

PROGRESS IN BIOMEDICAL OPTICS AND IMAGING

Vol. 26 No. 50

Medical Imaging 2025

Physics of Medical Imaging

John M. Sabol
Ke Li
Shiva Abbaszadeh
Editors

17–21 February 2025
San Diego, California, United States

Sponsored by
SPIE

Cosponsored by
United Imaging Healthcare Co., Ltd. (United States)

Published by
SPIE

Volume 13405

Part One of Two Parts

Proceedings of SPIE, 1605-7422, V. 13405

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 SPIDigitalLibrary.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 2025: Physics of Medical Imaging*, edited by John M. Sabol, Ke Li, Shiva Abbaszadeh, Proc. of SPIE 13405, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 1605-7422

ISSN: 2410-9045 (electronic)

ISBN: 9781510685888

ISBN: 9781510685895 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time)

SPIE.org

Copyright © 2025 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**

SPIDigitalLibrary.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

xv *Conference Committee*

Part One

NOVEL X-RAY SOURCES AND SYSTEMS

- 13405 02 **Rotating anode x-ray tube technology at the limit** [13405-1]
- 13405 03 **Multi-source static CT with adaptive fluence modulation to minimize hallucinations in generative reconstructions** [13405-2]
- 13405 04 **Reducing scatter and cone-beam artifacts in DE-CBCT (Best Student Paper Award - Runner Up, All-Conference Best Student Paper Award - Finalist)** [13405-3]
- 13405 05 **High-fidelity prefiltration using a double bowtie design for quantitative low-dose pediatric spectral CT imaging** [13405-4]
- 13405 06 **Classifying breast cancer and microcalcifications with multi-contrast single-mask phase contrast imaging** [13405-5]

CONE BEAM CT

- 13405 07 **Quantification of metal artifacts in metal artifact avoidance** [13405-6]
- 13405 08 **Optimization for spectral modulator in fast-KV-switching dual-energy CBCT imaging** [13405-8]
- 13405 09 **Deep learning-based noise reduction for ultra-low-dose dental CBCT images using paired datasets from different domains** [13405-9]

DETECTORS

- 13405 0A **An ultra-high sensitivity sensing collimation imager: design, modelling, and assessment** [13405-10]
- 13405 0B **First experimental demonstration of charge-cloud imaging for micrometer-scale resolution with a photon-counting silicon CT detector** [13405-11]
- 13405 0C **On the performance of a stacked dual-layer flat-panel detector** [13405-12]

- 13405 OD **A-Se thin film detector on ITkpix CMOS readout: time-over-threshold tuning and pixel performance analysis** [13405-13]
- 13405 OE **Optimizing parylene and photoconductor thickness in indirect conversion amorphous selenium detectors** [13405-14]
- 13405 OF **Experimental investigation of direct-indirect flat-panel imager using tellurium doped amorphous selenium** [13405-15]

PHOTON COUNTING DETECTOR CT

- 13405 OG **Implicitly defined PCCT material decomposition estimator and learned physics-informed neural proxy** [13405-16]
- 13405 OH **Log conversion with fewer counts for photon counting CT: decreasing both bias and variance simultaneously** [13405-17]
- 13405 OI **Design of a "3.5th generation" photon counting detector CT architecture for higher spatial resolution and decreased ring artifact** [13405-18]
- 13405 OJ **Deep bowtie and patient scatter correction applied to clinical photon-counting CT** [13405-19]
- 13405 OK **Increasing spatial resolution in photon counting CT by exploiting the non-linear partial volume effect** [13405-20]
- 13405 OL **Task-specific deep learning-based denoising for UHR cardiac PCD-CT adaptive to imaging conditions and patient characteristics: impact on image quality and clinical diagnosis and quantitative assessment** [13405-21]

BREAST IMAGING

- 13405 OM **Towards quantitative spectral mammography using triple-energy K-edge imaging and a two-pass reconstruction approach** [13405-22]
- 13405 ON **A single convolutional neural network for simultaneous estimation of breast thickness map and scatter maps in dual-energy digital breast tomosynthesis using a dual-layer detector** [13405-23]
- 13405 OO **Methodology to simulate temporal changes in breast tumors and parenchyma using Perlin noise** [13405-24]
- 13405 OP **Modular breast and tumor perfusion phantoms for validation of 4D dynamic contrast-enhanced dedicated breast CT** [13405-25]

