Klinikum rechts der Isar
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Extending the Signal Models of the ISMRM Fat–Water toolbox: Generalized Parameter Estimation in Multi-Echo Gradient-Echo-Based Chemical Species Separation

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Declaration of Financial Interests or Relationships

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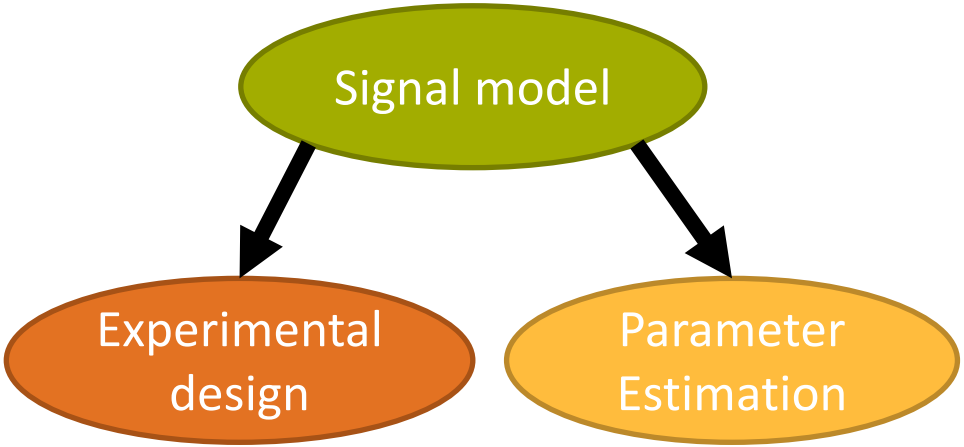
What is needed for water–fat imaging?



Which signal model to take?

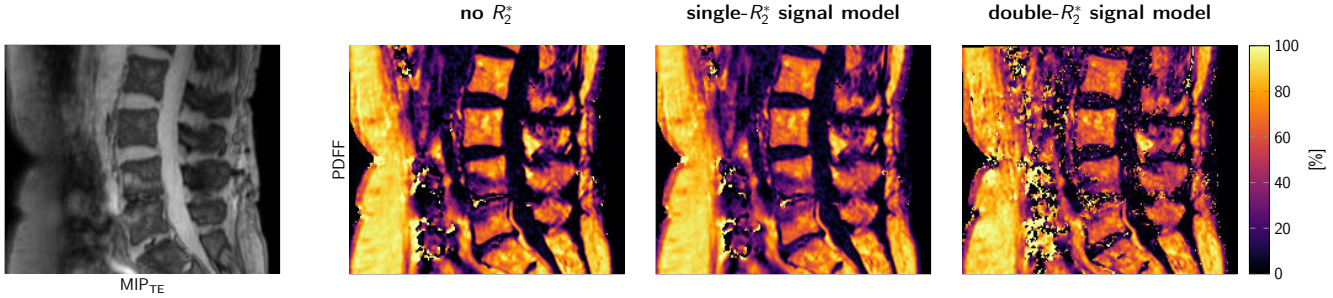
Signal model	Original signal-formula
single water component	$s_n = \varrho\, e^{(i\omega - R_2^*)t_n + \varphi}$
water–fat + field map	$s_n = \left(W + F\sum_{p=1}^{P}\alpha_m e^{i\Delta\omega_m t_n}\right) e^{i\omega t_n}$
single-R_2^* water–fat	$s_n = \left(W + F\sum_{p=1}^{P}\alpha_m e^{i\Delta\omega_m t_n}\right) e^{(i\omega - R_2^*)t_n}$
single-R_2^* water–fat + shift	$s_n = \left(W + F\sum_{p=1}^{P}\alpha_m e^{i(\Delta\omega_m + x)t_n}\right) e^{(i\omega - R_2^*)t_n}$
double-R_2^* water–fat	$s_n = \left(We^{-R_{W,2}^* t_n} + Fe^{-R_{F,2}^* t_n}\sum_{p=1}^{P}\alpha_m e^{i\Delta\omega_m t_n}\right) e^{i\omega t_n}$
fatty acid composition	$s_n = (W + a_{F_1}F_1 + a_{F_2}F_2 + a_{F_3}F_3 + a_{F_4}F_4)\, e^{(i\omega - R_2^*)t_n}$ $a_{F_1} = 9a_A + 6a_C + 6a_E + 2a_G + 2a_H + a_I$ $a_{F_2} = 2a_B$ $a_{F_3} = 4a_D + 2a_J$ $a_{F_4} = 2a_F + 2a_J$

