QSM Software Demo:

2016 Reconstruction Challenge

martinos.org/~berkin

qsm.rocks

Declaration of
Financial Interests or Relationships

Speaker Name: Berkin Bilgic

I have the following financial interest or relationship(s) to disclose with regard to the subject matter of this presentation:

- Licensing agreement with   Samsung
- Research support from   Siemens

Recon Challenge

- Showcase QSM Recon Challenge 2016

- Data available at

qsm.rocks

- Includes input phase, ground truth QSM, evaluation metrics, simple dipole inversion methods for benchmarking

Recon Challenge: Goals

■ Goals:

1. test ability of existing algorithms to recover susceptibility from in vivo phase data

2. serve as a common dataset for testing and benchmarking future algorithms

3. disseminate the results and lessons learned in a participant-driven paper
   -> in revision
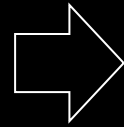
qsm.rocks

Goals of this demo

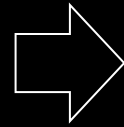- Challenge toolbox did not include the phase processing pipeline, only raw and tissue phase images
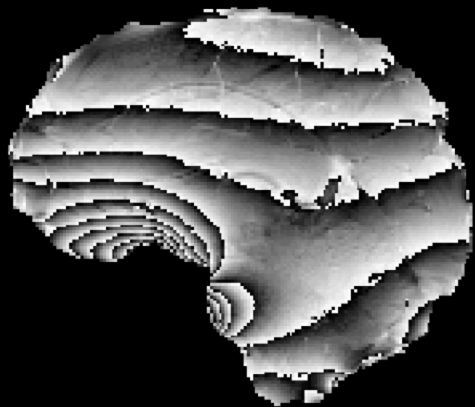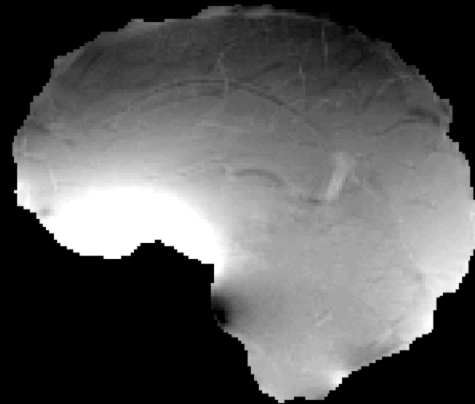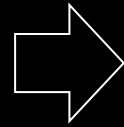

raw phase → unwrapped → LBV phase → input phase

Goals of this demo

- Challenge toolbox did not include the phase processing pipeline, only raw and tissue phase images

- Goals of this software demo:

  1. bridge this gap by starting from raw, wrapped phase and go through all the processing steps that went into the Challenge

  2. serve as a simple, stand-alone toolbox that could be a starting point for QSM recon in clinical and research studies

- Software will be available at:

