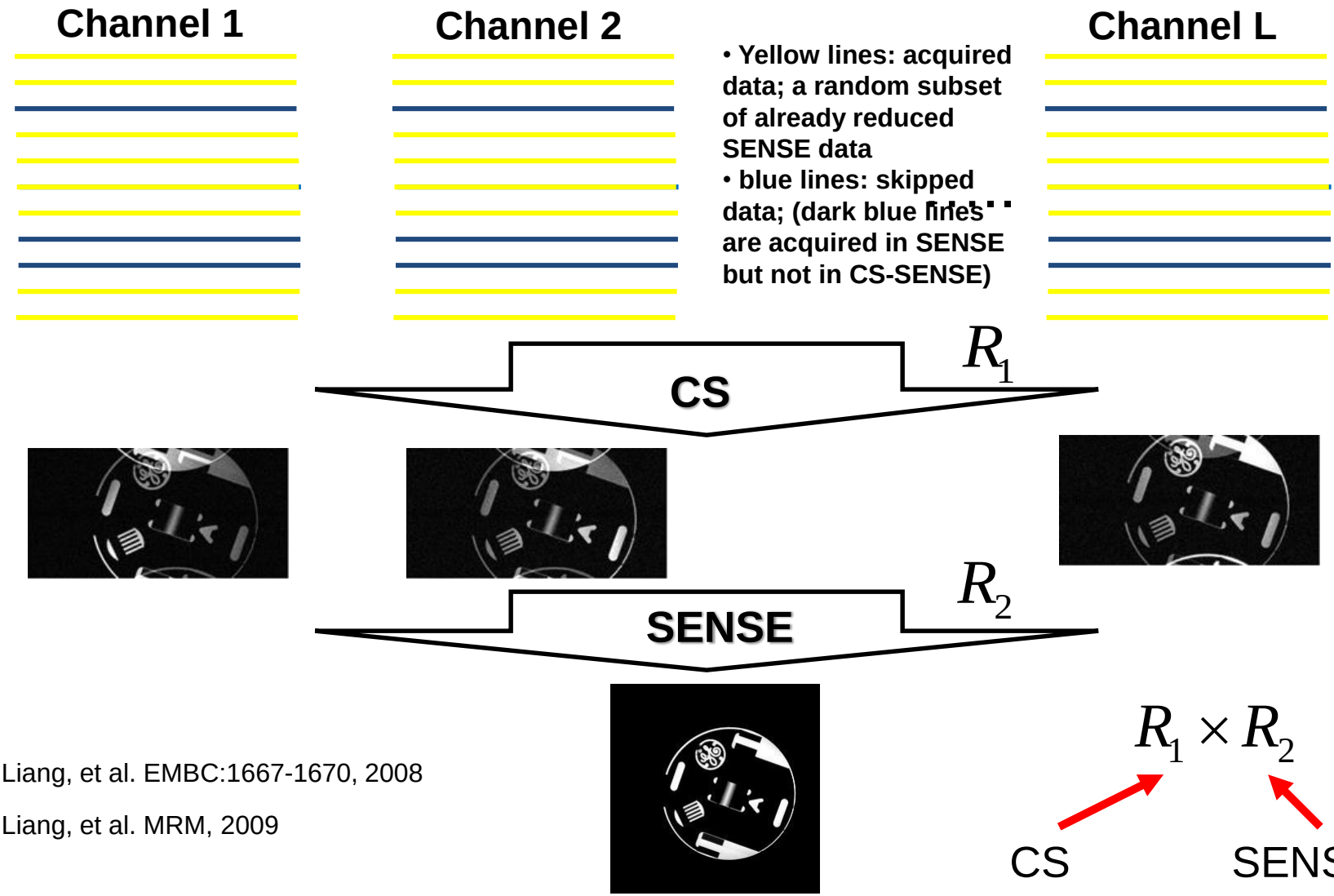
Motivation

- To integrate compressed sensing and parallel imaging which utilize different prior information (sensitivity and sparsity)
- To guarantee the incoherence condition of compressed sensing to be satisfied

Solution and Benefits

- CS-SENSE: Apply compressed sensing (SparseMRI[1]) and parallel imaging (SENSE[2]) sequentially
- Compression followed by parallel imaging involves a 2-step reduction
- This is a novel emerging technique leading to 4x acquisition speed
- Higher resolution images
- Easy to implement; simply change the software that performs image reconstruction; other current tools can be utilized