Purpose:

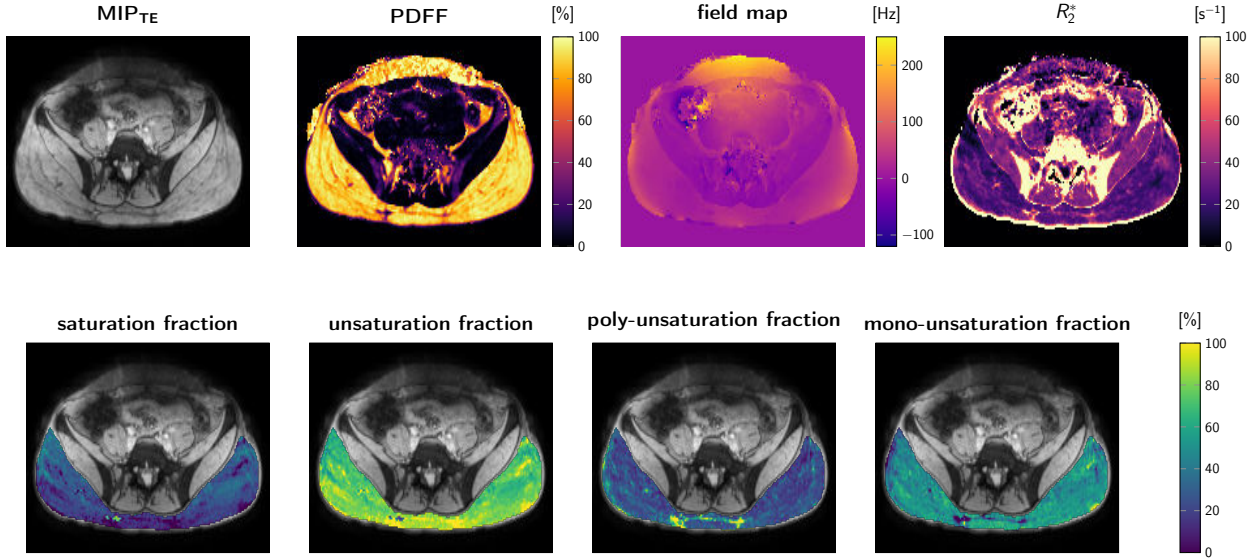
To develop a **generalized formulation** for
multi-echo gradient-echo-based chemical species separation
for all MR signal models
described by weighted sums of complex exponentials with
phases linear in the echo time.

