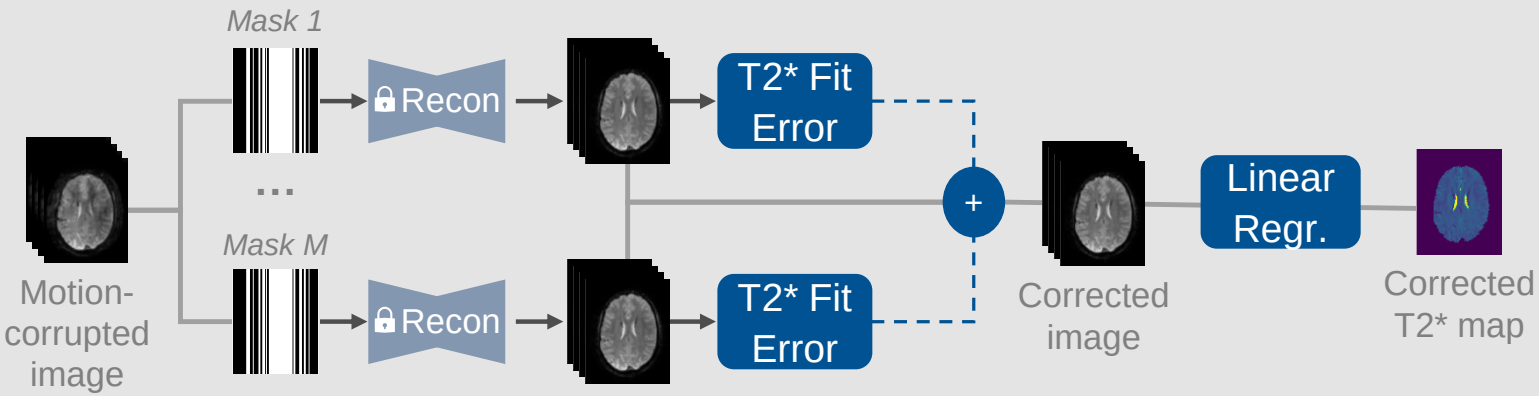

PHIMO: Physics-Informed Motion Correction of GRE MRI for T2* Quantification

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Abstract #0391 | Brain Motion Correction: Freeze, Don't Move! | 07 May 2024

