PROGRESS IN BIOMEDICAL OPTICS AND IMAGING
Vol. 24 No. 48

Medical Imaging 2023

Physics of Medical Imaging

Lifeng Yu
Rebecca Fahrig
John M. Sabol
Editors

19–23 February 2023
San Diego, California, United States

Sponsored by
SPIE

Cosponsored by
Siemens Healthineers
Konica Minolta Healthcare

Cooperating Organizations
American Association of Physicists in Medicine (United States)
Radiological Society of North America
World Molecular Imaging Society
Society for Imaging Informatics in Medicine (United States)
International Foundation for Computer Assisted Radiology and Surgery
Medical Image Perception Society (United States)

P*ublished by*
SPIE

Volume 12463

Part One of Two Parts

Proceedings of SPIE, 1605-7422, V. 12463

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIEDigitalLibrary.org.

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings:
Author(s), "Title of Paper," in *Medical Imaging 2023: Physics of Medical Imaging*, edited by Lifeng Yu, Rebecca Fahrig, John M. Sabol, Proc. of SPIE 12463, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 1605-7422
ISSN: 2410-9045 (electronic)

ISBN: 9781510660311
ISBN: 9781510660328 (electronic)

Published by
SPIE
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time)
SPIE.org
Copyright © 2023 Society of Photo-Optical Instrumentation Engineers (SPIE).

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.

SPIE. DIGITAL LIBRARY
SPIEDigitalLibrary.org

Paper Numbering: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B … 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

Contents

xiii *Conference Committee*

Part One

MONDAY MORNING KEYNOTES

12463 02 **State of the art in the task-based assessment of medical imaging systems (Keynote Paper)** [12463-501]

SESSION 1 PHOTON-COUNTING COMPUTED TOMOGRAPHY (PCCT)

12463 03 **A systematic assessment of photon-counting CT for bone mineral density and microarchitecture quantifications** [12463-1]

12463 04 **Noise2Noise for denoising photon counting CT images: generating training data from existing scans** [12463-2]

12463 05 **Photon counting spectral computed tomography in diagnosis of joint conditions using novel bismuth contrast agent** [12463-3]

12463 07 **Effects of bowtie scatter on material decomposition in photon-counting CT** [12463-5]

SESSION 2 TOMOSYNTHESIS AND PHASE CONTRAST

12463 08 **Feasibility of dynamic lung tomosynthesis using stationary x-ray source arrays** [12463-6]

12463 09 **Multimodal single-shot x-ray phase-contrast imaging using a high-resolution micropillar-based grating** [12463-8]

12463 0A **Simulation study of a novel ZnO nanowire cold cathode flat-panel x-ray source using EGSnrc for Talbot-Lau type grating interferometry** [12463-9]

SESSION 3 X-RAY DETECTORS

12463 0C **A study of crosstalk effect in pixelated photon counting detectors and impact to system imaging performance** [12463-11]

12463 0E **Comparison of energy bin compression strategies using a prototype silicon photon counting CT detector** [12463-13]

12463 0F **Charge sharing correction for photon counting detectors with coincidence counters** [12463-14]

12463 0G **Photon-count detector model using local parameters for pixel-to-pixel deviations** [12463-15]

12463 0H **Charge collection efficiency of CdTe detectors: impact of charge collection time and polarisation** [12463-17]

SESSION 4 MAMMOGRAPHY

12463 0I **4D digital breast phantom for contrast-enhanced imaging** [12463-18]

12463 0J **Theoretical basis and experimental validation of harmonic coherence-based ultrasound imaging for breast mass diagnosis** [12463-20]

12463 0K **A new approach for the objective assessment of breast imaging technologies: mass classification tasks** [12463-21]

12463 0L **Impact of cone-beam CT noise correlation on self-supervised denoising strategies for low dose breast CT imaging** [12463-22]

SESSION 5 IMAGING FOR THERAPY

12463 0M **Real-time single frame tomosynthesis: prototype and radiotherapy applications** [12463-23]

12463 0N **Predicting the dose distribution of multi-lesion lung stereotactic ablative radiotherapy plans using generative adversarial networks** [12463-24]

12463 0O **A histotripsy targeting approach using a mobile C-arm** [12463-25]

12463 0P **Spectral CT thermometry with improved temperature sensitivity for image-guided thermal ablation** [12463-26]