martinos.org/~berkin/qsm_demo.zip

Magnitude transversal orientation
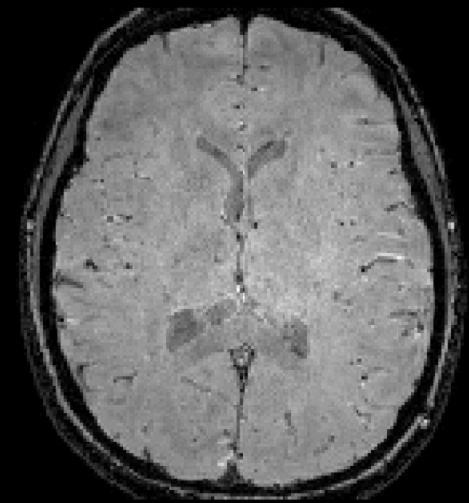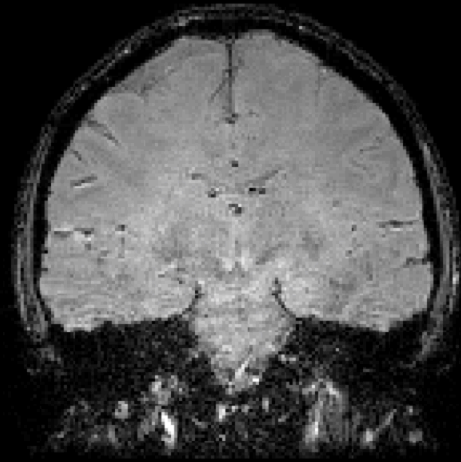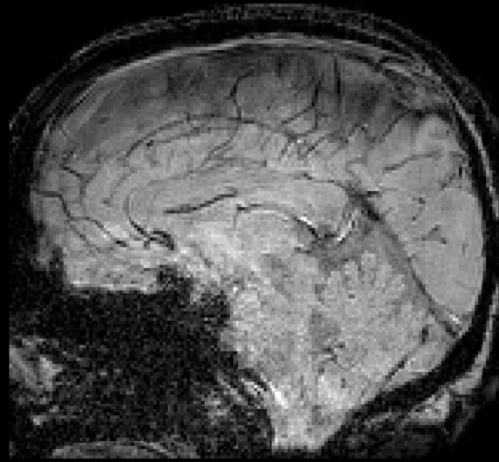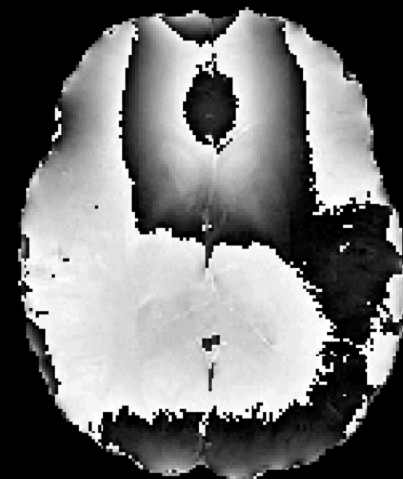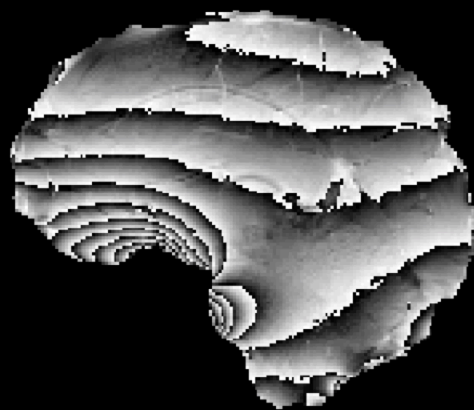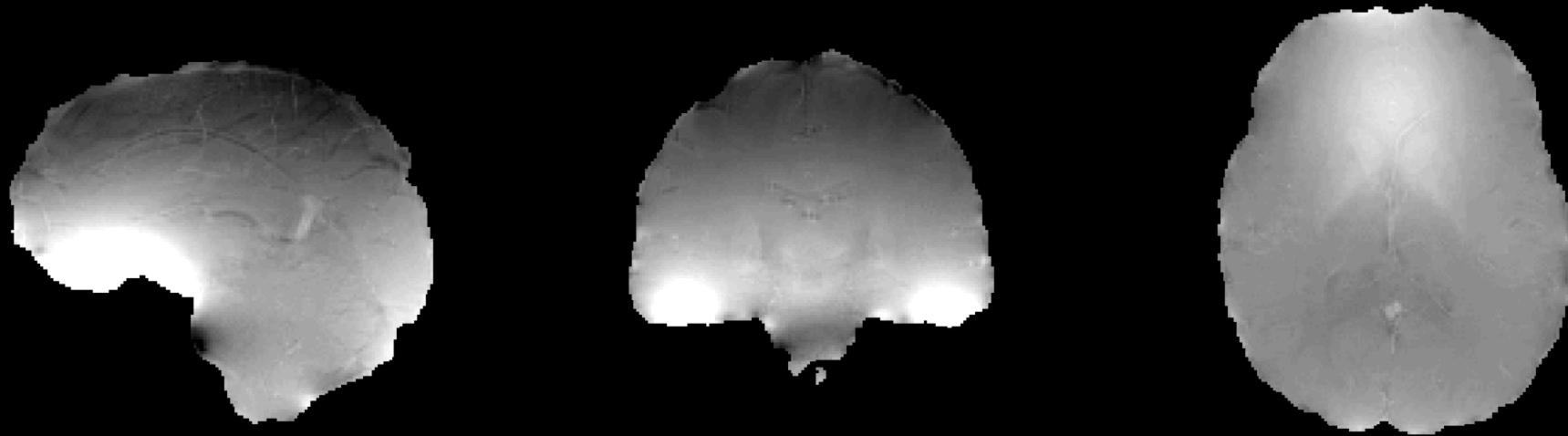
Magnitude: BET brain mask [1]
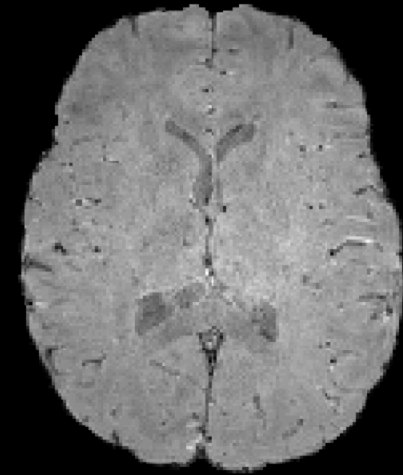
1. SM Smith HBM'02