Declaration of Financial Interests or Relationships

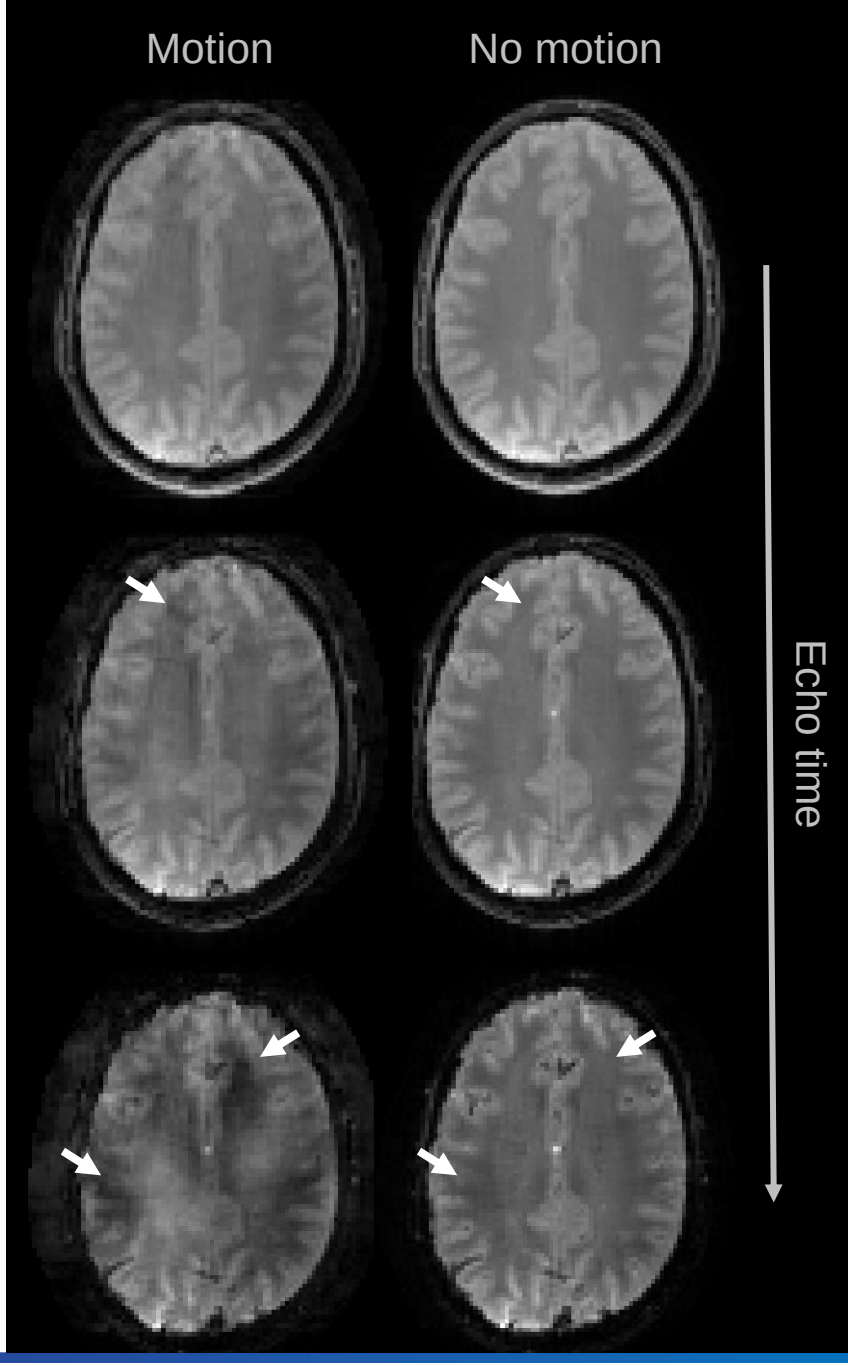
Speaker Name: Hannah Eichhorn

I have no financial interests or relationships to disclose with regard to the subject matter of this presentation.

Motion sensitivity of T2* quantification

- Motion-induced B_0 inhomogeneity changes impact T2* quantification from GRE MRI[1]
- Current retrospective MoCo method relies on redundant k-space acquisition ("HR/QR-MoCo")[2]
- DL-based MoCo mainly developed for high-resolution data or without ensuring data consistency[3,4]

→ PHIMO: **PH**ysics-**I**nformed **M**otion c**O**rrection

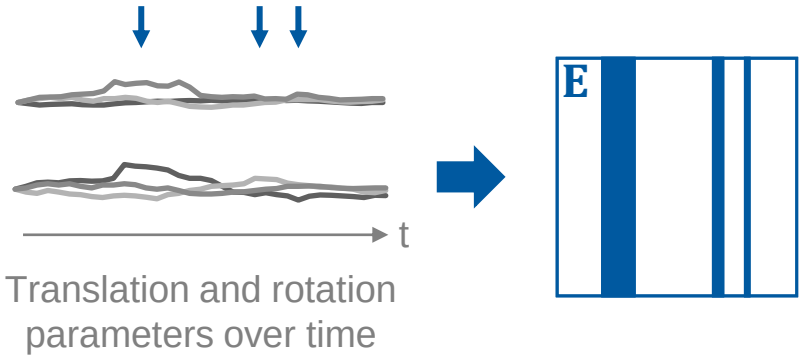


1 Magerkurth, J. et al. MRM (2011).
2 Nöth, U. et al. NeuroImage (2014).
3 Spieker, V. & Eichhorn, H. et al. IEEE TMI (2024).
4 Xu, X. et al. MRM (2022).

Line detection for MoCo

- Brain imaging: random rigid-body motion

- Assuming individual motion events: $\mathbf{E}\hat{y} \cong \boldsymbol{E}y$



Translation and rotation parameters over time

➡ Split MoCo into[1]:

