Fast Non-Cartesian Imaging and Sparse Sampling in MRI

We present two fMRI acquisition techniques: *Spiral-In/Out* and *Interleaved Spiral-In/Out* which reduce susceptibility-induced signal loss at air-tissue interface; they allow activation detection in prefrontal cortex and amygdala where common techniques falter.

Susceptibility-induced artifacts can also be minimized by parallel imaging techniques, *e.g*. sensitivity encoding (SENSE). Surprisingly, retention of sensitivity profile noise (no smoothing) can reduce thermal noise in reconstruction. Neuronal activation at high spatial resolution can therefore be detected.

Compressed sensing is a new technique for rapid acquisition; it conventionally means 1-norm approximation to 0-norm minimization. We introduce a fast 0-norm approximation, *Convex Iteration,* which requires fewer measurements than 1-norm under a total variation objective. A live Matlab reconstruction of highly undersampled image demonstrates its efficiency.

Finally, a fast convex optimization method to deconvolve haemodynamic response function (HRF) from fMRI signal is presented. This method, based on HRF being sparse in a wavelet domain, obviates the conventional extra calibration.