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MINIMUM FIELD STRENGTH REQUIREMENTS IN MRI

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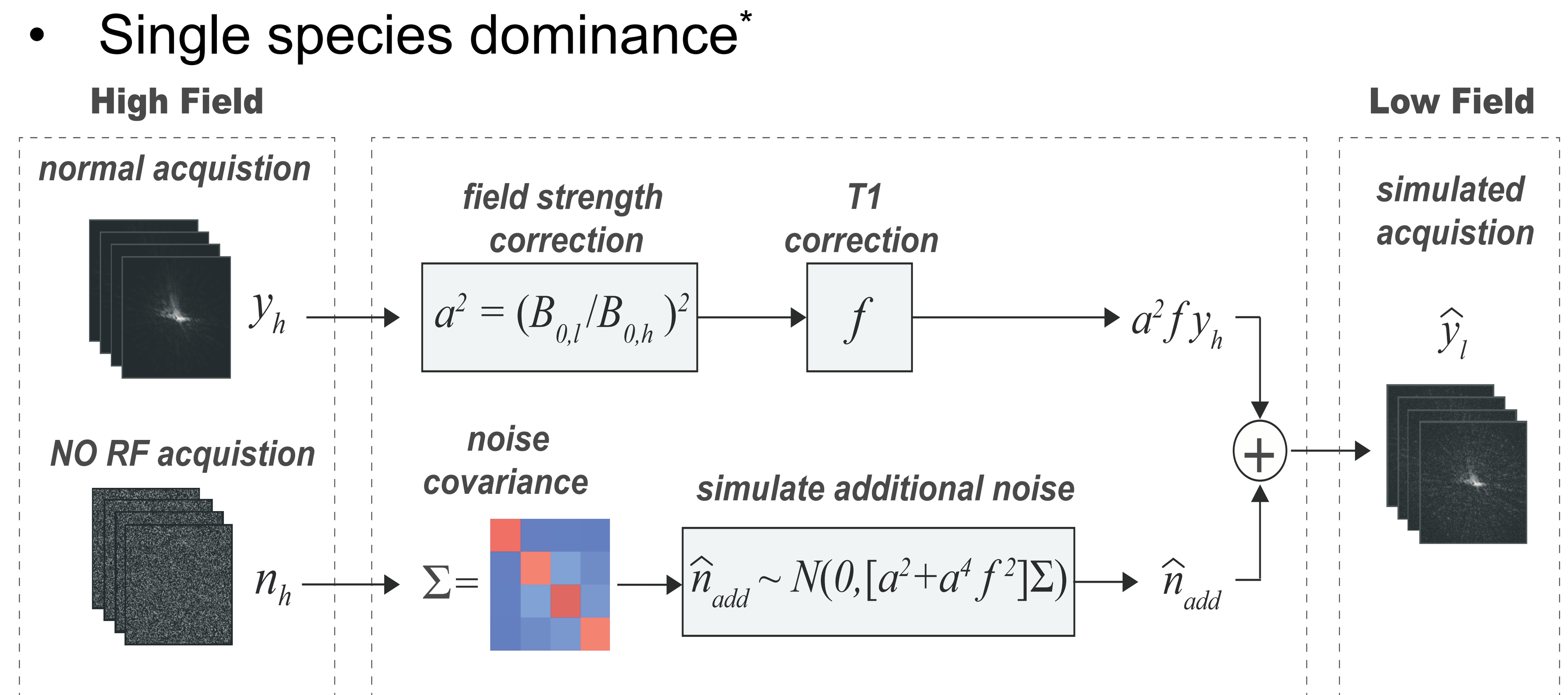
Motivation & Introduction

Magnetic resonance imaging (MRI) is one of the most powerful imaging modalities, and has had a significant impact on healthcare. MRI has two notable limitations, cost and speed. These are highly relevant in an era where rising healthcare costs have placed greater pressure on determining and optimizing the cost-effectiveness of imaging for specific diagnostic questions.

The purpose of this work is to provide a framework and a software tool for determining the minimum field strength requirements of novel MRI methods. Using this tool, a researcher could determine the relevance and applicability of their technique at lower field strengths (e.g. 0.1 to 0.5 T) even if they have only had the opportunity to test it at high field strength (e.g. ≥1.5 T).

