Fat-Free Breast Imaging with High Spatio-Temporal Resolution

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Technological advances in MR breast imaging provide advantages for patients while at the same time creating new challenges for clinicians and technologists. High specificity and sensitivity led to the March 2007 American Cancer Society guidelines recommending MRI screening for women with an approximately 20 to 25 percent or greater lifetime risk. Yet this same capability pushes imaging demands to larger matrix sizes, more signal-to-noise and higher temporal resolution.

Field inhomogeneities and breast implants further test the limit of existing fat suppression techniques. Bilateral breast imaging exacerbates these challenges due to larger field-of-view requirements. Techniques such as VIBRANT™ raise the bar even further with dual shim requirements and higher temporal resolution.

With Signa® MR750 3.0T, GE Healthcare takes MR breast imaging to a new level by harnessing the power of VIBRANT with IDEAL to address these breast imaging challenges in a robust and consistent manner. VIBRANT-Flex collects two echoes with water and fat, spins in- and out-of-phase and utilizes a two-point Dixon technique to synthesize water and fat images. Equipped with the most powerful gradients in the industry (50/200) and novel adaptive dB/dt optimization, the Signa MR750 enables VIBRANT-Flex to catch the shortest in- and out-of phase echoes to keep scan times comparable to single echo acquisitions even though twice the amount of data is collected. VIBRANT-Flex optimizes acquisition with a high signal-to-noise ratio (SNR) for acquiring high quality water and fat images. This capability lets the user prescribe thinner slices for high spatial resolution imaging.

Separate, don't suppress, fat

IDEAL separates fat from water without applying a suppression pulse, leading to a reduction in repeat scans and elimination of a separate non-fat scan. This technique allows visualization of structures within the breast to help diagnose or rule out pathology.

"With the non-fat-suppressed T1-weighted images, if we see bright fat in a nodule, we know it's an intra-mammary lymph node and we don't have to worry about it," says Jeffrey Weinreb, MD, FACR, Professor of Diagnostic Radiology at Yale University School of Medicine and Director of Medical Imaging, Chief of Body Imaging and Chief of MRI at Yale-New Haven Hospital (New Haven, Conn.). "That has prevented us from recommending unnecessary biopsies in a lot of patients."

Workflow is enhanced by eliminating the dependency of accurate shimming and providing higher spatial and temporal resolution acquisitions. The Signa MR750 boosts the thin slice capability of VIBRANT-Flex to 2048 slices, allowing for more robust bilateral axial and sagittal imaging. GE's exclusive ARC™ (Autocalibrating Reconstruction for Cartesian imaging) parallel imaging technique provides an acceleration factor of four for robust imaging that reduces scan time without compromising the diagnostic quality. For instance, a 360x360x160 1 mm^3 isotropic voxel VIBRANT-Flex acquisition can be completed in 54 seconds using the GE HD Breast Array (8-channel) with an ARC acceleration factor of four.

Dynamic volume reconstruction

The term "dynamic volume" comes to life with VIBRANT-Flex and Signa MR750. Increased computational complexity and the large dynamic volume needs of VIBRANT-Flex is resolved with a large bulk acquisition memory (BAM) space (14.6 GB for 32-channel) combined with the new Acquisition-to-Disk feature. The later routes data that overflows BAM directly to Disk for temporary storage until BAM becomes available, enabling multi-phase scans that would otherwise not be possible. This feature also enables the reconstruction speed to keep pace with the acquisition. With two phases of data in BAM, Acquisition-to-Disk keeps pace with 10+ phases of dynamic scanning.

The information contained in this document is current as of publication of the magazine.
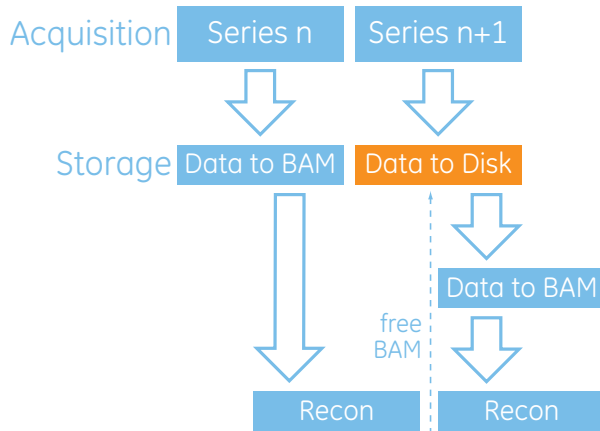
BREAST IMAGING   ISSUE SPOTLIGHT

