

Hybrid optimization between iterative and network fine-tuning reconstructions for fast quantitative susceptibility mapping

Jinwei Zhang^{1,2}, Hang Zhang^{1,3}, Pascal Spincemaille¹, Thanh Nguyen¹, Mert Sabuncu^{1,2,3}, Yi Wang^{1,2}

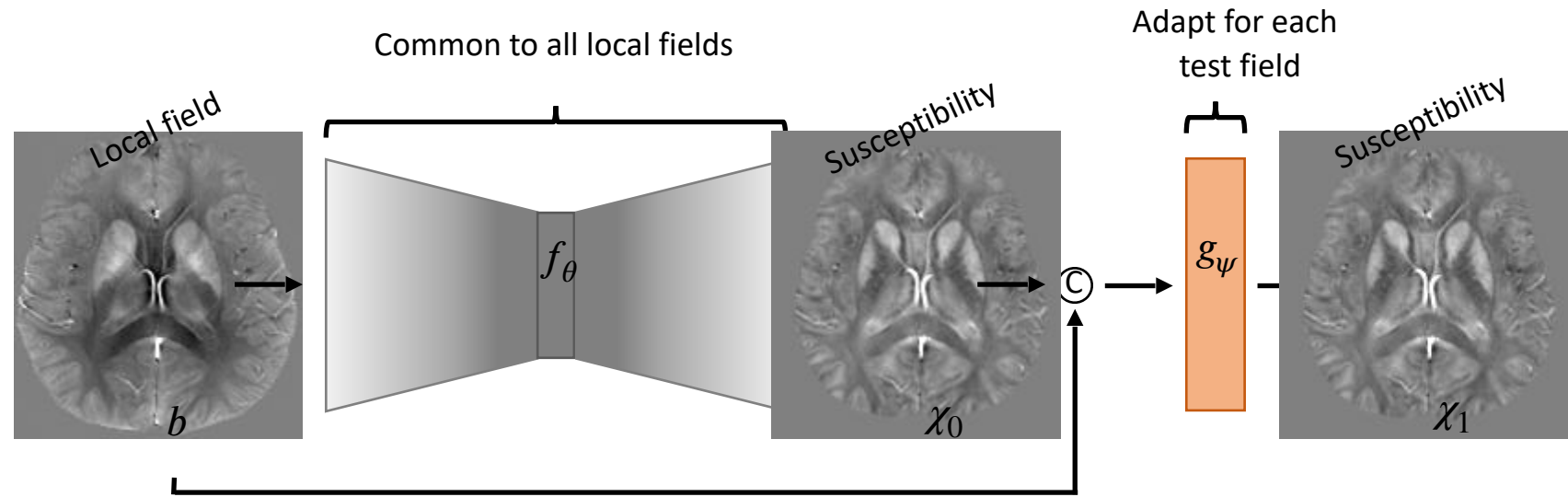
¹ Department of Radiology, Weill Medical College of Cornell University, New York, NY, USA

² Department of Biomedical Engineering, Cornell University, Ithaca, NY, USA

³ Department of Electrical and Computer Engineering, Cornell University, Ithaca, NY, USA



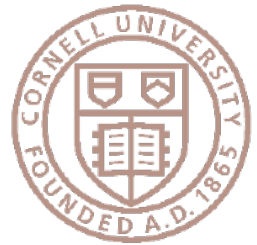
Modified architecture



Two steps training:

$$\min_{\theta, \psi} ||\chi_0 - \chi_{label}||_1 + ||\chi_1 - \chi_{label}||_1$$

$$\min_{\theta, \psi} ||W(F^H DF\chi_0 - b)||_2^2 + ||W(F^H DF\chi_1 - b)||_2^2$$



Hybrid optimization

Rewrite fidelity loss as:

$$\min_{\psi, \chi} \frac{\alpha}{2} \|W(F^H DF\chi - b)\|_2^2 + \frac{1-\alpha}{2} \|W(F^H DFg_\psi(\chi_0, b) - b)\|_2^2$$

s.t. $\chi = g_\psi(\chi_0, b)$,

Convert into augmented Lagrangian format:

$$\min_{\psi, \chi} \frac{\alpha}{2} \|W(F^H DF\chi - b)\|_2^2 + \frac{1-\alpha}{2} \|W(F^H DFg_\psi(\chi_0, b) - b)\|_2^2$$

$$+ \frac{\rho}{2} \|\chi - g_\psi(\chi_0, b) + \mu\|_2^2 - \frac{\rho}{2} \|\mu\|_2^2,$$

ADMM iterations:

DLL2
200 CG iters ➔

$$\chi^{n+1} = \arg \min_{\chi} \frac{\alpha}{2} \|W(F^H DF\chi - b)\|_2^2 + \frac{\rho}{2} \|\chi - g_{\psi^n}(\chi_0, b) + \mu^n\|_2^2,$$

$$\psi^{n+1} = \arg \min_{\psi} \frac{1-\alpha}{2} \|W(F^H DFg_\psi(\chi_0, b) - b)\|_2^2 + \frac{\rho}{2} \|\chi^{n+1} - g_\psi(\chi_0, b) + \mu^n\|_2^2, \quad \leftarrow \text{L2-FINE 4 iters}$$

Dual update ➔

$$\mu^{n+1} = \mu^n + \chi^{n+1} - g_{\psi^{(n+1)}}(\chi_0, b),$$