

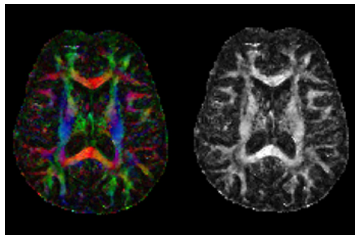
# APPLICATION SHEET: Diffusion Imaging

NeuroCam

skope-i

## CONSISTENT DIFFUSION DATA WITH HIGHEST SNR

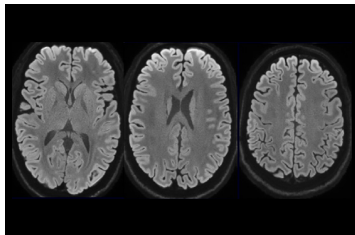
### REPRODUCIBLE RESULTS FROM YOUR MR SYSTEM



[1] Correct calculation of Color FA (left) and FA maps (right) is enabled by field monitored reconstruction of underlying diffusion images.

#### Consistent MR image data

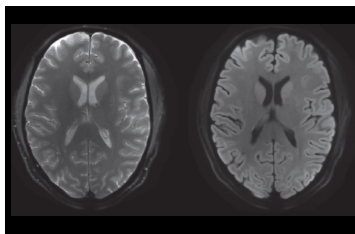
Diffusion encoding requires the use of strong gradients in order to achieve realistic diffusion encoding times. Eddy currents resulting from these strong gradients negatively impact image quality, for example, creating geometric distortions unique to each encoding direction. These distortions can lead to degraded spatial resolution in composite images, or incorrect quantitative values. Skope solutions allow you to directly measure eddy current-induced impacts on spatial encoding, and compensate for them with the skope-i image reconstruction engine. Improve your quantitative diffusion imaging, even in multi-center settings by adding Skope tools to your workflow.



[2] Spiral readout diffusion imaging results in the high SNR images when acquired using field monitoring.

#### Diffusion acquisition with high SNR

Higher image resolution, higher b-values, and more sophisticated b-tensor encoding are enabled or disallowed based on the SNR of the image. Diffusion is inherently low signal-to-noise ratio (SNR). Skope tools enable you to employ sequences with the higher intrinsic SNR, without increased sensitivity to image artifacts from the diffusion encoding gradients. It allows you to replace potentially inefficient EPI with spiral or other time-efficient readout module, reducing your echo time by up to 50%. This increases the available SNR, facilitating higher image resolution, shorter scan durations and more reliable statistical analyses.



[3] Single shot imaging using a head only gradient system is robust and high SNR when field monitored

#### Robust single-shot imaging

While single-shot EPI is highly robust against motion, it is susceptible to encoding errors and suffers from many image artifacts. With the Skope technology, EPI becomes even more robust, facilitating single-shot imaging with highest anatomical fidelity. Single-shot spiral MRI with unprecedented quality becomes possible as well, allowing you to explore imaging with shortest possible echo times. These images will ultimately lead to repeatable results with higher sensitivity and specificity.

### NeuroCam™ and skope™-i

Performing accurate diffusion imaging with high resolution and achieving consistency among diffusion images is hindered by inaccurate image encoding by the MR system.

By concurrently measuring the field dynamics with the NeuroCam, one can correct for systematic and physiologic artifacts and achieve more accurate and consistent diffusion imaging. Based on the acquired MRI data the skope-i, image production software, produces consistent diffusion images for repeatable and reproducible diffusion MR studies.



# APPLICATION SHEET: Diffusion Imaging

## 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 measure- ment

Measurable variable	Magnetic field magnitude
Temporal resolution	1 $\mu$ s
intrinsic $k_{max}$	$\pm 9580$ rad/m

## Spatial field expansion

Basis	Real-valued spherical harmonics up to 3 <sup>rd</sup> 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 ( $k_0$ ) - 2 <sup>nd</sup> order perturbations ( $k_4 - k_8$ ) - 3 <sup>rd</sup> 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

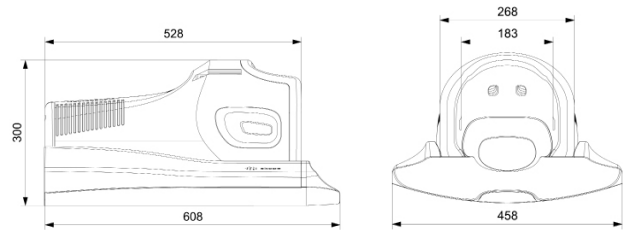
The image production software complements the NeuroCam and takes into account

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

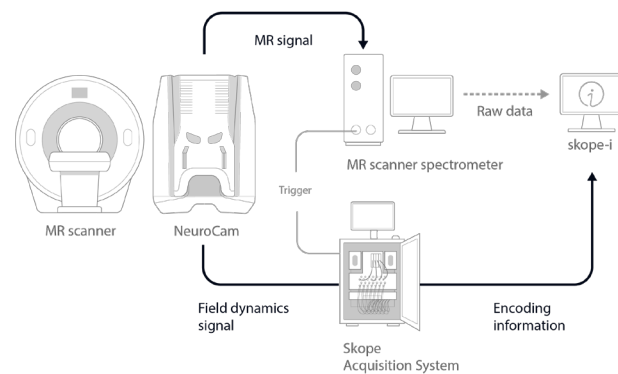
Publications related to initial research and referenced MR images:

- [1] Feizollah et al. ISMRM 2021 #3653
- [2] Lee et al. (2020) On the signal-to-noise ratio benefit of spiral acquisition in diffusion MRI. DOI: 10.1002/mrm.28554
- [3] Wilm et al. (2020) Minimizing the echo time in diffusion imaging using spiral readouts and a head gradient system. DOI: 10.1002/mrm.28346

## Technical Illustration



## Integration into MRI setup



## Reconstruction pipeline

