
Yi Wang

*Updated substantially in 2015, as exemplified by additions in Chapter 3*

Figures in ppt files are available: Download.

Principles of Magnetic Resonance Imaging provides a contemporary (2016) introduction to the fundamental concepts of MRI and connects these concepts to the latest MRI developments. Graphic illustrations are used to visualize the complete solution to the Bloch Equation and to clarify underlying biophysical processes, simplified calculations and specific examples are used to add precision in appreciating abstract concepts, and insightful interpretations and clinical examples are presented to appreciate biomedical information in MRI signal. This book contains three parts:

**I. Section the body into voxels.**
Part I describes the Fourier encoding matrix for an imaging system, realization of Fourier encoding using the gradient field in magnetic resonance, and k-space sampling.

**II. What's in a voxel?**
Part II examines the effects of the biophysical processes in a voxel on MRI signal. A unified distributional evaluation of the phase factor in a voxel and intuitive biophysical models are developed for MRI signal dependence on Spin fluctuation in a thermal microenvironment, which leads to T1/T2 relaxation rates reflecting cellular contents in a water voxel. Micro- and macro physiological motion, which includes diffusion, perfusion, flow and biomechanical motion. Molecular electron response to the $B_0$ field, which leads to magnetic susceptibility and chemical shift. The connection of MRI contrast physics to biomedical applications is visualized in the following three terms: 1) cellularity for T2 weighted imaging and diffusion weighted imaging (the latter emphasizing cellular geometry), 2) vascularity for T1 weighted imaging with Gadolinium injection, MR perfusion, and MR angiography, and 3) biomolecularity for MR spectroscopy, and tissue magnetism with emphasis on biometallic imaging.

**III. How to operate MRI?**
Part III describes MRI safety issues, hardware, software, MRI scanning, and routine MRI protocols.

This MRI book also uses basic concepts to demonstrate and expose students to the latest technological innovations, including: $B_{1+}$ and $B_{1-}$ mapping; Chemical exchange saturation transfer (CEST); Electric property tomography (EPT); Magnetic particle imaging (MPI); MR elastography (MRE); Moving spin tagging including ASL, SPAMM and DENSE; Navigator motion compensation; Parallel or accelerated imaging including SENSE, GRAPPA, compressed sensing and other Bayesian approaches; Quantitative susceptibility mapping (QSM).

**QSM (quantitative susceptibility mapping): magnetic resonance imaging of tissue magnetism.**

Yi Wang

Quantitative Susceptibility Mapping gives a systematic account of the fundamentals of physical concepts, technical algorithms, and biomedical applications associated with magnetic resonance imaging of tissue magnetism. Recent progresses in MRI phase analyses and in numerical optimization solvers of inverse problems and promising applications in studying iron and oxygen metabolisms and hemorrhage have attracted many people to investigate quantitative susceptibility mapping (QSM). The objective of this book is to provide a comprehensive and timely introduction for the newly formed and rapidly growing QSM community. Emphasis has been placed on clarity throughout the narrative. Detailed considerations are presented to clarify the subtleties of the physics of magnetism and magnetic resonance signals:

- Thorough demonstrations of the forward problem from magnetic susceptibility to field.
- Comprehensive descriptions of major approaches to solving the field to susceptibility inverse problem.
- Specific examples of clinical and scientific applications.

Engineers, physicists, and clinicians at all levels, from students to established investigators, will find Quantitative Susceptibility Mapping a useful aid in understanding the physical principles of magnetic resonance imaging of tissue magnetic properties.
MRI from Picture to Proton presents the basics of MR practice and theory in a unique way: backwards! The subject is approached just as a new MR practitioner would encounter MRI: starting from the images, equipment and scanning protocols, rather than pages of physics theory. The reader is brought face-to-face with issues pertinent to practice immediately, filling in the theoretical background as their experience of scanning grows. Key ideas are introduced in an intuitive manner which is faithful to the underlying physics but avoids the need for difficult or distracting mathematics. Additional explanations for the more technically inquisitive are given in optional secondary text boxes. The new edition is fully up-dated to reflect the most recent advances and includes a new chapter on parallel imaging. Informal in style and informed in content, written by recognized effective communicators of MR, this is an essential text for the student of MR.

PDF | Functional magnetic resonance imaging (fMRI) is a neuroimaging technique that provides brain activation maps with a spatial resolution of a few millimeters. The BOLD (blood oxygenation level dependent) fMRI method is the most commonly used technique. It measures... We begin with reviewing the basic principles of MRI physics. for a better understanding of fMRI and the nature of the BOLD signal. Basic Principles of MRI Physics. In MRI, magnetic properties of hydrogen (H) atoms, in other words protons, are utilized because they are abundant. in tissues and have the simplest atomic configuration. After an introduction on the basic principles of magnetic resonance imaging and the electric and magnetic properties of biological tissues, the basic phenomena to understand the bio-effects are described in classical terms. Values of field strengths and frequencies commonly utilized in these diagnostic systems are reported in order to allow the integration of the specific literature on the bio-effects produced by magnetic resonance systems with the vast literature concerning the bio-effects produced by electromagnetic fields. Chakeres DW, Kangarlu A, Boudoulas H, Young DC: Effect of static magnetic field exposure of up to 8 Tesla on sequential human vital sign measurements. J Magn Reson Imaging 2003, 18: 346–352. 10.1002/jmri.10367View ArticleGoogle Scholar.