PHYSICS/IMAGE-GUIDED PROCEDURES: JOINT SESSION WITH CONFERENCES 13405 AND 13408

- 13405 0Q **Learning-based dual-domain rigid motion estimation in interventional C-arm cone-beam CT** [13405-26]
- 13405 0R **In silico study of quantitative digital subtraction angiography (qDSA) blood velocity measurements versus catheter geometry** [13405-27]
- 13405 0S **Can we assess brain perfusion even when DSA images are contaminated by motion artifacts?** [13405-28]

IMAGE RECONSTRUCTION WITH DIFFUSION MODELS

- 13405 0U **Patlak reconstruction from dynamic PET based on diffusion models: evaluations using total-body dynamic datasets** [13405-30]
- 13405 0V **Joint reconstruction and scatter estimation in cone-beam CT using diffusion posterior sampling** [13405-31]
- 13405 0W **Generative super-resolution PET imaging with Fourier diffusion models** [13405-32]
- 13405 0X **3D diffusion posterior sampling for CT reconstruction** [13405-33]

ANGIOGRAPHY AND RADIOGRAPHY

- 13405 0Z **Impact of spectral separation on robustness to scatter errors in quantitative dual-energy radiography** [13405-35]
- 13405 10 **Synthetic mask energy subtraction angiography: phantom study** [13405-36]
- 13405 11 **Deep learning fluoroscopy denoising: a beam quality insensitive approach** [13405-37]
- 13405 12 **Microparticle x-ray targets** [13405-38]

VIRTUAL CLINICAL TRIALS

- 13405 14 **ISIT-GEN: an in silico imaging trial to assess the inter-scanner generalizability of CTLESS for myocardial perfusion SPECT on defect-detection task (Best Student Paper Award, All-Conference Best Student Paper Award - Finalist)** [13405-41]
- 13405 15 **A representation-based method for continuous CT image reconstruction** [13405-43]

- 13405 16 **The role of harmonization: a systematic analysis of various task-based scenarios** [13405-104]
- 13405 17 **Deep virtual CT workflow for evaluating AI in low-dose CT lung cancer screening: a 2D demonstration** [13405-40]

CT IMAGE QUALITY

- 13405 18 **In vivo evaluation of non-invasive temperature monitoring with spectral CT thermometry** [13405-44]
- 13405 19 **The impact of noise texture on a deep learning denoising model for high-resolution cardiac EID-CT** [13405-45]
- 13405 1A **A perfusion phantom for dynamic micro-CT imaging** [13405-46]
- 13405 1B **Patient-specific channelized hotelling observer to estimate lesion detectability in CT** [13405-47]
- 13405 1C **Motion compensation in cardiac CT for the entire heart using a residual U-Net** [13405-48]
- 13405 1D **Contrast-guided virtual monoenergetic image synthesis via adversarial learning for coronary CT angiography using photon counting detector CT** [13405-49]

PHASE CONTRAST AND DARK FIELD IMAGING

- 13405 1E **Quantitative characterization of speckle-based x-ray imaging setup for sub-resolution microstructure analysis using standardized samples** [13405-50]
- 13405 1G **Analytic and accurate reconstruction method for x-ray dark-field computed tomography** [13405-52]
- 13405 1H **Single-shot dark-field and phase contrast micro-CT with single-mask phase contrast imaging** [13405-53]

DEEP LEARNING APPLIED TO IMAGING PHYSICS

- 13405 1I **Joint estimation of anatomy and implants in x-ray CT using a mixed prior model** [13405-54]
- 13405 1J **Deep-learning micro-CT perfusion quantification** [13405-55]
- 13405 1K **Improving low-contrast liver metastasis detectability in deep-learning CT denoising using adaptive local fusion driven by total uncertainty and predictive mean** [13405-56]
- 13405 1L **A detection task-specific deep learning method to improve the quality of sparse-view myocardial perfusion SPECT images** [13405-57]

POSTER SESSION: CBCT

- 13405 1O **Deep learning reconstruction of triple-source CT data with sparse view and truncation** [13405-60]
- 13405 1P **Unified scatter estimation in x-ray spectral cone-beam CT using linear Boltzmann transport equation with labels on energy groups** [13405-61]
- 13405 1Q **Cephalometric radiograph generation from 3D dental CBCT images with automatic positioning** [13405-62]
- 13405 1R **Improving soft tissue contrast using a multisource CBCT for potential application in adaptive radiation therapy** [13405-63]
- 13405 1S **Multi-scale information guided dual-domain fusion network for metal artifact reduction in dental CBCT** [13405-64]