SESSION 6 NEW SYSTEMS AND MULTI-SOURCE COMPUTED TOMOGRAPHY

12463 0Q **Data driven methods for ultrasound computed tomography** [12463-27]

12463 0S **Preliminary investigation of image reconstruction from data over reduced angular range in spectral-spatial electron paramagnetic resonance imaging** [12463-29]

12463 0T **Spectral micro-CT imaging of multiple K-edge elements using GaAs and CdTe photon counting detectors** [12463-31]

12463 0U **Multiple focal spots for high resolution CT** [12463-32]

12463 0V **Adaptive kernel-based scatter correction for multi-source stationary CT with non-circular geometry** [12463-33]

12463 0W **Preliminary evaluation of a multi-source CBCT design** [12463-34]

SESSION 7 FLUOROSCOPIC AND RADIOGRAPHIC IMAGING

12463 0X **Approaches for three material decomposition using a triple-layer flat-panel detector** [12463-35]

12463 0Y **Three-material decomposition using a dual-layer flat panel detector in the presence of soft tissue motion** [12463-36]

12463 0Z **Use of high-speed angiography HSA-derived boundary conditions and Physics Informed Neural Networks (PINNs) for comprehensive estimation of neurovascular hemodynamics** [12463-37]

12463 10 **Integration of single-shot quantitative x-ray imaging on a C-arm system for static and dynamic phantom studies** [12463-38]

SESSION 8 CONE BEAM COMPUTED TOMOGRAPHY (CBCT)

12463 12 **Cone-beam CT trajectory optimization for metal artifact avoidance using ellipsoidal object parameterizations** [12463-40]

12463 13 **Cone-beam CT with a noncircular (sine-on-sphere) orbit: imaging performance of a clinical system for image-guided interventions** [12463-41]

12463 14 **Multi-stage Adaptive Spline Autofocus (MASA) with a learned metric for deformable motion compensation in interventional cone-beam CT** [12463-42]

12463 15 **Quantitative dual-energy imaging of bone marrow edema using multi-source cone-beam CT with model-based decomposition** [12463-43]

12463 17 **Multi-constrained multi-material decomposition for dual energy CBCT** [12463-45]

SESSION 9 BREAST TOMOGRAPHY AND DIGITAL TRIALS

12463 18 **A scatter correction method for contrast-enhanced digital breast tomosynthesis with a dual-layer detector** [12463-46]

12463 19 **Deep CNN task-based image quality assessment: application to digital breast tomosynthesis reconstruction and denoising** [12463-47]

12463 1A **Design of an in silico imaging trial with growing breast cancer lesions: comparison between DM and DBT detectability** [12463-49]

12463 1B **Development and application of a virtual imaging trial framework for airway quantifications via CT** [12463-50]

12463 1C **A complete procedure to prepare virtual clinical trials in digital breast tomosynthesis** [12463-51]

12463 1D **A dense search challenge phantom fabricated with pixel-based 3D printing for precise detectability assessment** [12463-52]

SESSION 10 PET/SPECT RECONSTRUCTION

12463 1E **Development and task-based evaluation of a scatter-window projection and deep learning-based transmission-less attenuation compensation method for myocardial perfusion SPECT (Physics of Medical Imaging Student Paper Award)** [12463-53]

12463 1F **Super-resolution reconstruction of γ-ray CT images for PET-enabled dual-energy CT imaging** [12463-54]

12463 1G **MR guided PET image denoising based on denoising diffusion probabilistic model and data consistency constraint** [12463-55]

12463 1H **Optimal dynamic step and shoot temporal design for quantitative multi-organ dynamic PET imaging** [12463-56]

12463 1I **Memory-efficient self-supervised learning of null space projection operators** [12463-57]

SESSION 11 CT NOISE REDUCTION AND IMAGE QUALITY & AI/ML

12463 1J **Contrast- and noise-dependent spatial resolution measurement for deep convolutional neural network-based noise reduction in CT using patient data** [12463-58]

12463 1K **Patient-specific uncertainty and bias quantification of non-transparent convolutional neural network model through knowledge distillation and Bayesian deep learning** [12463-64]

12463 1L **Unsupervised learning of robust models for cardiac and photon-counting x-ray CT denoising** [12463-60]