Parameter Estimation

std. WFI models



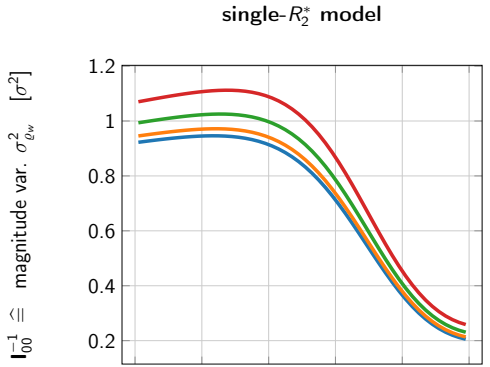
fatty acid composition models

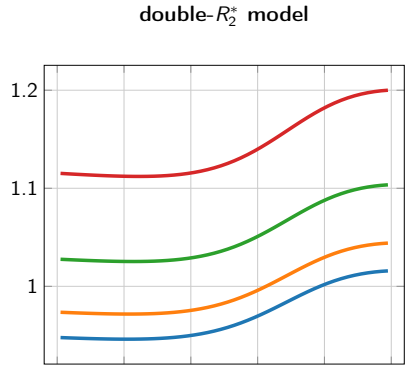


Experimental design

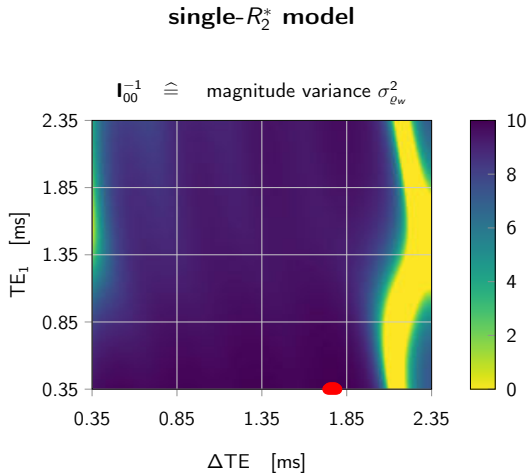
Cramer-Rao analysis-based:

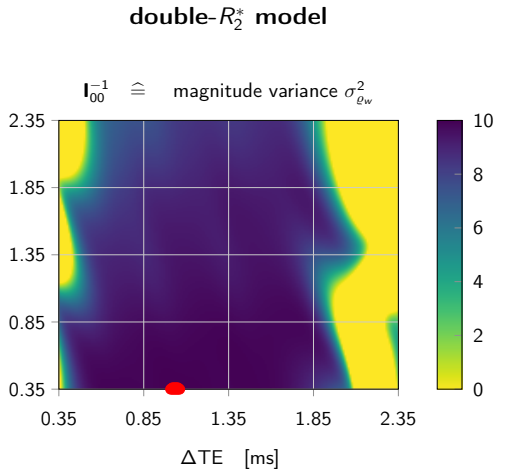
tissue-parameter-specific noise evaluation