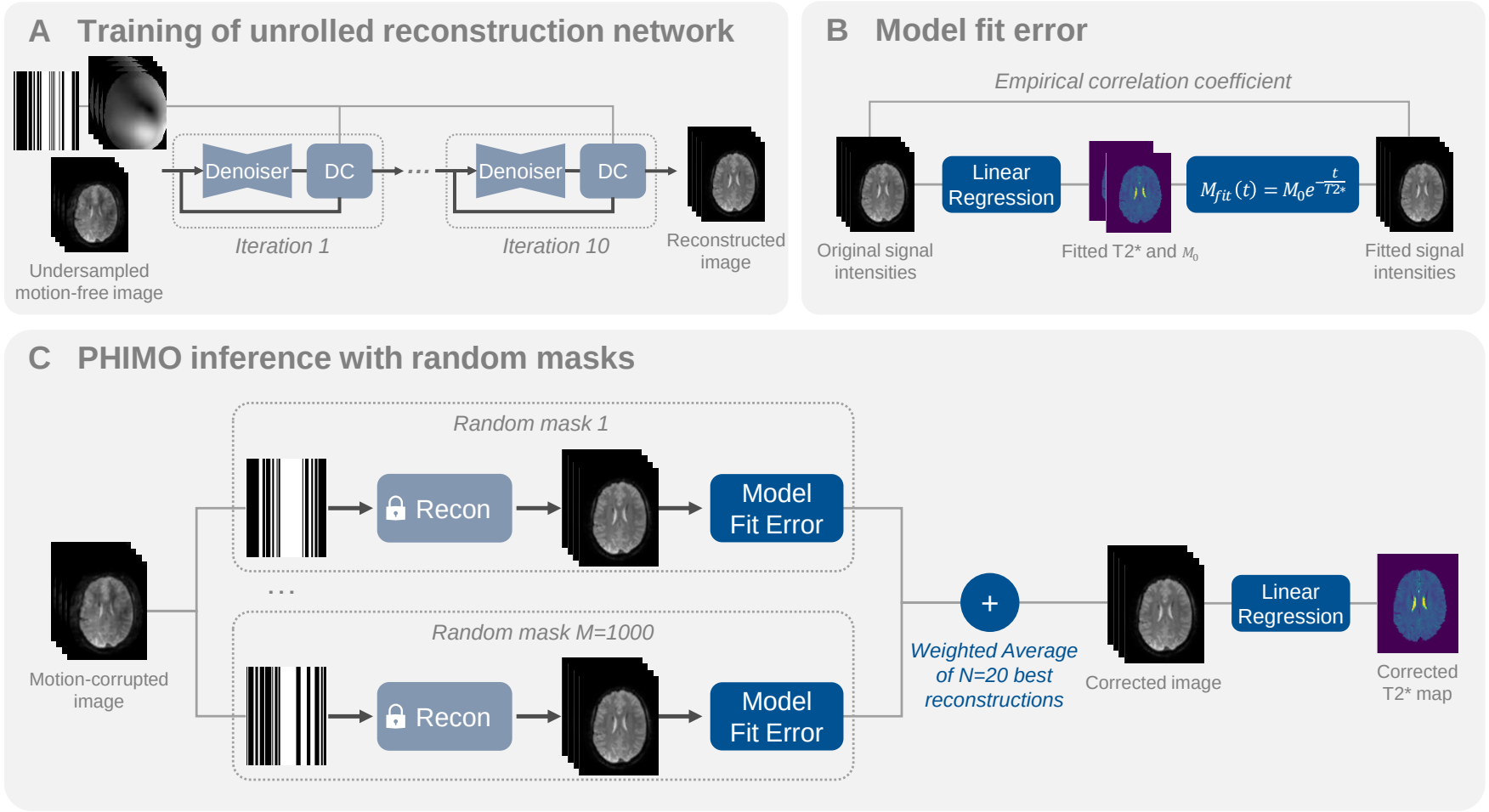
i. Detection of motion-corrupted k-space lines
ii. Reconstruction of undersampled k-space data

Motion-corrupted k-space

Motion-free k-space

1 Oh, G. et al. IEEE TMI (2021).

PHIMO



1 Oh, G. et al. IEEE TMI (2021).

Data

Multi-coil k-space data from 14 volunteers
(multi-slice 2D GRE, 12 echoes, TE1=ΔTE=5 ms)

