# Comparison of Myelin Water Fraction Brain Images Using Multi-Echo T2-Weighted GRASE Relaxation and Steady-State Methods

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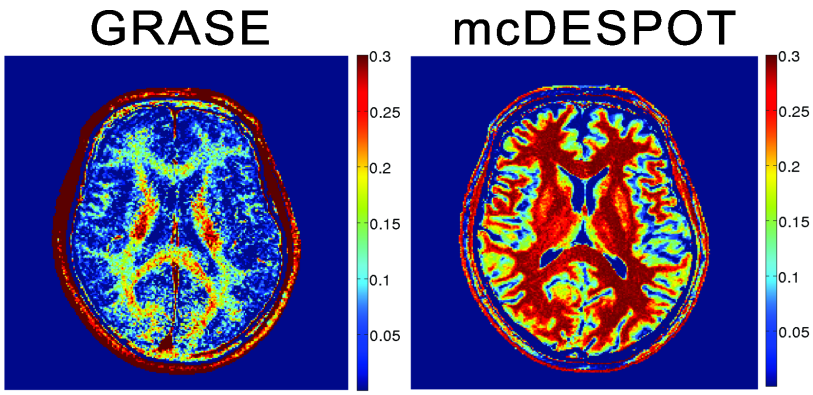
**Target audience** Those working with MR techniques for measuring myelin content.

**Purpose** Myelin water fraction (MWF) is conventionally measured by acquisition of the $T_2$ decay curve[1]. Recently a steady-state approach entitled multicomponent driven equilibrium single pulse observation of $T_1/T_2$ (mcDESPOT) was also been employed for myelin water fraction mapping[2]. While both spin echo and mcDESPOT techniques have been applied for detection of demyelination in MS lesions and NAWM[3,4], the two approaches have not yet been compared on the same subjects. The goal of this study was to compare MWF values derived from the $T_2$ decay curve with those derived from mcDESPOT in a cohort of normal volunteers.

**Methods** All MR imaging experiments were performed on a 3.0T MR scanner (Achieva 3.0T, Philips Medical Systems, Best, The Netherlands) using an eight-channel phased-array head coil for reception and the internal quadrature body coil for transmission. In this study, a gradient and spin echo (GRASE) $T_2$ decay curve and mcDESPOT measurements were acquired from ten healthy volunteers on a 3T MR. For both sequences, the field of view (FOV) was 230 cm × 192 cm × 100cm with 20 slices collected at 5mm thickness and reconstructed as 40 slices with 2.5mm thickness. The mcDESPOT scanning protocol was performed immediately after the $T_2$-weighted GRASE sequence.

**Results** We compared differences in transmit ($B_1$) magnetic field inhomogeneity, MWF, and $T_2$ of intra / extracellular water between the two techniques. mcDESPOT yielded significantly higher MWF values than the multi-echo T2-weighted GRASE approach. mcDESPOT MWF values were very consistent across the white mater while values from the GRASE approach varied across white matter regions. The $B_1$ maps from both methods were qualitatively similar while the intra/extracellular $T_2$ maps were significantly different.




Representative axially-oriented slice through the myelin water fraction from $T_2$-weighted GRASE sequence and mcDESPOT sequence.

While the multi-echo $T_2$ relaxation approach assumes that no exchange between myelin water and intra/extracellular water takes place on the time scale of the experiment, standard mcDESPOT analysis includes exchange in the model. It was hypothesized that exchange could account for the differences in MWF values between white matter regions using the multi-echo T2 relaxation approach. To investigate this effect, the mcDESPOT data were also analyzed assuming no exchange between myelin water and inter/extracellular water. In this case, the derived $T_2$ results from $T_2$-weighted GRASE were roughly consistent with mcDESPOT results; However, the mcDESPOT derived MWFs were still significantly higher than the MWFs from the $T_2$-weighted GRASE.

**Discussion** As the figure demonstrates, MWF maps created by the two methods for the same volunteer are very different. More research is required to understand why the results of the two techniques are not in agreement. Possible explanations could be 1) magnetization transfer effects, 2) the limited number of $T_2$ components in the mcDESPOT model or 3) the constrained nature of the mcDESPOT fits.

**Conclusion** In this work, both GRASE and mcDESPOT methods were performed together on the same scanner for ten healthy subjects. Further investigation is needed to understand the mechanisms leading to the differences between results from these two methods.

**References**

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