12463 1M **Task-driven CT image quality optimization for low-contrast lesion detectability with tunable neural networks** [12463-61]

12463 1N **Addressing the challenge of CT number bias in low-dose photon counting CT without access to raw detector count data** [12463-62]

12463 1O **Bench testing performance of deep learning-based CT image denoising methods: influence of object background on image sharpness and noise texture** [12463-63]

SESSION 12 COMPUTED TOMOGRAPHY IMAGE RECONSTRUCTION AND AI/ML

12463 1P **Empirical unbiased zero-count correction in photon counting CT** [12463-59]

12463 1Q **Harmonizing CT images via physics-based deep neural networks** [12463-66]

12463 1R **Cardiac phase estimation using deep learning analysis of pulsed-mode projections: towards autonomous cardiac CT imaging** [12463-67]

12463 1S **MB-DECTNet: a model-based unrolled network for accurate 3D DECT reconstruction** [12463-69]

POSTER SESSION

12463 1T **ListmodeCNN: deep learning-based PET list-mode image reconstruction** [12463-70]

12463 1U **Experimental study for discrimination between iodine and sucrose using photon counting CT assuming malignant/benign tumor** [12463-71]

12463 1V **Generation of training dataset for deep-learning noise reduction** [12463-72]

12463 1W **PET image reconstruction with parallax correction based on a distance-driven deep neural network** [12463-73]

12463 1Y **Unpaired learning with a data-dependent noise-generative model for low-dose CT sinogram restoration** [12463-75]

12463 1Z **Development of a spatial-spectral phantom for evaluation of vascular CT imaging** [12463-76]

12463 20 **First-generation clinical dual-source photon-counting CT: quantitative and ultra-high-resolution spectral imaging** [12463-77]

12463 21 **Reducing dose in renal perfusion CT scans: the effects on quantitative imaging features for patients of different sizes** [12463-78]

12463 22 **Annual medical physics compliance testing of a photon counting CT scanner in comparison to other state-of-the-art scanners** [12463-79]

12463 23 **Enhancing bare metal stent visibility using multi-energy subtraction x-ray imaging** [12463-82]

12463 24 **A flexible metasurface to improve knee MRI** [12463-83]

12463 25 **Acquisition of blockwise truncated and non-truncated bi-plane C-arm data for CBCT volume-of-interest imaging** [12463-84]

12463 26 **Extraction of alveolar walls in 3D lung micro-images from large-field synchrotron radiation micro-CT using U-Net** [12463-85]

12463 27 **Penalty-driven enhanced self-supervised learning (Noise2Void) for CBCT denoising** [12463-86]

12463 28 **Corrections to Bremsstrahlung spectra for a hyperspectral x-ray detector** [12463-87]

12463 29 **Experimental optimization of photon-counting dual-energy thoracic imaging** [12463-88]

12463 2A **2D versus 3D comparison of angiographic imaging biomarkers using computational fluid dynamics simulations of contrast injections** [12463-89]

12463 2B **Spatial dependency of multiplanar reconstruction in digital breast tomosynthesis** [12463-90]

12463 2C **Smoothing-parameter tuning for regularized PET image reconstruction using deep learning** [12463-91]

12463 2D **Low-dose dual-tracer PET image reconstruction based on attention mechanism** [12463-92]

12463 2E **A dual-layer direct/indirect flat panel detector for improved material decomposition: first studies of the indirect layer** [12463-93]

12463 2F **Millimeter wave radar-based motion monitoring method in magnetic resonance imaging system** [12463-94]

Part Two

12463 2G **3D-GAN to generate representative and realistic three-dimensional breast cancer models for virtual clinical trial applications** [12463-95]

12463 2H **An anatomic clutter phantom for lung-ventilation-imaging studies** [12463-96]

12463 2J **Physics-informed multi-modal imaging-based material characterization for proton therapy** [12463-98]

12463 2K **In vivo proton range validation using pseudo proton radiography** [12463-99]

12463 2L **Optimization of MV-kV dual-energy CT imaging for tomographic therapy** [12463-100]

12463 2M **First evaluation of 3D measurements of the compressed breast shape for digital breast tomosynthesis in the medio-lateral oblique view** [12463-101]

12463 2N **Computational method to artificially insert clusters of microcalcifications in digital breast tomosynthesis** [12463-102]

