# ADAPTIVE K-T BLAST/K-T SENSE FOR ACCELERATING CARDIAC PERFUSION MRI

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**Introduction:** Recently proposed *k-t* BLAST/*k-t* SENSE techniques (1) have proven very efficient for monitoring periodic changes, for instance, heart wall motion in cine cardiac MRI. The periodicity permits acquiring training data prior to actual scan to learn spatiotemporal correlations for optimized reconstruction of reduced data. However, using *k-t* BLAST/*k-t* SENSE in situations when the dynamic changes are arbitrary is problematic.

We present adaptive *k-t* BLAST/*k-t* SENSE that features self-calibration and self-training, which allow application of the methods to imaging a wide range of dynamic processes. The adaptation is achieved by using Variable Density (VD) sampling and TSENSE calibration (2). The new method was tested on first-pass contrast enhanced myocardial perfusion data.

**Methods and Results:** The proposed approach relies on the observation that coil sensitivities and training data could be well approximated by low-resolution estimates. The VD *k*-space trajectory (Fig. 1) used in the method has a lower reduction factor in the *k*-space center ($R_C$=2). The low-resolution data are supplied to TSENSE to provide training data and time varying sensitivities for *k-t* BLAST/*k-t* SENSE reconstruction. The *k*-space edges are undersampled with a much higher factor (4). Total acquisition speedup depends on a fraction of central *k*-space area $n_{cntr}$ used for calibration. The reconstruction procedure is shown in Fig. 2.

The cardiac perfusion data were obtained on a 1.5T Siemens Sonata MR system using saturation recovery TrueFISP (TR=2.3 ms, TI=90ms, flip angle=50°, 4 slices, 40 frames) and 8-element surface coil array (Nova Medical, Inc.). The VD sampling ($R_C$=2, $R_O$=4, $n_{cntr}$=0.15) was simulated from data acquired with $R$=2. *k-t* BLAST/*k-t* SENSE equations were solved iteratively by a conjugate gradient algorithm.

Figure 3 shows results of reconstruction of the data and comparison to the reference TSENSE reconstruction.

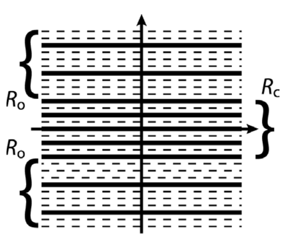


**Figure 1.** Variable density *k*-space sampling. The pattern is shifted in time with a period equal to local reduction factor (i.e., $R_C$ for the central area, and $R_O$ for the *k*-space edges).

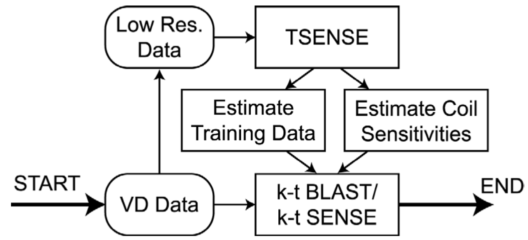


**Figure 2.** Adaptive *k-t* BLAST/*k-t* SENSE

**Discussion:** We developed an adaptive *k-t* BLAST/*k-t* SENSE method that may be used for imaging aperiodic dynamic changes, without prior acquisition of training and reference data. The flexibility comes at an expense of acquisition speedup, which is somewhat lower for the adaptive method ($R$=3.53 compared to $R$=4 for non-adaptive method in the example).

The method was tested on cardiac perfusion data. Further studies are needed to investigate practical aspects of the method including optimal VD sampling and reconstruction artifacts, and to compare it to the related approaches (3).

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**References:** [1] Tsao J, et al. MRM, 2003; 50:1031-1042. [2] Kellman P, et al. MRM, 2001; 45:846-852. [3] Boubertakh R, et al. ISMRM 2004, p. 343.

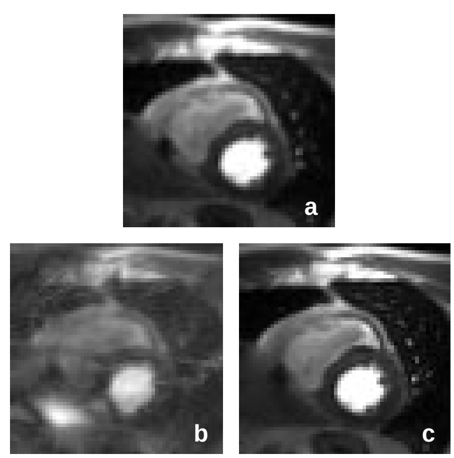


**Figure 3.** Magnified part of a slice from (a) TSENSE ($R$=2) reconstruction, (b) direct inversion of VD data, and (c) adaptive *k-t* SENSE reconstruction ($R$=3.53).