POSTER SESSION: IMAGE-GUIDED INTERVENTION AND RADIOTHERAPY

- 13405 1T **Respiratory volume prediction for pediatric TIS patients with MAGEC rod treatment from pre-operative dynamic MRI and chest radiographs** [13405-65]
- 13405 1U **Investigation of the effect of training set parameters on deep neural network prediction accuracy of fluoroscopic procedure-room scatter dose distributions** [13405-66]
- 13405 1V **Experimental evaluation of metal artifact avoidance and reduction for anterior cervical discectomy and fusion surgery** [13405-67]
- 13405 1W **The role of SiPM-based PET for accurate volume delineation** [13405-68]
- 13405 1X **Direct head orientation parameter estimation for IPEN** [13405-69]
- 13405 1Y **Swine liver segmentation for FEM-based image fusion in CBCT guided histotripsy** [13405-70]
- 13405 1Z **CycleGAN with multi-scale block and attention gate for synthesizing CT image in adaptive radiotherapy** [13405-71]

POSTER SESSION: IMAGE RECONSTRUCTION

- 13405 20 **Projection-embedded Schrödinger bridge for CT sparse view reconstruction** [13405-72]
- 13405 21 **Second-generation AI iterative reconstruction for abdominopelvic CT imaging of colorectal cancer: a comprehensive evaluation** [13405-75]
- 13405 22 **A deep-learning reconstruction framework for low-dose, dynamic x-ray CT** [13405-76]

- 13405 23 **Reconstructing multiple basis images directly from dual-energy CT data using the basis-region model and volume conservation constraint** [13405-77]
- 13405 24 **Accurate image reconstruction from truncated offset CT data using TVL1 algorithm** [13405-78]
- 13405 25 **Optimizing hyperparameters in regularized tomographic reconstruction via pixel-wise adaptive fine-tuning** [13405-79]
- 13405 26 **Regularizing neural fields for 3D computed tomographic imaging from sparse projections** [13405-80]
- 13405 28 **Black-box optimization of CT acquisition and reconstruction parameters: a reinforcement learning approach** [13405-82]
- 13405 29 **Optimization-based image reconstruction for limited-angle dual-energy cone-beam CT** [13405-83]
- 13405 2B **Wavelet-based iterative network for dual-domain sparse-view CT reconstruction using MRI priors** [13405-85]

Part Two

POSTER SESSION: ARTIFICIAL INTELLIGENCE

- 13405 2C **Optimization of the U-Net++ model for cerebral artery segmentation based on deep learning in computed tomographic angiography images** [13405-86]
- 13405 2D **Multiple organ segmentation for CT scout images** [13405-87]
- 13405 2E **Fully automated AI-based dual-energy subtraction system for chest radiography** [13405-88]
- 13405 2F **Dose-aware adaptive denoising network for low-dose CT** [13405-89]
- 13405 2G **Quality enhancement of radiographic x-ray images by interpretable mapping** [13405-90]
- 13405 2H **Self-supervised metal artifacts reduction with a continuous constraint along the z-axis** [13405-91]
- 13405 2I **Early step skipping score-based generative model for low-dose CT denoising** [13405-92]
- 13405 2J **Simulating scanner- and algorithm-specific 3D CT noise texture using physics-informed 2D and 2.5D generative neural network models** [13405-93]
- 13405 2K **Synthesis of realistic medical images with pathologies using diffusion models with application to lung CT and mammography** [13405-94]

- 13405 2L **Compressibility analysis for the differentiable shift-variant filtered backprojection model** [13405-95]
- 13405 2M **PET image denoising based on diffusion models and sequential Monte Carlo posterior sampling** [13405-96]
- 13405 2N **Noise aware system generative model (NASGM) of PET: a deep learning-based model for PET image simulation with quantitative assessment** [13405-97]
- 13405 2P **PET image reconstruction with diffusion priors and half-quadratic splitting** [13405-99]
- 13405 2Q **CT synthesis from MRI using 3D swin UNETR and distillation for upper abdominal radiotherapy treatment planning** [13405-100]
- 13405 2R **Validation and implementation of a deep learning-based automated approach for myocardial segmentation in clinical CT perfusion measurement** [13405-101]
- 13405 2T **Feature extraction effect in multi-agent reinforcement learning-based denoising model for digital tomosynthesis** [13405-103]