Figure 1: Acquisition-to-Disk – Data overflow in BAM is stored directly to the disk allowing VIBRANT-Flex to utilize multi-phase prescriptions that require space larger than BAM limit.
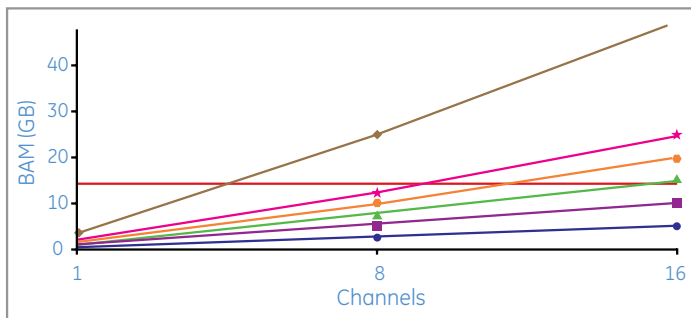

Figure 2: Sample high resolution protocol 360x360x160 and its BAM usage.

The powerful Volume Reconstruction Engine (VRE) 2.0 combined with performance optimization allows ARC™ to unalias both in-phase and out-of-phase images while IDEAL processes two large data volumes to synthesize water and fat images. The result is rapid reconstruction that keeps total exam time in check.

The ability to process large datasets with ease and speed makes dynamic volume imaging a reality with VIBRANT-Flex. From image quality to workflow enhancements, VIBRANT-Flex continues to set higher standards in MR breast imaging. ∎
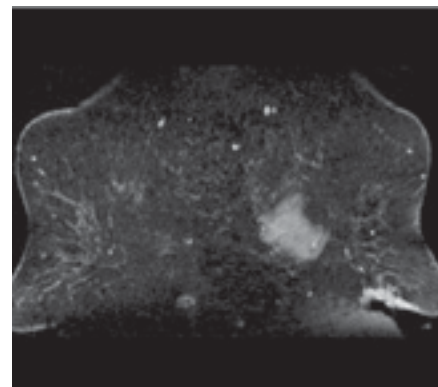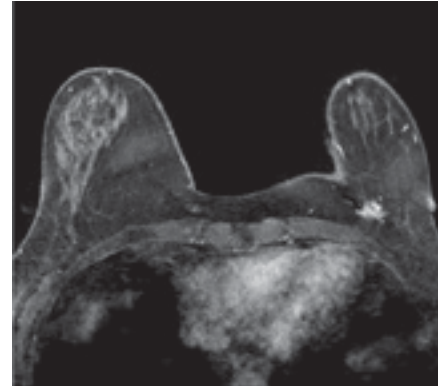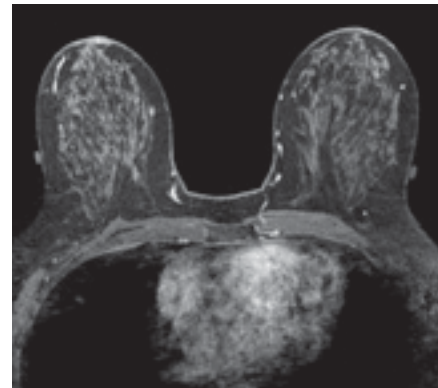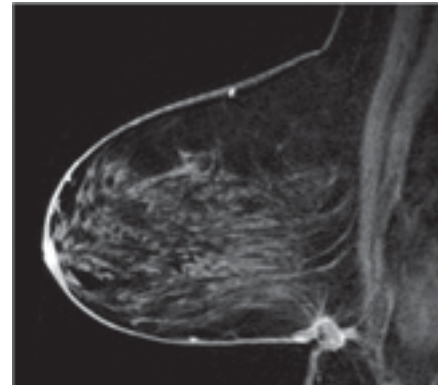

Figure 3: Sagittal VIBRANT-Flex water image with 1x1x1 mm isotropic resolution along with axial and coronal reformats. Signal uniformity and high-resolution allows reformats to be visually indistinguishable from the native acquisition plane.