AbstractID: 6030 Title: The History (and Future) of MRI Physics

The history of MRI is now a little over 30 years old. It's impact on the scientific, and in particular medical, community has been immense, and shows no sign of slowing. From the first demonstration in 1973 of the spatial encoding of proton density information in the nuclear magnetic resonance signal, via the application of pulsed magnetic field gradients, a succession of technological developments now makes MRI the modality of choice for a wide range of cross sectional biomedical imaging applications. This talk will offer some insights into the origins of MRI, the rapid development of spin echo and gradient recalled echo, 2D and 3D, imaging and the birth of faster and faster imaging involving multiple echoes (RARE and echo planar imaging). Additionally, interpretation of MRI-accessible contrasts emerged, offering specific insights into physiology via NMR relaxation time constants and such MRI "flavors" as diffusion weighted imaging. In parallel, MRI-specific contrast media ("magnetic dyes") were introduced in the 1980's offering both "enhancement" of MRI signal as well as the opportunity to study dynamic processes (such as bolus tracer passage, with concomitant estimation of perfusion and, later, microvascular permeability). The 1990's saw the continued clinical adoption of MRI as well as the commitment to physiologically-specific imaging and the introduction of blood oxygenation level dependent (BOLD) contrast and the birth of "functional magnetic resonance imaging, fMRI", for the spatial mapping of brain functional organization. More recently yet further acceleration in image acquisition speed has been offered by the introduction of multiple (parallel) receiver coil elements and the adoption of the principles of sensitivity encoding. Presently, acceleration factors of x2 are routine, x4 are commonplace and x9 or more are in development. The future offers the possibility of massively parallel acquisitions with effectively single-shot temporal resolution of the order of milliseconds. While the contrast resolution of MRI is transitioning from anatomy through physiology towards biochemical processes, the speed of MRI is accelerating from static to real-time, hurdling successive physical and physiological boundaries (such, as involuntary motion, breath-hold, cardiac cycle and ultimately towards the speed of neuronal processes). The overall vision of this talk is to convey the ongoing development of MRI towards both increasing spatial and temporal resolution as well as towards increasingly specific biological interpretation.

Educational Objectives

1. To understand the origins and background of today's MRI
2. To understand the rapid development of MRI acquisition speed
3. To understand the use of tailored MRI to derive physiologically specific image contrast
4. To anticipate the continued acceleration of both imaging speed and biological application of MRI