# Diffusion-weighted imaging in body applications using the sliding multislice concept with continuously moving table acquisition

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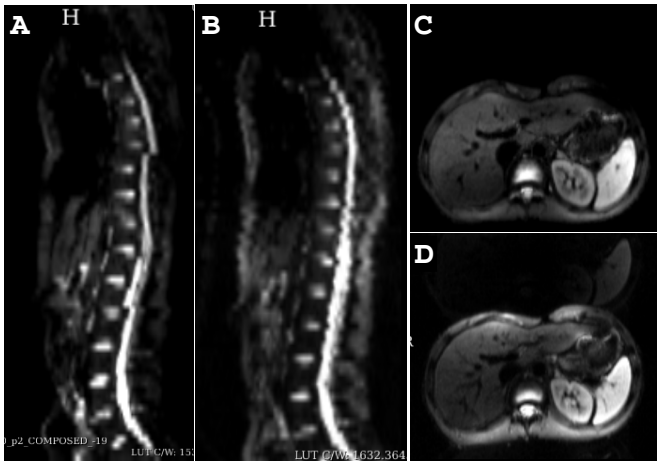
**Introduction:** We propose an imaging method for diffusion-weighting (DW) in clinical body applications using the continuously moving table (CMT) approach with sliding multislice (SMS) [1]. In contrary to previous approaches that use a single-slice CMT STIR-DW acquisition [2], we developed a sliding multislice-multishot scheme with SPAIR preparation for efficient and clinically acceptable scan times offering multiple b-values for DW as well as multiple averages for increased signal-to-noise ratio (SNR). This new CMT DW EP sequence is compared to an established static multistation DW protocol clinically used in body applications with respect to diffusion weighting, SNR, artifacts, and scan times.

**Materials and Methods:** The SMS concept extends the single-slice acquisition in the isocenter during table motion to an efficiently acquired stack of table positions in near isocenter for multiple slices, preparation scans, reference scans for parallel imaging, repeated averages as well as multiple DW. Therefore physical scan time is getting close to static multistation multislice protocols. A protocol dedicated for body applications is implemented on a 3T whole-body MR system (MAGNETOM Skyra, Siemens, Erlangen). In-plane resolution is set to 2x2 mm² (mat 156x192, parallel imaging f=2) with slice thickness 6 mm (20% gap). The total field-of-view in *z*-direction is set to 520 mm for comparisons with a 3-stations static DWI protocol. DW gradients ($b$=100, 450, 800 s/mm²) in *x*- and *y*-direction simultaneously allow for TR/TE= 2800/58 ms (table speed 5.1 mm/s) resulting in a net scan time of about 6:18 min. (6 averages). Shim and adjustments for CMT protocols are prepared in advance and take about 60 s. This protocol set-up is compared to a static 3-stations DWI approach with similar parameters, net scan time 5:00. Static multistation DWI perform adjustments before each station separately which results in total scan times of at least 9 up to 12 min. Both approaches are compared with respect to SNR (assessed by repeated measurements [3]) and diffusion quantification, image quality, artifacts, and fat suppression.

**Results:** Acquisitions in phantoms (multiarray body coils) and in-vivo brain (head-neck-coil) demonstrate similar SNR and diffusion quantification in CMT DW as in static DWI. No additional artifacts arise from the SMS CMT approach; the diffusion contrast is not impaired if DW gradients are set perpendicular to the moving direction. In the body region with large coverage, the most obvious advantages are widely reduced geometric distortions, the elimination of "broken spine" artifacts that arise at borders of composed multistation images (despite distortion correction), and the significant reduction of the total scan time. Whereas similar net scan times can be achieved in SMS CMT, no additional adjustments are carried out like in static multistation approaches. So total scan times are strongly reduced especially with head-feet coverages >500 mm. SNR and image quality are comparable, but impaired in the CMT approach due to higher sensitivity to physiological effects; fat suppression seems to be less efficient, and ghosting from motion and N/2 seems to be increased due to higher sensitivity to EPI phase correction.




*Axial body DWI with multistation vs. SMS continuously moving table acquisition; 75 slcs,* b*=100, 450, 800 s/mm², 2x2x6 mm², 6 avgs; total scan time including shimming and adjustments ~10-12 min (static; A,C), ~7 min (cmt; B,D).* b*=800 s/mm² are shown.*
*"Broken spine" in composed multistations (A,C) is eliminated by SMS CMT DWI (B,D); image quality and SNR are comparable, but impaired in the CMT approach (D) due to higher sensitivity to physiological effects (breathing, motion, N/2 artifacts).*
*E) An inverted MIP (*b*=800 s/mm²) is shown derived from the SMS CMT approach.*

**Discussion and Conclusions:** The newly developed sliding multislice-multishot approach with continuously moving table for efficient diffusion-weighted acquisitions significantly reduces total scan times (including shimming and adjustments) for large coverages in body imaging. Due to the stepless CMT approach and near-isocenter scanning geometric distortion artifacts at more distant slices and at borders of composed multistation slabs like the "broken spine" are eliminated. SNR and image quality is comparable to established body EP-DWI protocols. Further (and necessary) improvements of EPI phase correction and fat suppression will enqueue diffusion-weighting in the series of CMT acquisitions dedicated to body applications.

References:
[1] Fautz HP, Kannengiesser SAR, Mag Reson Med 55:363 (2006). [2] Han Y, Weigel M, et al., Mag Reson Med 65:1557 (2011). [3] Firbank MJ, Coulthard A, et al., Phys Med Biol 44:N261 (1999).