Quantitative Magnetic Resonance (MR) Imaging – An Important Area for the Medical Physicist

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Medical imaging provides for novel assessments of both normal and abnormal function in the human body. Magnetic resonance (MR) imaging, in particular, is a wide-spread technology that allows for unprecedented volumetric imaging without needing ionizing radiation. Today, MR imaging is used in a variety of clinical and research applications.

Medical physicists and other imaging scientist have contributed greatly to the development of a specific class of MR imaging techniques – known collectively as quantitative MR imaging. Fundamentally, an MR image consists of a matrix of image intensity values. In principle these values are quantitative; however, in a typical MR image they are generally utilized in a relative (*i.e.*, qualitative or semi-qualitative) manner, as each image pixel often has a complex dependence on many factors including scanner-specific properties. In reality, underlying each image are the intrinsic (and often very quantitative!) contrast mechanisms of the nuclear magnetic resonance phenomenon including T1 and T2 relaxation, diffusion, perfusion, permeability, oxygenation, susceptibility, *etc*.

Relative MR data provides valuable information about the anatomical structure of the human body, allowing an experienced radiologist to be able to identify abnormal structures or morphological changes related to pathological processes. Nonetheless, changes on MR images potentially can more powerful when used in a quantitative fashion to identify abnormal tissue. The potential exists to see earlier or subtler disease changes with quantitative MR images and assessment tools. Applications will be reviewed and discussed to to illustrate the potential of quantitative imaging.