Assumption and Method

- Body noise dominance
- Consistent RF transmit and receive field (B_1)
- Consistent B_0 inhomogeneity
- Steady state acquisition
- Single species dominance*



Example Applications

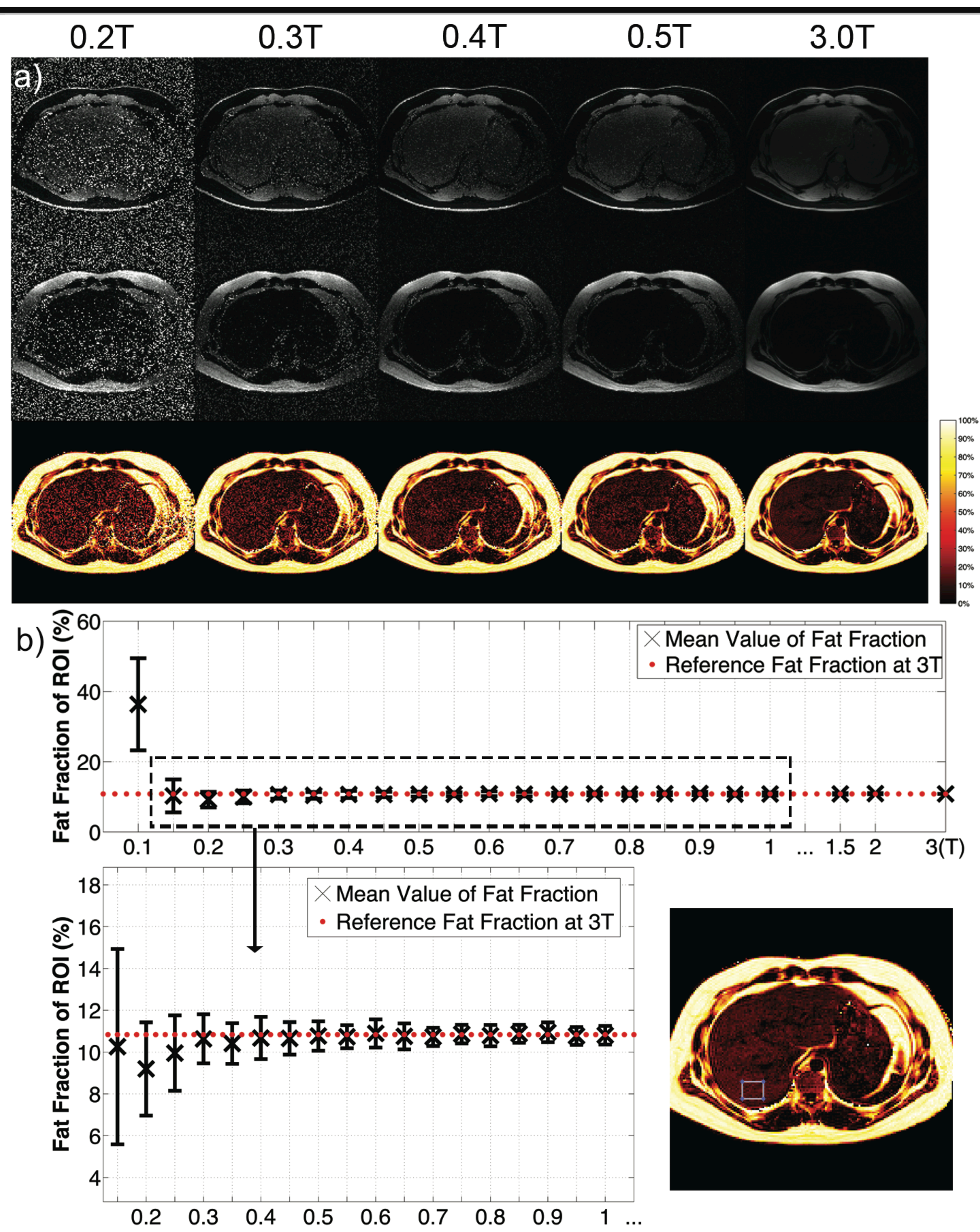


Fig. 1 Abdominal Fat-Water Separated Imaging

Results: Fat-water separated images reconstructed from data acquired at 3 T and simulated at low fields. Top row: water only; middle: fat only; bottom: fat fractions. Fifty separate simulations were performed at each field strength. Quantitative fat fractions were calculated in the ROI.

Conclusion: Although the accuracy and precision needed for a clinical liver fat biomarker is unknown, once determined, this analysis could facilitate determination of the required minimum B_0. For example, if the accuracy and precision needed are both 2%, it suggests B_0 = 0.3 T would be sufficient.