12463 2O **A motion-level-aware denoising framework for x-ray fluoroscopic images** [12463-103]

12463 2P **Direct reconstruction and separation for triple-tracer PET imaging based on three-dimensional encoder-decoder network** [12463-104]

12463 2Q **PKAID-Net: prior knowledge aware iterative denoising neural network for photon counting detector CT** [12463-105]

12463 2R **An experimentally validated simulation model of a two-bin flat-panel cadmium telluride photon-counting detector for spectroscopic breast imaging applications** [12463-106]

12463 2U **Characterization of a carbon nanotube x-ray source array for a multisource CBCT** [12463-109]

12463 2V **Eye-lens dose reduction using Region of Interest (ROI) attenuators in neuroimaging** [12463-110]

12463 2W **Impact of non-Gaussian noise properties, not characterized by the noise power spectrum, on CT noise texture** [12463-111]

12463 2X **Mass density estimation based on single-energy computed tomography via deep learning** [12463-112]

12463 2Y **Utility of phantom-based testing for evaluating the performance of AI in MRI image reconstruction** [12463-113]

12463 2Z **Comparing multi-view synthetic radiography derived from tomosynthesis with standard bitewing radiography** [12463-114]

12463 30 **Accurate image reconstruction in dual-energy CT with limited-angular-range data from completely non-overlapping scanning arcs** [12463-115]

12463 31 **Support-based extended field-of-view CT reconstruction for radiation treatment planning** [12463-116]

12463 32 **System matrix approach for attenuation compensation in photoacoustic tomography** [12463-117]

12463 34 **MMD-Net: multi-material decomposition network for high quality dual-energy CT imaging** [12463-119]

12463 35 **Anatomy registration via patient sensing for chest x-ray digital tomosynthesis** [12463-120]

12463 36 **Deep learning volumetric brain segmentation based on spectral CT** [12463-121]

12463 37 **Low-dose CT imaging performance of U-Net for varied spatial resolutions** [12463-122]

12463 38 **Dual-domain modulation for high-performance multi-geometry low-dose CT image reconstruction** [12463-123]

12463 39 **Robust multi-institution low-dose CT imaging with semi-supervised federated learning network** [12463-124]

12463 3A **Spectral CT denoising using a conditional Wasserstein generative adversarial network** [12463-125]

12463 3B **Deep learning-based all-in-one combined visualization strategy for disease screening in CT imaging** [12463-126]

12463 3C **Noise-conscious explicit weighting network for robust low-dose CT imaging** [12463-127]

12463 3D **Bayesian ensemble learning with denoiser pool for low-dose CT reconstruction** [12463-129]

12463 3E **Self-attention network for weak-supervised learning multi-material decomposition in dual energy CT** [12463-130]

12463 3F **Adaptive semi-supervised learning material estimation network in dual-energy CT** [12463-131]

12463 3G **Sparse constraint-based iterative estimation of effective atomic number and electron density for dual energy CT** [12463-132]

12463 3H **Charge integration-based pulse pileup correction in photon counting detectors** [12463-133]

12463 3I **K-edge photon counting CT imaging using a dual-bin photon counting detector and kV switching** [12463-134]

12463 3J **Analytic helical cone-beam artifact reduction for CT** [12463-135]

12463 3K **A novel single-cell ion chambered AEC to reduce exposure dose for spot image acquisition in R&F applications** [12463-136]

12463 3L **Reverberant magnetic resonance elastography** [12463-137]

12463 3M **Multi-energy CT material decomposition using Bayesian deep convolutional neural network with explicit penalty of uncertainty and bias** [12463-138]

12463 3N **Clinician-interactive AI for RECIST measurements in CT imaging** [12463-139]

12463 3O **Improvements in dose efficiency with high resolution scan modes in photon counting CT** [12463-140]

12463 3P **A study on the accuracy of polynomial fitting for direct computation of material lengths from projection data in dual energy CT** [12463-141]

12463 3Q **PixelPrint: a collection of three-dimensional printed CT phantoms of different respiratory diseases** [12463-142]

12463 3R **Improving the quality of dental crown using a transformer-based method** [12463-143]

12463 3S **Model-based deep learning to achieve interpretable spectral CT denoising** [12463-144]

12463 3U **Reconstruction of local noise power spectrum from a single CT data acquisition** [12463-146]

