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K-space use for MRI intra-voxel analysis: advantage in neuroimaging

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Analyzing signals inside MRI K-space with the use of compressed sensing algorithms we want to separate, inside single voxel, the different kind of tissues eventually present inside it.

The use of compressed sensing is well known in many other fields for image analysis (i.e. remote sensing) related to separation of random intra-voxel contributes so is specifically suitable also in MRI acquisitions having them same kind of characteristics.

So using it for clustering single contributions inside a single voxel can be a big step forward in MRI imaging.

Using Spin-Echo sequences we find that different materials evidence the different response in terms of TE signaling so to compose the 100% inside the examinated single voxel.

Analyzing relaxation time due to spin-spin interaction of considered materials we can put in evidence the different nature of signals sources therefore also the different tissues composing the single voxel.

While with the above described use of compressed sensing k-space analysis our goal is to improve the spatial resolution obtained with the actual MRI imaging techniques we can reach another target considering the intrinsic characteristics of compressed sensing k-space processing.

We can insulate single contributions coming from random signal analysis in not completely defined k-spaces (under-sampled) so we can moreover use these algorithms for faster than actual time acquisition imaging.

In this way we obtain an improved temporal resolution compared with same time acquisition as actual.

This kind of advantage can be immediately used for such sampling as fMRI where an high temporal resolution is suitable for image analysis where an high time domain resolution shows clear advantages when is maintained an affordable spatial domain one getting affordable acquisition times.

Having such possibility to separate different intra-voxel contributes, something in some way similar to what is done with MRS techniques, but with much less complications and with not so high fields involved, permits to give an important contribution to understanding and reading MRI results expanding the possibility related to their use.