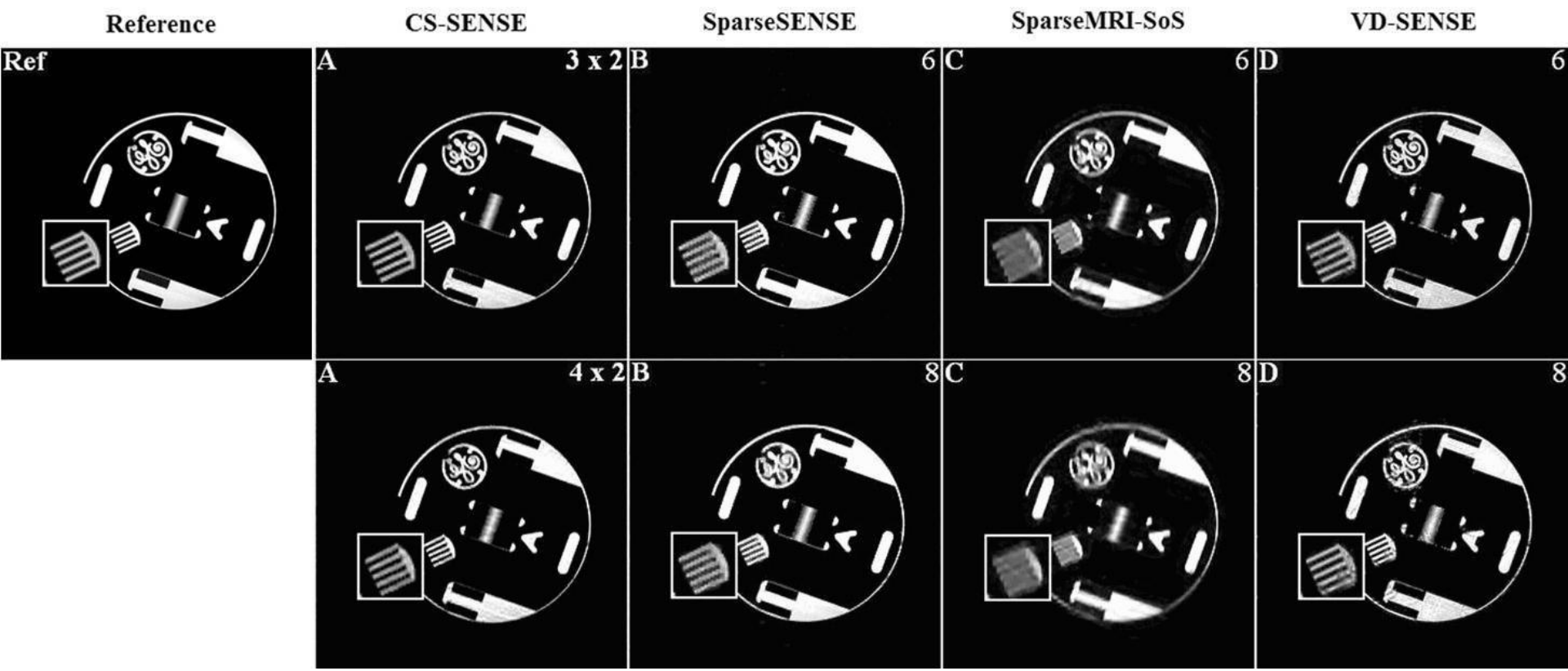
How CS-SENSE [1,2] work



[1] Liang, et al. EMBC:1667-1670, 2008

[2] Liang, et al. MRM, 2009

CS-SENSE Phantom Results: Improved Image Quality



8-channel, 256×256 matrix; reduction factor on the top right corner

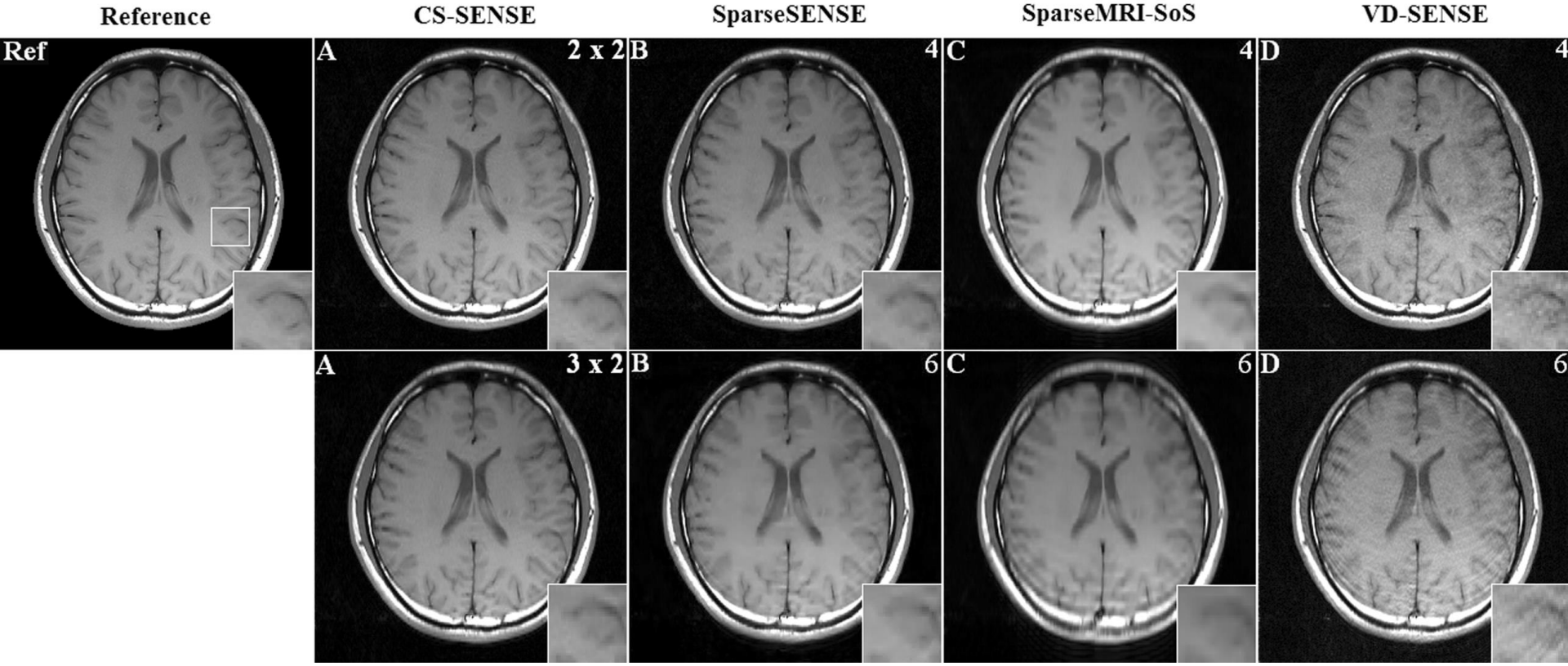
SparseSENSE[5-8]: Regularized SENSE with sparse constraint and random sampling

SparseMRI-SoS: SparseMRI for each coil (full FOV) + Sum-of-Square

VD-SENSE[9]: Variable-density SENSE

[5] Zhao, et al. ISMRM, 2008 [6] Wu, et al. ISMRM, 2008 [7] King, et al. ISMRM, 2008 [8] Liu, et al. ISMRM, 2008 [9] Madore. MRM, 52:310-320, 2004

CS-SENSE and Improved *In Vivo* Results



- **Better image resolution observed with CS-SENSE**

8-channel, 256×256 matrix; reduction factor on the top right corner

Summary

CS-SENSE: Compressed sensing in parallel MRI

- Sequential implementation of conventional compressed sensing (CS) followed by parallel imaging (pMRI)
- Achieves a reduction factor that is the product of the factors achieved by CS and pMRI
- Applications in dynamic and functional imaging, such as cardiac imaging, functional imaging, and dynamic contrast-enhanced (DCE) imaging, especially in three-dimensional imaging

Next Generation MRI Systems: High Resolution, Real-time Imaging

(OTT ID's 1114, 1169, 1188, 1208/1251)

Inventor: Lei (Leslie) Ying, Ph.D.
Department of Electrical Engineering and Computer Science

For further information please contact:

Jessica Silvaggi
Licensing Manager
1440 East North Avenue
Milwaukee, WI 53202
Tel: 414-906-4654