Raw phase

Laplacian unwrapping [2]: STI Suite

2. W Li et al NIMG'11

-2π 2π

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- Roemer coil combination fails to remove B1+ phase and includes some contribution from B1- of the body coil

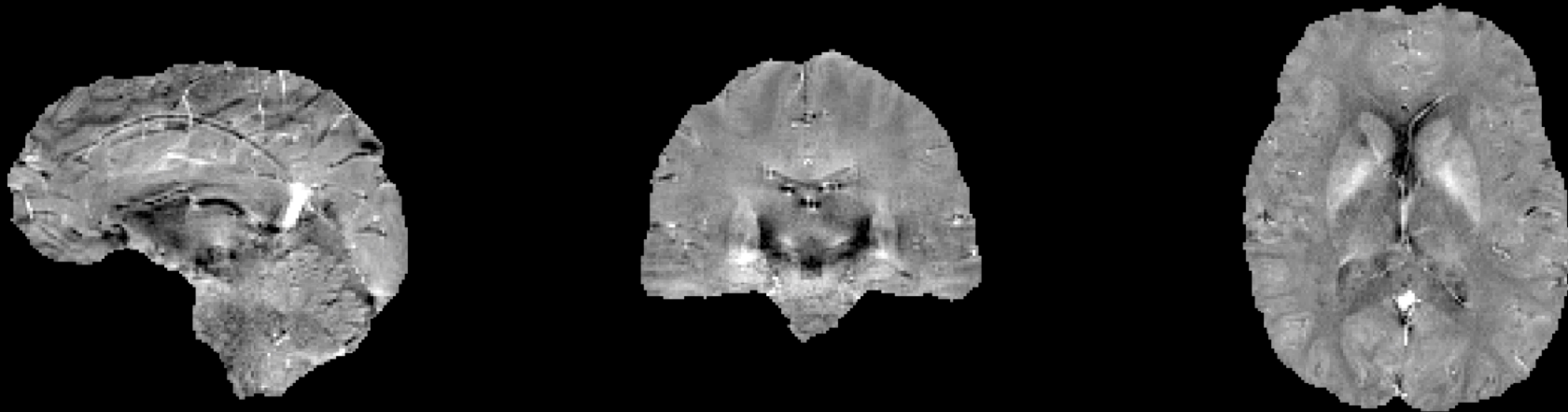Laplacian Boundary Value (LBV) background removal [3]: MEDI Toolbox
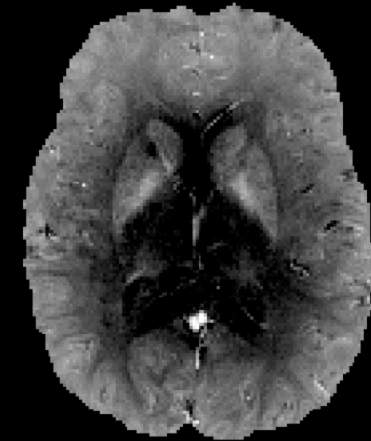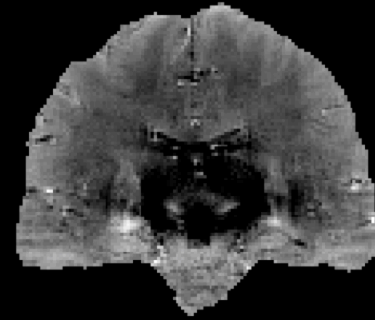
in ppm, normalized by $(\gamma \cdot TE \cdot B_0)$
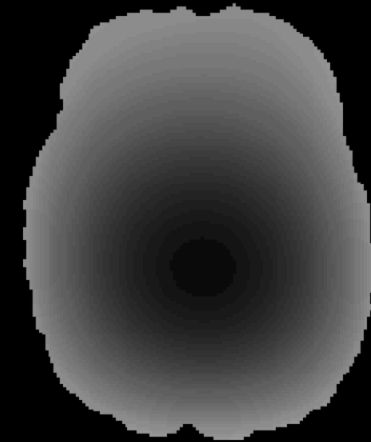
3. D Zhou et al NMR in Biomed'14