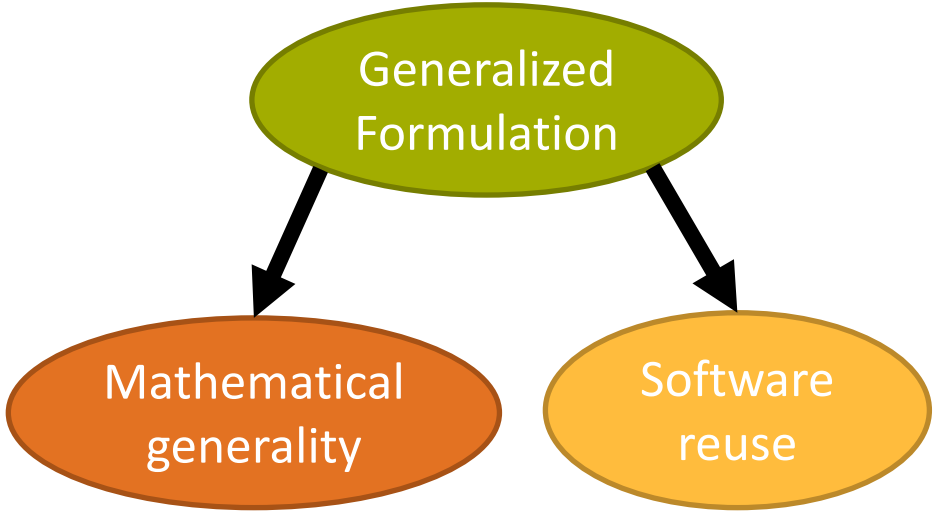


TE selection



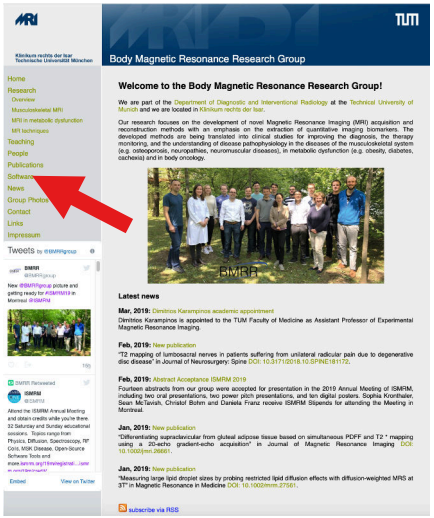


Main advantages



Software available

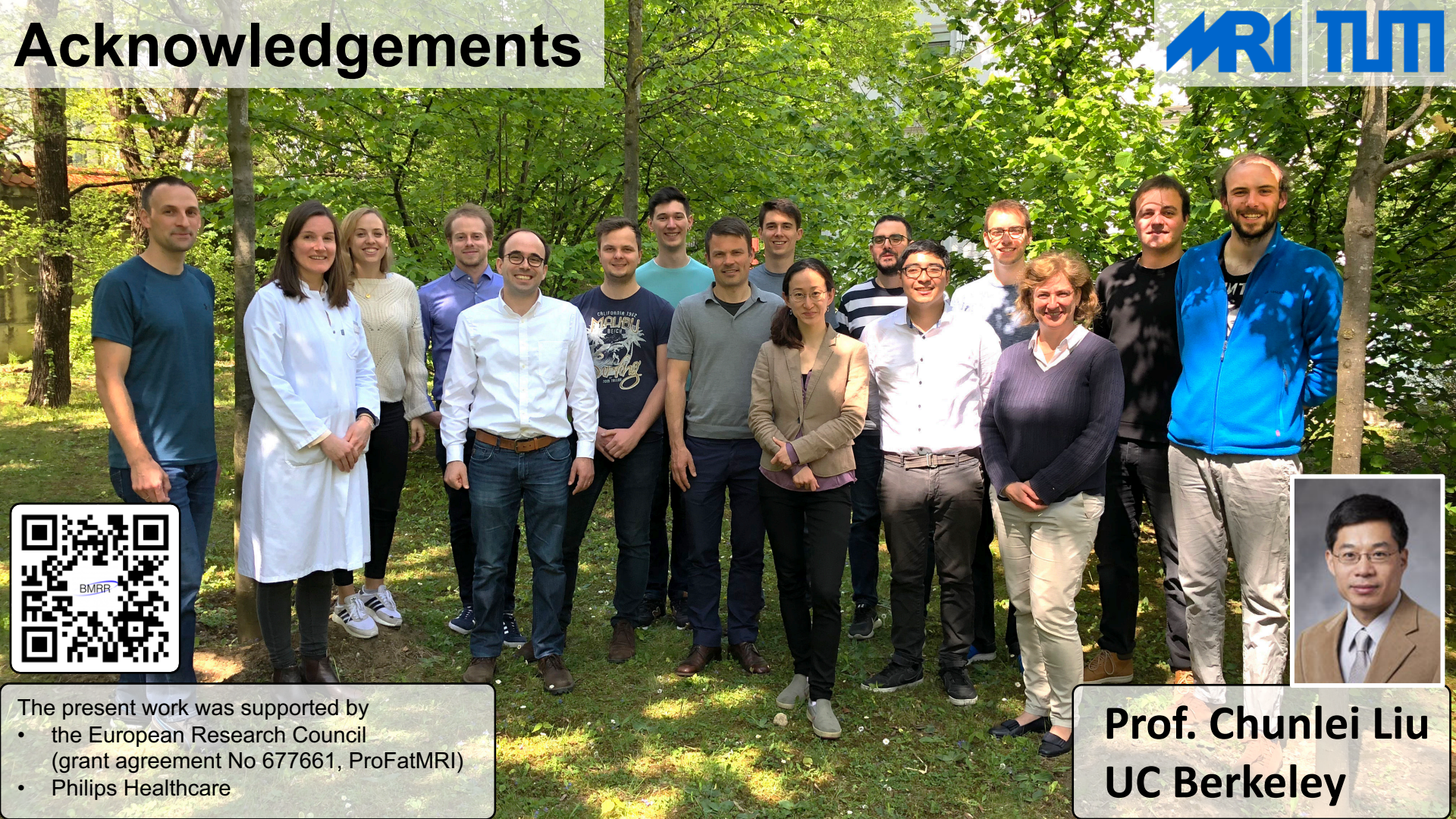
„MR_CSS“



http://bmrr.de/software

based on the ISMRM wf toolbox

Acknowledgements



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