Spatial encoding in MRI with nonlinear fields

In our group we have been investigating the possibilities for imaging which arise when relaxing the conventional requirement that the encoding fields are linear. We have a custom-built insert-coil for a clinical human scanner which is capable of generating second order encoding fields with comparable switching performance to the standard linear gradient sets. When the x and y gradients are replaced by second order encoding fields, the encoding is no longer bijective. Parallel imaging techniques can then be used to resolve the encoding ambiguities – hence the term PatLoc (Parallel Acquisition Technique using Localized Gradients).

As our hardware is capable of driving the standard linear gradients simultaneously with the second order fields, we have also investigated higher-dimensional encoding – where more encoding channels are used than spatial dimensions of the object. This moves away from conventional Fourier encoding – and currently reconstruction must be performed by a time-consuming iterative approach.

Following recent ethics approval, we are now able to present in-vivo images using these novel encoding strategies.