Diffusion-Weighted Imaging: Artifacts & Remedies in Body MRI

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In vivo diffusion-weighted imaging (DWI) was first reported in 1990, where it was initially used to observe restricted directional diffusion within a cat brain (1). The authors speculated that DWI could potentially be used for “…stereospecific evaluation of white matter in the brain and spinal cord and in the characterization of demyelinating and dysmyelinating diseases.” Today, DWI in the brain has become a part of routine neuroimaging.

In the body, DWI has been used to create black blood images of the liver (2), as well as becoming established as “…an attractive noninvasive, quantitative technique that yields parameters that relate to tissue structure, cellularity, and necrosis” (3). However, DWI presents challenges in the abdominal cavity that are not, in general, an issue in neuroimaging, including, but not limited to, cardiac and respiratory motion, transient tissue motion, increased magnetic susceptibility due to the multitude of organs and fluid/air spaces present, and B0 inhomogeneity.

In general, the focus of this course is to introduce the artifacts that occur when performing DWI for body applications, with explanations of the artifacts based on MR physics principles presented. In particular, solutions will be provided to reduce the artifacts seen in spin-echo echo planar diffusion-weighted imaging (SE-EP-DWI) in the body. Examples and explanations will be presented for the manifestation of motion and susceptibility in SS-EP-DWI images, including how patient physiology can significantly impact the magnitude of these artifacts. Potential remedies that involve physiological gating and triggering, as well as k-space acquisition schemes and B0 field related optimization will be described.

The goal of this course is to provide the attendees with a fundamental understanding of the source of body diffusion-weighted imaging artifacts, and the practical remedies that are available on most commercial MR systems today.

References: