HARDWARE AND METHODS FOR IMAGING WITH NON-LINEAR ENCODING FIELDS

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We have recently designed and implemented an 84-channel gradient coil for spatial encoding with non-linear magnetic fields, shown in Fig1 (Feng et al ISMRM 2015, Litting et al ISMRM 2015). The new coil allows for an unprecedented flexibility in selection of the encoding field, but at the same time presents a number of technological and mathematical challenges. One such challenge is to create customized hardware capable of driving a maximal number of individual channels. Our implementation allows for current an



Fig. 1: 84-channel matrix gradient coil

independent control of up to 12 electrical channels with the coil elements grouped into clusters as recently proposed by Kroboth et al (ISMRM 2015). Another challenge is to find an appropriate encoding trajectory to optimally exploit the encoding capabilities of the coil. A number of approaches have been presented, out of which probably the most flexible and universal is from Layton et al (MRM 2016), which is based on the iterative optimisation of the pixel variance. A disadvantage of this approach however, is the poor control of the trajectory properties, which is currently generated by the genetic algorithm optimisation. The random character of the generated trajectories is expected to result in experimental challenges due to system imperfections. Future directions and alternative approaches are discussed.

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