MARKERLESS OPTICAL TRACKING FOR PROSPECTIVE MOTION CORRECTION USING AN OPEN SCANNER INTERFACE

Kornel Kowalczyk[1*], Patrick Hucker[2*], Nico Splitthoff[3], Thomas Gaass[1], Tobias Kober[4], Maxim Zaitsev[2], and Stefan Glimberg[1]

[1] TracInnovations, Ballerup, Denmark, [2]Division of Medical Physics, Department of Radiology, University Medical Center Freiburg, Freiburg, Germany, [3] Siemens Healthineers AG, Erlangen, Germany,[4] Siemens Healthineers International AG, Lausanne, Switzerland.

** These authors contributed equally to this work*

INTRODUCTION

In this study we present the first motion correction results using markerless optical tracking connected through a vendor-provided research extension of their open scanner API. Patient motion is a major problem in brain imaging, resulting in poor image quality and time consuming rescans.[1] This enables dynamic adjustment of imaging parameters to correct patient motion in real-time, without the need for physical markers.[2, 3]

DISCUSSION

PMC significantly enhances image quality in all tested brain motion scans. The scanner API ensures a clear separation between the motion tracking system and the MR system itself. Future objectives include leveraging scanner state information to boost PMC efficiency, testing more realistic motion paradigms, and exploring more sequence variants. The successful performance and integration of this study are vital steps toward the impending clinical approval of this technology.

METHODS

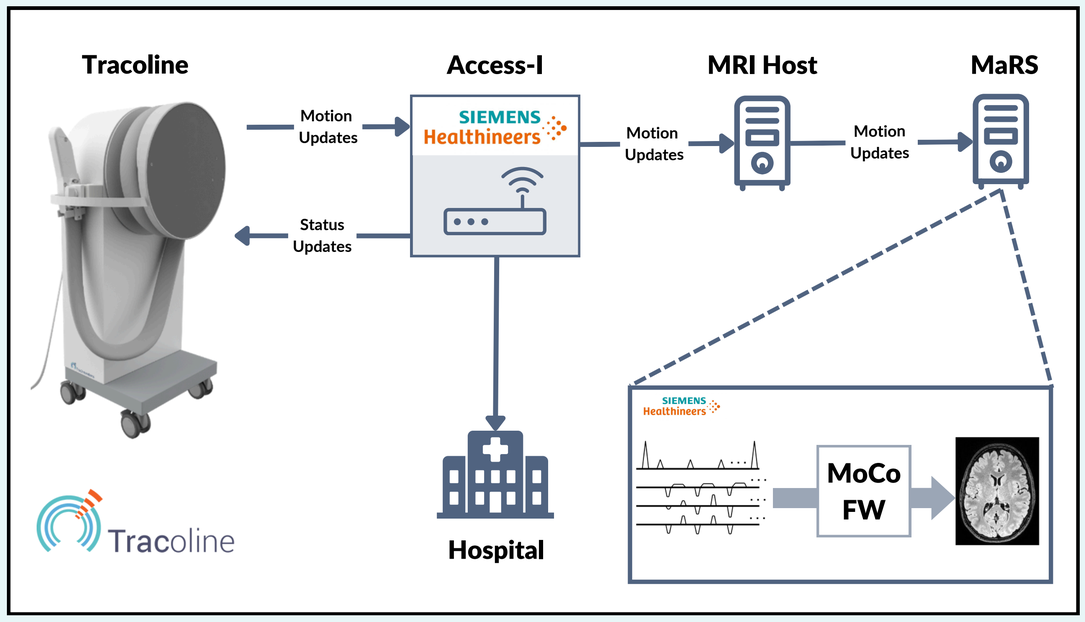

Fig. 1: The Tracoline motion tracker and the MRI scanner communicate bi-directionally via a research extension of the scanner interface Access-I; Thirty motion updates are sent per second to MaRS; The MoCo Framework adjusts the gradients according to the motion updates prior to the acquisition.

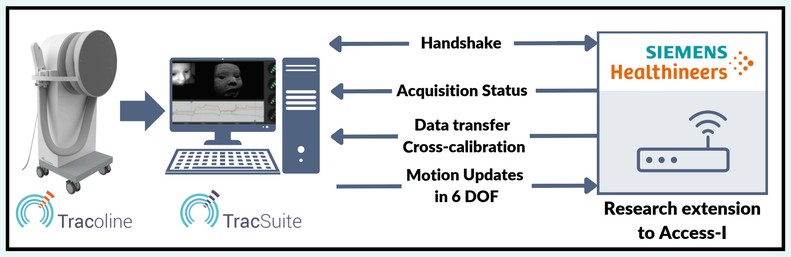

Fig. 2: A research extension to Access-I enables bi-directional communication for a more efficient motion tracking and motion correction workflow.