-0.05ppm   0.05ppm

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- To mitigate this transmit phase, fit and subtract 3D polynomial

Input phase presented to the contestants

-0.05ppm   0.05ppm

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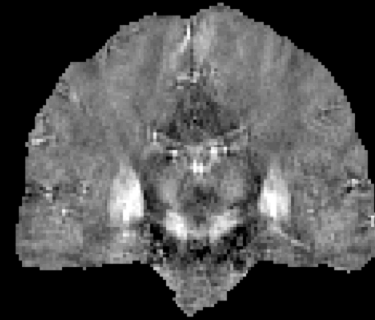
Removed polynomial fit
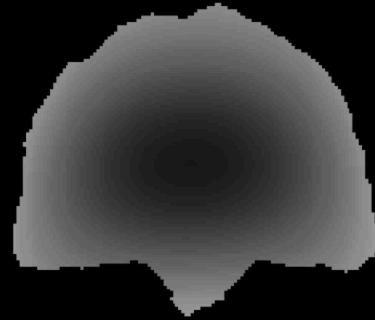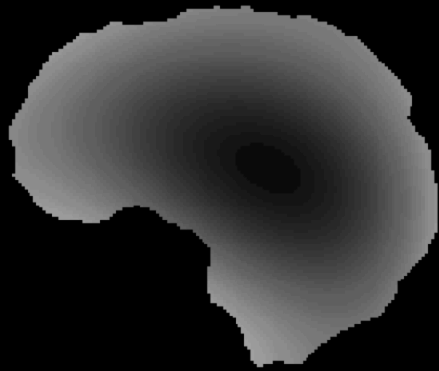
-0.05ppm   0.05ppm

- compute inverse kernel by truncating small values in the inversion

- some noise amplification and dipole artifacts present

- avoids spatial smoothing

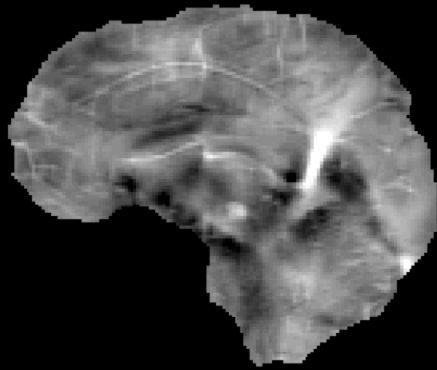## QSM: Truncated K-space Division (TKD) [4]