Training Recon:
6 + 2 subjects

Testing MoCo:
6 subjects

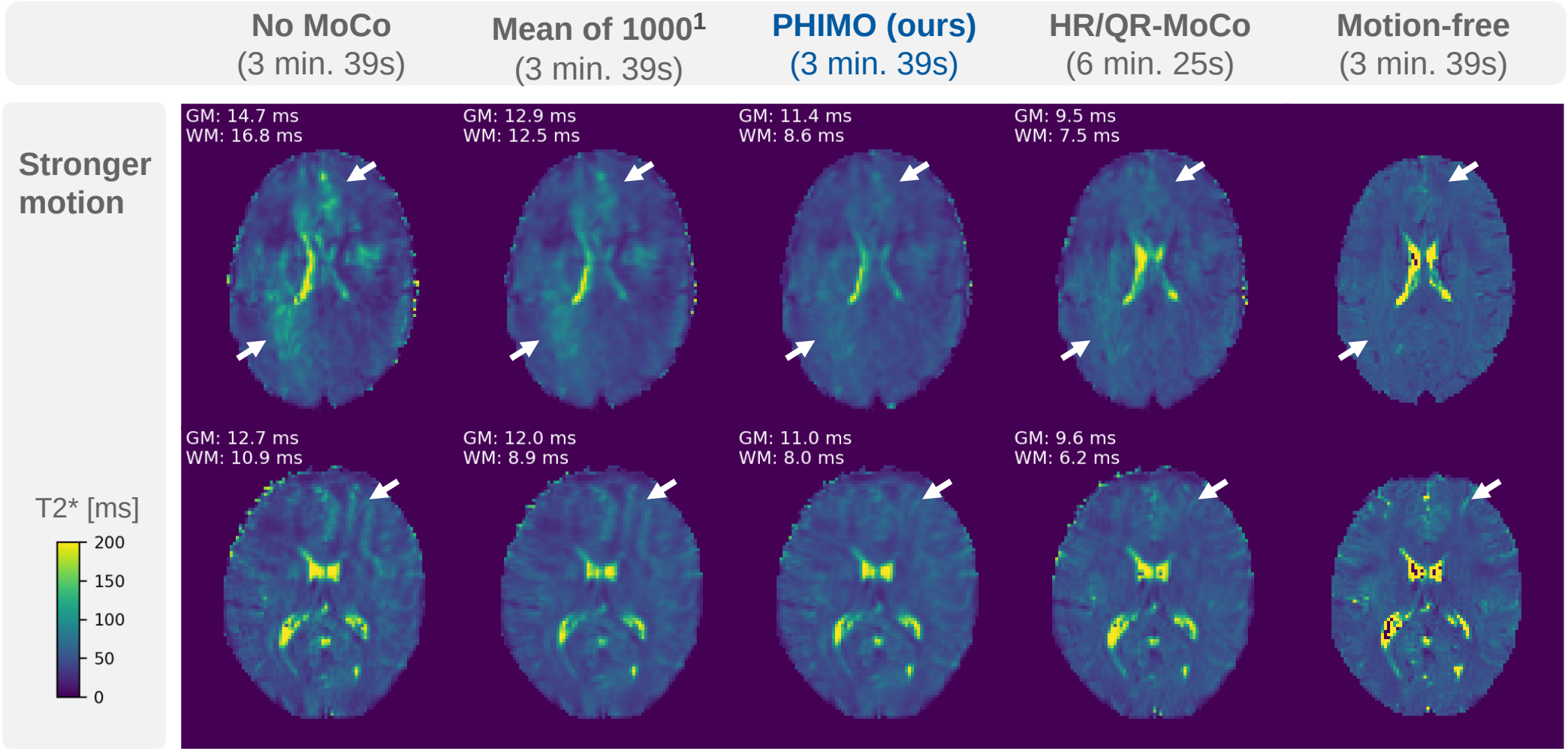
Repeated scans with and without random head motion

Half- and quarter resolution data for HR/QR-MoCo[1]

Metrics calculated on registered images (to motion-free scan)