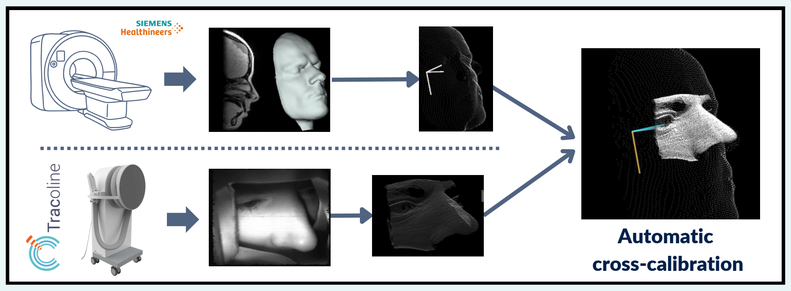

Fig. 3: A research extension to Access-I enables fully automated cross-calibration; in about 20 sec this procedure extracts and aligns a surface from the scanner with the same 3D reconstructed surface from the Tracoline system, calculating a transformation matrix from the camera to the scanner coordinate system.

RESULTS

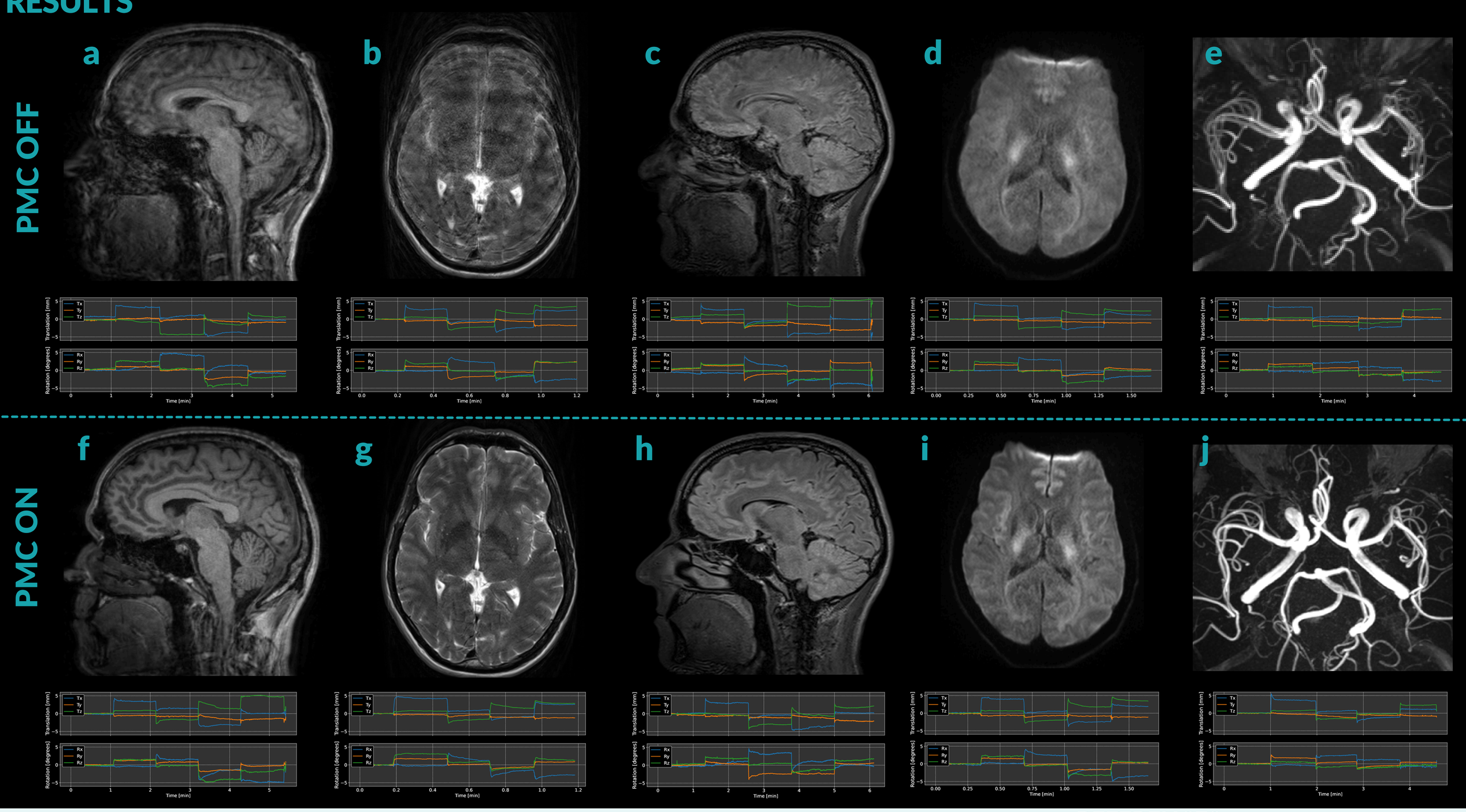

Fig. 4: Prospective motion correction experiments using a typical brain protocol including T1 MPRAGE, T2 TSE, T2 SPACE FLAIR, DWI and TOF MRA. All scans were acquired with the same movement pattern (5-stage diamond shaped pose changes) using the streamlined Access-I integrated workflow. Scans (a-e) did not have PMC enabled. Scans (f-j) were PMC enabled. The motion tracking data is plotted below each dataset, demonstrating motion throughout each dataset pair.

REFERENCES

1. Jalal A, et al. 2015 [doi: 10.1016/j.jacr.2015.03.007]
2. Frost R, et al. 2019 [doi: 10.1002/mrm.27705]
3. Slipsager JM, et al. 2022 [doi: 10.1002/mrm.28991]