Quantitative T1 and T2 mapping

Methods and applications of quantitative relaxation time measurement in the brain and the heart

Michela Tosetti (Pisa – Italy)

michela.tosetti@fsm.unipi.it

Magnetic resonance imaging (MRI) is an excellent method for diagnosis and staging of brain and heart diseases. The common approaches in standard MRI are inherently non quantitative. MRI signal is generated using highly-interacting local magnetic fields, which impacts on reproducibility. For this reason, radiologists usually observe hyper or hypo-intensities of tissue compared with surroundings, rather than basing their diagnosis on quantification of physical parameters. But "contrast" does not relate directly to a measurement of a single physical parameter. Calculating fundamental parameters allows quantitative, rather than simply qualitative, assessment, leading to results which are less scanner dependent (making longitudinal or multi-centre studies easier) and potentially increasing sensitivity to changes associated with disease. Here, the methods of quantitative relaxation time measurements will be describe. Normally they consist in the repetition of a sequence of RF pulses, gradients and delays, where each sequence parameter is either left constant or incremented at each repetition. The quantitative parameters can be estimated by fitting the measured signal to steady state signal models and a successful quantitative analysis starts with careful consideration of the appropriate acquisition procedure. Quantitative changes in longitudinal (T1) and transverse (T2) relaxation times in discrete regions have obtained interesting results in many disorders. Unfortunately these methods are based on the measurements of a single parameter at a time and require significant scan time and consequently none of the quantitative protocols are routinely adopted in clinical practice. Recently, a new approach estimating multiple parameters at once, called MR fingerprinting (MRF), has been proposed by *Da Ma* et al. in 2013; this method has received great interest in the research community as it has the potential to be used for quantitative MRI also in the clinical practice.