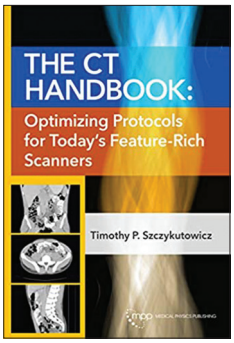
The Computed Tomography Handbook: Optimizing Protocols for Todays' Feature-Rich Scanners



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This book covers extensively a wide range of topics ranging from basics to advanced clinical computed tomography (CT) imaging, including positioning of the patient to the complete workflow in a radiology imaging set-up. Pictorial representations in each chapter are very valuable for the entire CT team for easy understanding. This book can be used as a quick reference guide for setting clinical protocols, trouble-shooting, identifying artifacts and for purchasing newer CT scanners. This book is suitable for a wide group of health-care professionals such as radiology residents, technologists, medical physicists, clinical engineers, radiology managers, and application specialists.

Chapter 1: Introduction to Computed Tomography

This chapter provides a short description of the working principle of a clinical CT scanner and includes brief details on various options available on the modern CT scanner. The chapter also discusses briefly on small animal imaging and models and industry. A valuable part of the chapter is a few comments on some common misconceptions in today's CT scanners used in medicine.

Chapter 2: Example Computed Tomography Exam Workflows

This chapter is very valuable for the CT operator, nursing staff, and radiologist as they are involved in preparing and setting up the examination for the patient. Description of routine and advanced CT examination protocols, selection of protocols, landmarks for each anatomical region, and scan ranges are included in the chapter. Basic cross-sectional CT anatomy tutorial with a lot of images is a useful guide for residents and CT operators.

Chapter 3: Image Quality and System Performance

Performance evaluation of a CT scanner is quite challenging in modern CT scanners due to differences in make, model, and manufacturer specifications. This chapter is mostly focused on AAPM Report 233 on the performance evaluation of CT systems. Methods of assessing image noise, image contrast, contrast-to-noise ratio, spatial and temporal resolution are discussed along with specific factors influencing image quality.

Chapter 4: Dose

Radiation risk from CT with details on radiation damage and guidance on dose limits for various body regions and a quick reference guide to the fetal dose calculations are included in this chapter. A comprehensive note on CT patient dose surrogates such as CTDI, SSDE, DRLs, gender and age-specific k-factors for the conversion of DLP to effective dose, ImPACT CT organ dose calculated for a few CT scanner models have been included in this chapter. The chapter concludes with discussion on a few patient shielding requirements for diagnostic CT examinations.

Chapter 5: Reconstruction Options

The radiological community always strives to provide images of acceptable image quality for the clinical requirement. Post-processing CT raw data require adequate skills. Reconstruction options that can be tailored as per the radiologist's requirements are discussed in great detail. Brief descriptions of window width and levels, iterative denoizing, beam hardening corrections, and a master protocol concept applied to image reconstruction types are some of the salient descriptions of this chapter.

Chapter 6: Acquisition Parameters and The Master Protocol Concept

Modern CT scanners have multiple parameters that can be adjusted for obtaining diagnostic quality images. Understanding CT acquisition parameters is the key for good imaging. This chapter discusses on some practical aspects involved in setting acquisition parameters that will be of help in optimizing clinical protocols in various CT scanners. The master protocol table is useful to define relative dose and exposure parameters for the clinical protocols specific to the region of interest.

Chapter 7: Automatic Exposure Control

The automatic exposure control (AEC) has been widely used in radiography; however, the AEC functioning in modern CT scanners varies from vendor to vendor though the concept remains the same. Details on tube current modulation, beam energy modulation with its effect on image quality are detailed in this chapter. The chapter describes how AEC can change various scan parameters during the scan.

Practical advice with the use of AEC and how this has been worked upon by several vendors are discussed in detail in this chapter.

Chapter 8: Computed Tomography Contrast

This chapter is particularly useful for the CT operators as it discusses the contrast media, injectors, time delay for scan, and other parameters useful for optimizing contrast studies in CT. The tables illustrating the volume of contrast media with its strengths and flow rates for a given volume and injection duration are necessary information for clinical imaging.

Chapter 9: Beam Energy, Computed Tomography Number and Dual-Energy Computed Tomography

Beam energy, energy ranges in CT scanners, and CT numbers as a function of beam energy are among few concepts that have educational value and may be implemented in a clinical setup. Dual-energy and spectral imaging are also clinically relevant in the current scenario. This chapter includes a useful periodic table with k-edge energies to understand how different materials will enhance at different beam energies.

Chapter 10: Patient Positioning

This is a very relevant chapter for CT operators as proper positioning plays a vital role in imaging and is often overlooked. The chapter discusses CT localizing, patient positioning and its effect on image quality and dose modulation.

Chapter 11: Protocol Management

The uniformity of CT protocol is beneficial for the harmonized workflow, especially in a setup with medical physicists, radiologists, technologists, and application specialist. This chapter introduces few case scenarios to customize CT protocols (e.g., scan time, slice thickness, contrast details, and image reconstruction) and works as a template for the CT protocol team.

Chapter 12: Protocol Review

Details on dose tracking software, including dose data collection from several scanners, normalizing dose information, and analysis to interrogate dose data are discussed in this chapter. A note on pitfalls of dose comparisons, method of reviewing dose information, and diagnostic reference levels are discussed. Radiologist's quantitative image review scoring rubrics for various anatomical regions based on overall image quality, image noise, texture, as well as artifacts are discussed in this chapter.

Chapter 13: Clinical Multidetector Computed Tomography

This is a very interesting chapter on clinical recommendations specific for various body regions and imaging sections. Techniques for appropriate patient positioning and questions to review internally with the CT vendors, especially for perfusion imaging, are useful. A discussion on cardiac gated imaging and consideration for children while imaging is included in this chapter.

Chapter 14: Cone-Beam Computed Tomography and Nondiagnostic Computed Tomography

The chapter discusses tomographic image reconstruction using cone-beam CT and the artifacts due to the inherent scan time of moving the c-arm gantry. A note on industrial, micro CT and CT simulators used in the radiotherapy treatment planning have also been included.

Chapter 15: Informatics and Computed Tomography

Methods of CT dose reporting using dose slide from the CT scanner, DICOM information, dose information from the vendor log file, and knowledge on scanner output for calculation of dose are discussed in this chapter. The chapter also introduces networking of managing master protocol, CT workflow in multiple scanners, and multi-site CT fleet from different locations.

Chapter 16: Artifacts

Artifacts have been classified into two groups: Isocentric (scanner related) and nonisocentric (patient induced). The chapter introduces artifact identification from the reading room and is useful for the radiologist. Extensive coverage of several artifacts encountered in CT imaging is very useful for learning and troubleshooting. Some practical methods of identifying artifacts using phantoms are discussed in detail and are useful for the medical physicists and engineers.

Chapter 17: Buyers Guide of Optional Features in Computed Tomography

This chapter is split in to five sections to discuss multidetector computed tomography (MDCT) used in diagnostic imaging, positron emission tomography (PET), PET/CT and interventional settings; specific clinical options; auxiliary equipment; matrix of scanners; and planning a CT suite. This chapter will be useful for the CT team for appropriate decisions on purchasing MDCT scanner.

Concluding remarks: Modern CT scanners with its varied features require a collaboration of medical physicists, practicing

radiologists, technologists, and application specialists to understand its concepts and thus form a robust CT team. With lot of practical illustrations and images, this book is organized for individuals who have basic knowledge in CT imaging. Overall, I would recommend this book for technologists, radiologist, medical physicists, and application specialists.

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