1 Nöth, U. et al. NeuroImage (2014).

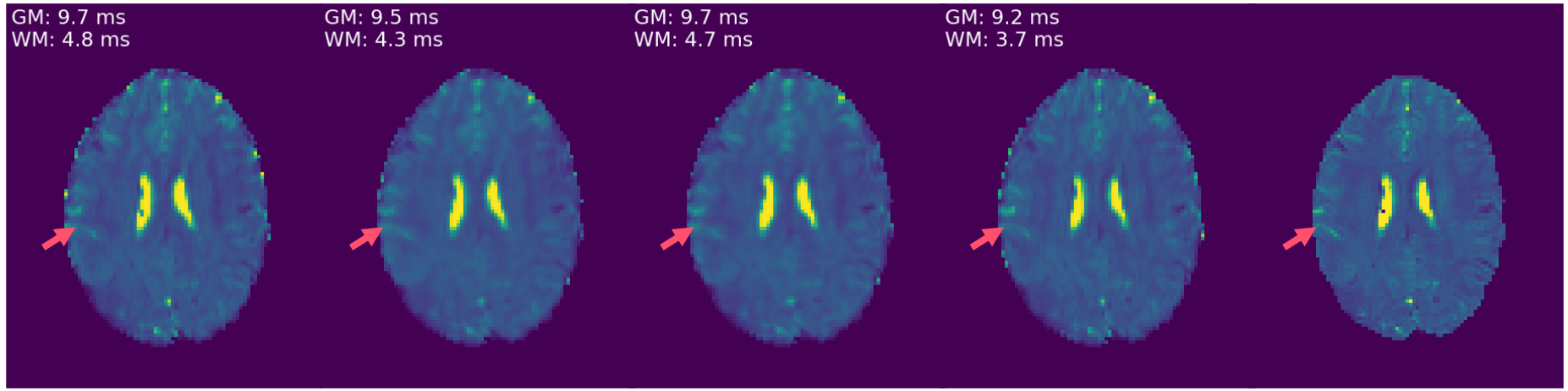
Example T2* maps



1 Oh, G. et al. IEEE TMI (2021).

Example T2* maps

	No MoCo (3 min. 39s)	Mean of 1000[1] (3 min. 39s)	**PHIMO (ours)** (3 min. 39s)	HR/QR-MoCo (6 min. 25s)	Motion-free (3 min. 39s)
Minor motion	GM: 9.7 ms WM: 4.8 ms	GM: 9.5 ms WM: 4.3 ms	GM: 9.7 ms WM: 4.7 ms	GM: 9.2 ms WM: 3.7 ms	
Without					

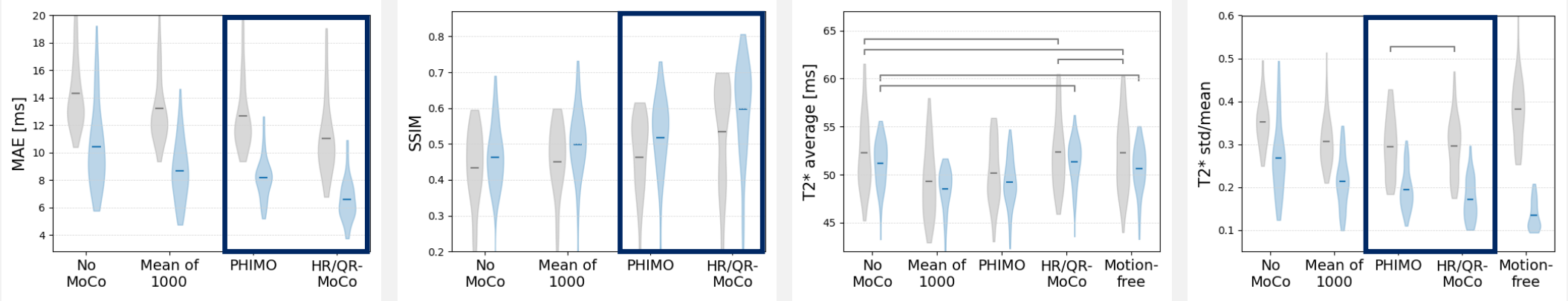


Quantitative evaluation

GM
WM

MAE (↓) | SSIM (↑) | Average T2* | Coefficient of variation (↓)

