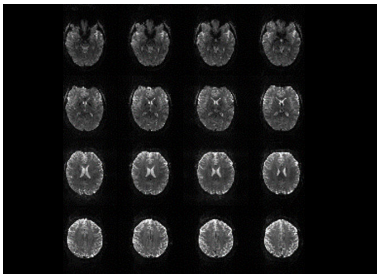
skope

APPLICATION SHEET: **fMRI in Neuroscience**

NeuroCam skope-i

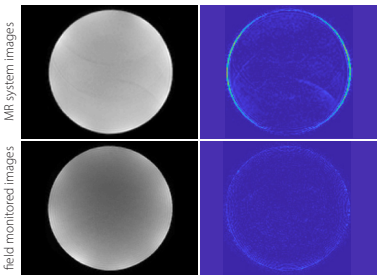
ENABLE HIGH-FIDELITY fMRI ACQUISITION METHODS
IMPROVE AND EXPAND YOUR NEUROSCIENCE RESEARCH



EPI images reconstructed from a field-monitored finger-tapping experiment

Enable your fMRI scans to more accurately represent the physiology you study

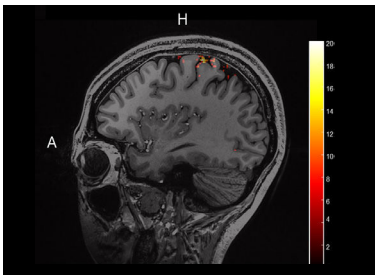
Current fMRI methods for neuroscience leverage multiple methods of accelerating image acquisition. Acceleration is key for achieving high temporal and spatial resolution; however, it often introduces distortions and artifacts. These arise from amplification of deviations from the expected image generation. Reconstructing images using encoding information measured by Skope field cameras results in improved image quality.



[1] T2*W EPI difference to DW EPI

Geometrical congruence for multi-modal imaging

Deviations from the expected image generation process are present in all fMRI scans. These deviations result in geometrical misalignment between images at the start and end of long resting-state-fMRI scans and between individuals in an fMRI study - leading to erroneous anatomical allocation of the group-level BOLD signal or even a failure to detect a population effect. Moreover, multi-modal imaging studies can fail due to anatomical inconsistency between different contrasts (e.g., fMRI and DWI). Measuring the encoding fields with Skope tools can recover the geometrical congruence, thus enabling reliable group-level analyses and multi-modal imaging studies.



Structural image overlaid with t-value statistical map, finger-tapping experiment

Optimize fMRI data quality

Functional MRI images change in MR signal intensity that are small in comparison to artifactual signal variation from perturbing sources: e.g., magnetic field drifts or changing gradient performance. Not accounting for these sources results in reduced sensitivity for detecting the BOLD signal – requiring longer scan times and more subjects to test the hypotheses. The NeuroCam, in combination with skope-i, directly measures and accounts for perturbations in image encoding from both scanner and physiological sources. This results in images that can be more reliably used to detect the physiologic BOLD response, for improved activation maps and improved sensitivity for neuroscience research.

NeuroCam and skope-i

Detecting functional signal from the brain with high anatomical consistency is hindered by perturbations of encoding magnetic fields. This often results in a failure of detecting functional neurophysiological effects.

By concurrently measuring the field dynamics with the NeuroCam, one can correct for systematic and physiologic artifacts and achieve more accurate and consistent functional imaging. Based on the acquired MRI data the skope-i, image production software, produces exquisite images, which enable the investigation of novel neuroscientific questions.

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NeuroCam for 3T
Physical dimensions

Housing (w x d x h), incl. base	60 cm x 46 cm x 30 cm
Head fit	> 95% of adult population
Full face access	open view and possibility to use eye tracking tools

Dynamic field measurement

Measurable variable	Magnetic field magnitude
Temporal resolution	1 µs
intrinsic k_{max}	± 9580 rad/m

Spatial field expansion

Basis	Real-valued spherical harmonics up to 3rd order
Output terms for image correction	Generalized k-space (16 terms: k_0 – k_{15}) - 3D k-space (k_1 - k_3) - Dynamic B_0 perturbation (k_0) - 2nd order perturbations (k_4 - k_8) - 3rd order perturbations (k_9 - k_{15})

Camera Acquisition System

The field sensor signals of the NeuroCam are acquired by the 16-channel Skope Camera Acquisition System and automatically processed to provide the actual magnetic field dynamics. The field dynamics can be conveniently displayed in the user interface or piped directly into the skope-i, image production software.

skope-i, image production software

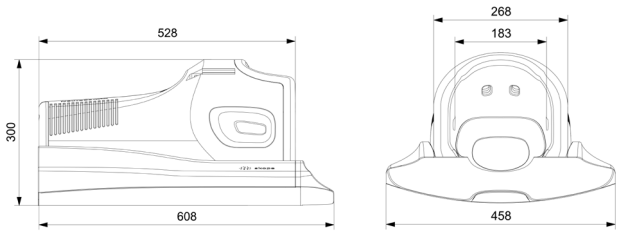
The image production software complements the NeuroCam and takes into account

- Measured/simulated gradient encoding
- Coil sensitivity information (SENSE)
- Static B_0 maps
- Higher order field evolution

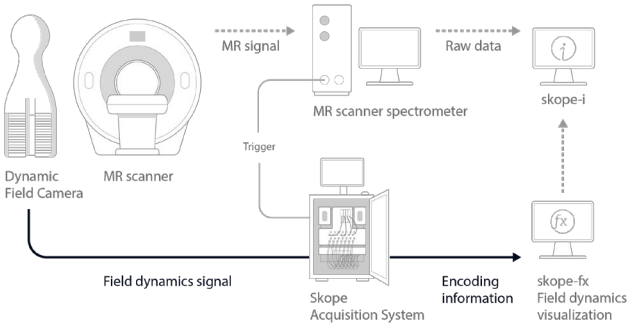
Publication related to MR images:

[1] Magnetic field monitoring improves geometrical consistency in a multi-modal imaging protocol. ISMRM Workshop on Advanced Neuro MR, Seoul, 2018.

Technical illustration



Integration into MRI setup



Reconstruction pipeline