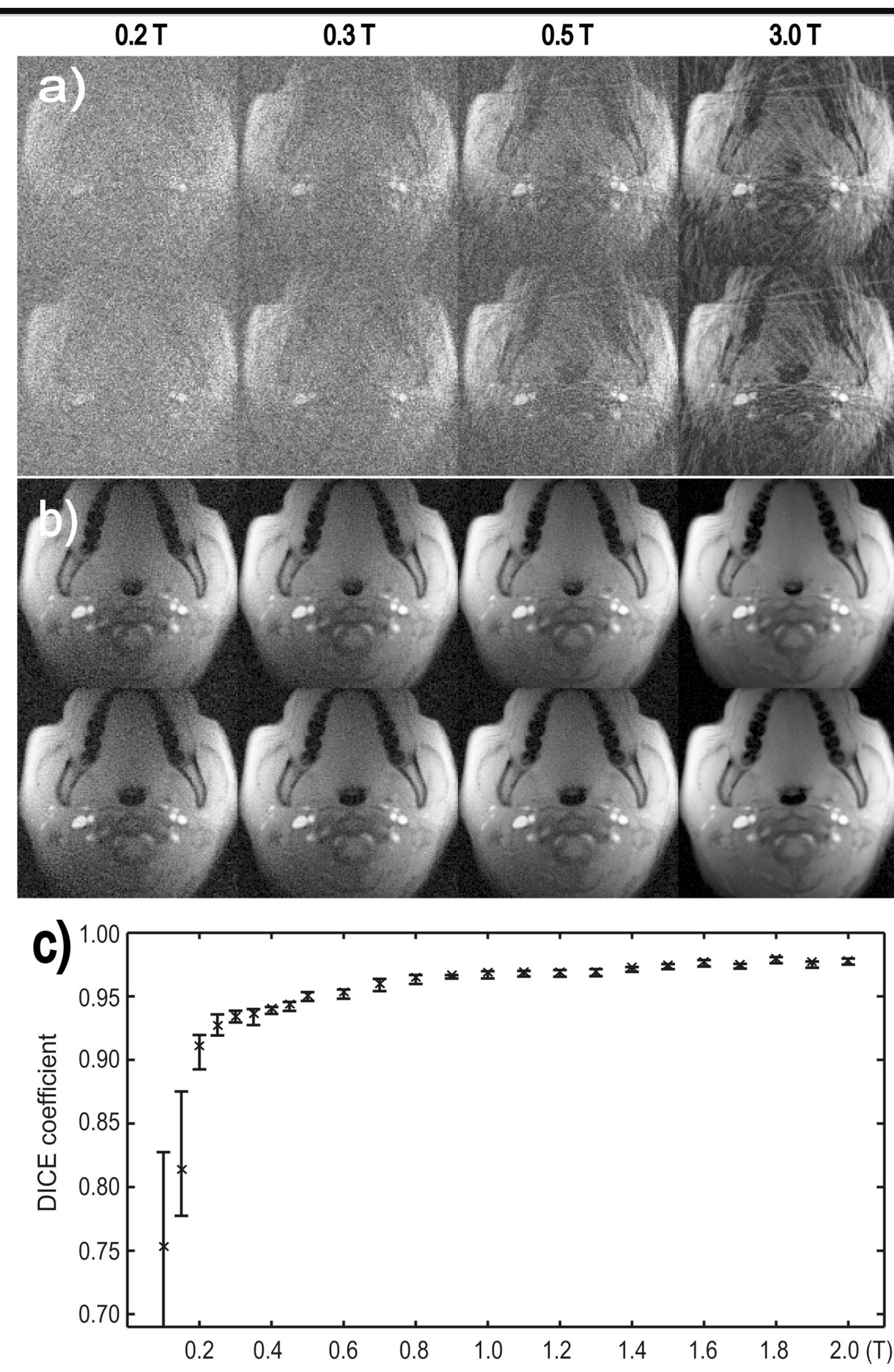


Fig. 2 Upper Airway Compliance Measurement

Results: Gridding reconstruction for data simulated at 0.2 T, 0.3 T, 0.5 T, and at acquired 3 T. The same frames using conjugate-gradient-SENSE with compressed sensing reconstruction. Airways segmented from images using reconstructions in b) are used to calculate the average DICE coefficients over 100 temporal frames (3 breaths) at different field strengths.

Conclusion: In our experience, DICE coefficient > 0.9 is acceptable for this application, suggesting that the minimum field requirement is 0.2 T.

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