RMSE=71%

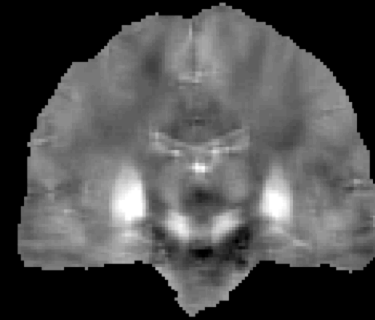4. S Wharton et al MRM'10
K Shmueli et al MRM'09

-0.10ppm   0.14ppm

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- dipole inversion with smooth image gradients

- dipole artifacts mitigated at the cost of over smoothing

QSM: Closed-form L2 regularization [5]

RMSE=66%

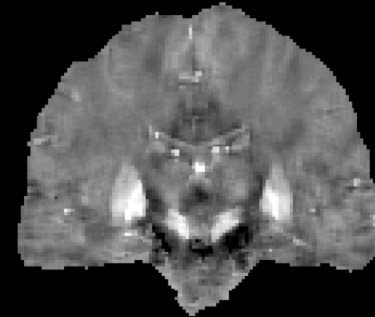5. B Bilgic et al JMRI'14

-0.10ppm   0.14ppm

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- nonlinear solver using total generalized variation
- fast version of nonlinear-MEDI
- good trade-off between dipole artifact mitigation and smoothing
- uses magnitude image for noise weighting

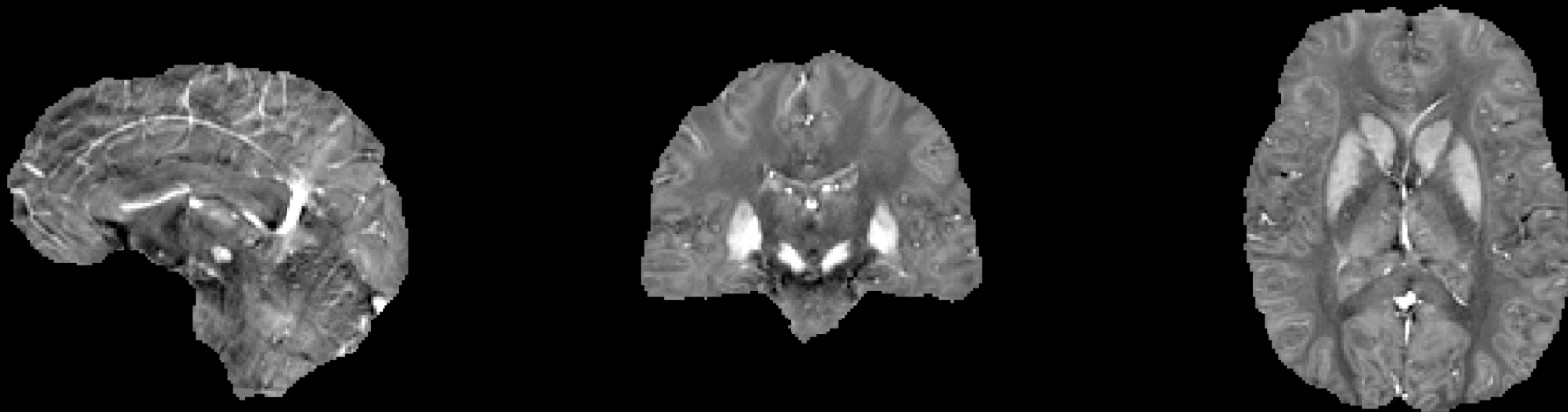## QSM: FANSI [6]

RMSE=61%

-0.10ppm   0.14ppm

6. C Milovic et al ISMRM'17
Monday @ 16:15
#3669
Computer 103

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QSM: COSMOS [7] from 12 orientations

7. T Liu et al MRM'09

-0.10ppm   0.14ppm

Thanks!

Questions / Comments:

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