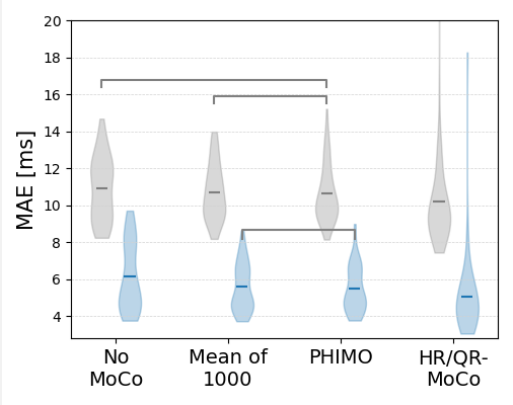
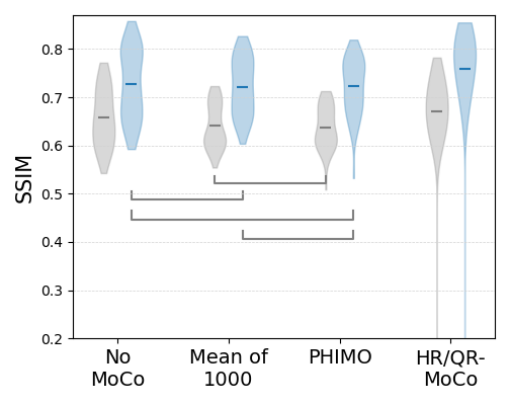
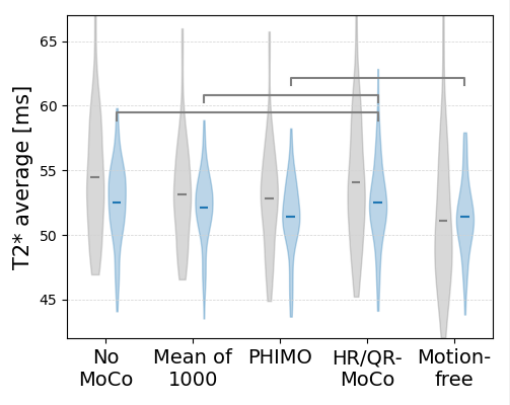
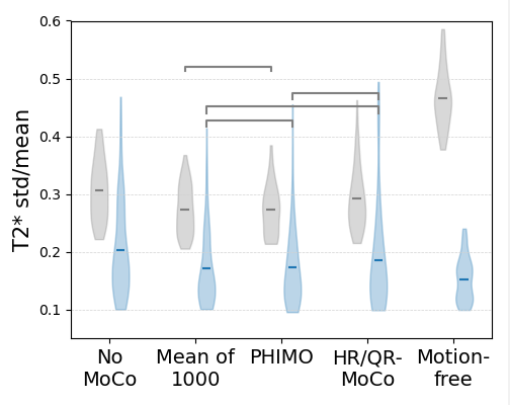
Stronger motion



* Brackets indicate comparisons without statistical significance.

Quantitative evaluation

GM
WM

	MAE (↓)	SSIM (↑)	Average T2*	Coefficient of variation (↓)
Minor motion				

* Brackets indicate comparisons without statistical significance.

PHIMO reduces strong motion artefacts

✓ Decreases acquisition time by **over 40%** compared to HR/QR-MoCo[1]

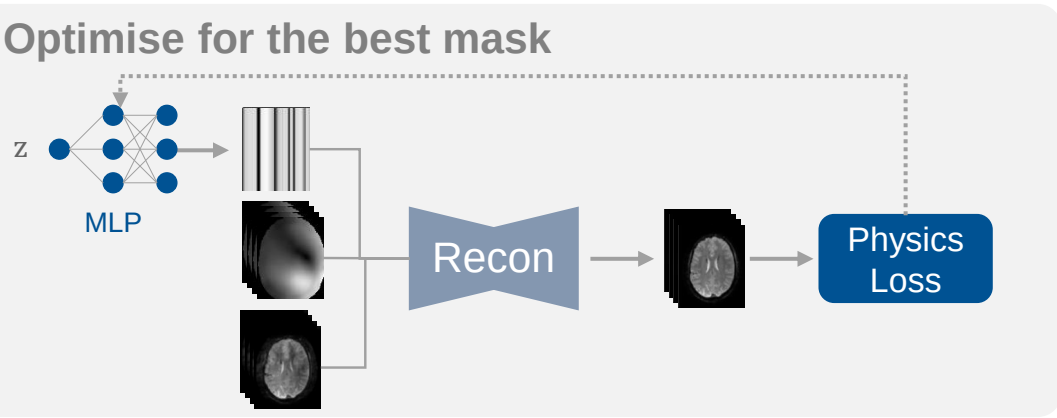
✓ Importance of **physics-loss**

✓ No paired motion data required for training

- Assumption of randomized motion events
- Residual blurring present

  → next step: optimizing for the best mask[2]

Preprint:



1 Nöth, U. et al. NeuroImage (2014). **2** Eichhorn, H. et al. arXiv (2024).

Preprint:

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