12463 3V **Bayesian optimization of laser-Compton x-ray sources for medical imaging applications** [12463-147]

12463 3W **Parameter selection for convex optimization time calibration for a 2-panel PET system** [12463-148]

12463 3X **Direct respiratory motion correction of whole-body PET images using a deep learning framework incorporating spatial information** [12463-150]

12463 3Y **Clinical developments of a stationary head CT using CNT x-ray source arrays** [12463-151]

12463 3Z **In silico tools for evaluating denoising and super-resolution algorithms applied to radiographic images** [12463-152]

12463 41 **Hybrid a-Se/RD53B CMOS detector: initial studies** [12463-154]

12463 42 **Automatic quality control in computed tomography volumes segmentation using a small set of XCAT as reference images** [12463-155]

12463 43 **Automated animation pipeline for visualizing in silico tumor growth models** [12463-156]

12463 44 **Assessment of projection interpolation to compensate for the increased radiation dose in DBTMI** [12463-157]

12463 45 **Performance assessment of a focussed gamma probe using Monte Carlo simulations** [12463-158]

12463 46 **An edge-preserving mean curvature regularization for CT reconstruction** [12463-159]

12463 47 **Development of an iterative method for the geometric calibration of a photon counting detector-based cone beam CT system** [12463-160]

12463 48 **Evaluation of low-contrast detectability of photon-counting-detector CT using channelized Hotelling observer and an ACR accreditation phantom** [12463-161]

12463 49 **Evaluating the feasibility of using reduced scan length for non-contrast CT during image-guided liver ablations** [12463-162]

12463 4A **Material decomposition for photon-counting CT using a flux-independent neural network** [12463-163]

12463 4C **Experimental dual-kV reconstructions of objects containing metal using the cOSSCIR algorithm** [12463-165]

12463 4D **Dose evaluation of simultaneous breast radiography and mechanical imaging** [12463-166]

12463 4F **A comparison of digital-based CNT and analogue-based filament x-ray source in regard to intraoperative specimen x-ray system's development** [12463-168]

12463 4G **A portable x-ray source based on CNT for chest radiography** [12463-169]

12463 4H **Geometric comparison of chest tomosynthesis system with thermionic filament and carbon nanotube field emitter-based x-ray sources** [12463-170]

12463 4I **Operation of multi-beam compact tomosynthesis system using carbon nanotube emitters** [12463-171]

12463 4J **Deep learning CT image restoration using system blur models** [12463-172]

12463 4K **Carbon nanotube x-ray tube with bipolar operation for dental application** [12463-173]

12463 4L **Is two better than one? Super resolution for dual-layer radiography with convolutional neural networks** [12463-174]

12463 4M **Development of reflective type digital cell irradiation system based on carbon nanotube for biological research of low-dose radiation** [12463-175]

12463 4N **Pulse driving of CNT cathode-based electron emitter for multi-x-ray source** [12463-176]

12463 4O **Carbon nanotube emitter x-ray source for high-resolution micro-computed tomography** [12463-177]

12463 4P **Multi-modality GLCM image texture feature for segmentation and tissue classification** [12463-178]

12463 4Q **Spectral correction using dual-material signal-to-thickness calibration** [12463-179]

12463 4R **Development of a dynamic phantom for near infra-red optical and computed tomographic brain imaging** [12463-180]

12463 4S **Bone suppression technique for multidirectional dynamic chest radiography: a virtual imaging trial** [12463-7]

12463 4T **Towards appropriate use of test phantoms in training deep learning models for mammographic image conversion** [12463-19]

DIGITAL POSTER SESSION

12463 4U **Effects of x-ray excitation voltage on X-SWIR intensity and x-ray dose** [12463-30]

12463 4V **VVBP-tensor-based deep learning framework for high-attenuation artifact reduction in digital breast tomosynthesis** [12463-48]

12463 4W **Semi-centralized federated learning network for low-dose CT imaging** [12463-65]

12463 4X **Dual-domain projection fidelity network for sparse-view helical CT reconstruction** [12463-68]

12463 4Z **VVBP-tensor-based deep neural network for metal artifact reduction in computed tomography** [12463-128]

12463 50 **In-line stationary multi-source tomosynthesis for high throughput 3D x-ray inspection: a simulation study** [12463-149]