POSTER SESSION: VIRTUAL CLINICAL TRIAL AND PHANTOMS

- 13405 2U **Development of a virtual photon-counting micro-CT imaging platform for preclinical cancer studies** [13405-105]
- 13405 2V **A Monte Carlo model of coronary artery plaque growth for use in computational phantoms** [13405-106]
- 13405 2X **An integrated PET-CT simulation pipeline for biomedical imaging research** [13405-108]
- 13405 2Y **3D CTGAN: generating 3D heterogeneous tissue textures for virtual phantoms** [13405-109]
- 13405 2Z **Development of breast suppression technique for dynamic chest radiography using a mixed dataset of virtual and real patients** [13405-110]
- 13405 30 **Characterizing 3D-printed deformable CT phantoms for respiratory motion applications** [13405-111]
- 13405 31 **Efficient formation of patient-specific finite-element models of the heart** [13405-112]
- 13405 33 **Replication of ultra-high-resolution patient features in 3D-printed CT phantoms (Honorable Mention Poster Award)** [13405-114]

POSTER SESSION: DETECTORS

- 13405 34 **Evaluating the impact of detector internal noise on antiscatter grid performance in x-ray imaging: a Monte Carlo simulation study** [13405-115]
- 13405 35 **Efficient GPU-accelerated Monte Carlo simulation for x-ray diffraction imaging with spectroscopic detector modeling** [13405-116]
- 13405 36 **Modelling the impact of including the charge carrier creation and transport in photon counting detectors on the radiographic image formation** [13405-117]
- 13405 37 **The potential of scintillator-based photon counting detectors: evaluation using Monte Carlo simulations** [13405-118]
- 13405 38 **Performance evaluation of small pixel-sized Gd₂O₂S and CsI CMOS x-ray detectors** [13405-119]

POSTER SESSION: NOVEL IMAGING METHODS

- 13405 39 **Grating-based dark-field computed tomography: an ex-vivo porcine lung study** [13405-120]
- 13405 3F **A dataset of x-ray diffraction patterns of common amorphous materials** [13405-126]
- 13405 3G **Head-to-head comparison of analog-filament vs a digital-CNT x-ray sources: a paradigm shift in radiology** [13405-127]
- 13405 3I **Optimizing transmit field inhomogeneity of parallel RF transmit design in 7T MRI using deep learning** [13405-129]

POSTER SESSION: PHOTON COUNTING DETECTOR CT

- 13405 3J **Pixel-to-pixel variation correction using cylindrical phantoms in photon-counting CT: total count results** [13405-130]
- 13405 3K **Feasibility of photon-counting micro-CT for intraoperative specimen imaging: a simulation study** [13405-131]
- 13405 3L **Scatter levels in triple-energy photon-counting x-ray imaging** [13405-133]
- 13405 3M **Comparative evaluation of noise texture and images of a synthetic lung nodule using energy-integrating and photon-counting CT** [13405-134]
- 13405 3N **Lung nodule volumetry accuracy and precision on energy-integrating and CdZnTe photon-counting CT technologies** [13405-135]

- 13405 3O **Deep learning-based iodine map prediction with photon-counting CT images** [13405-136]
- 13405 3P **Balance between the number of projections and exposure time in photon counting CT with a data-driven approach** [13405-137]
- 13405 3Q **Optimizing photon-counting CT protocol for enhanced pancreatic cancer imaging: a phantom study comparing kV settings and imaging modes** [13405-138]
- 13405 3R **Influence of anti-scatter grid on the SNR of photon-counting and energy-integrating detectors: a simulation study** [13405-139]
- 13405 3S **The utility of photon-counting CT localizer radiograph in bone densitometry** [13405-140]
- 13405 3T **Advancing image domain performance evaluation in photon-counting computed tomography: a physics-guided deep learning approach** [13405-141]
- 13405 3V **A Monte Carlo-based assessment of a SPECT/CT system with a single photon counting detector: a feasibility study** [13405-143]
- 13405 3W **Multi-material decomposition using photon-counting CT: iodine and residual error measurements** [13405-144]
- 13405 3X **Joint contrast-enhanced and non-contrast CT segmentation by means of PCCT data: improved AI tuning illustrated for kidney segmentation** [13405-145]
- 13405 3Y **Assessment of spatial resolution variability in clinical photon-counting detector CT** [13405-146]
- 13405 3Z **Influence of small pixel size on noise power spectrum and low-contrast detectability in clinical photon-counting CT** [13405-147]
- 13405 40 **Evaluation of spectral performance in photon-counting CT for breast cancer imaging: a feasibility phantom study** [13405-148]
- 13405 41 **One-step material decomposition for photon-counting CT using implicit neural representation and physics-guided model** [13405-149]
- 13405 42 **Line profile edge-width half maximum analysis of mixed coronary plaque phantom by photon counting CT: impact of calcium and iodine on detection of low attenuation plaque with ground truth reference** [13405-150]

POSTER SESSION: BREAST IMAGING

- 13405 43 **Monte Carlo simulation of photon-counting breast CT system: from implementation to image quality evaluation** [13405-152]
- 13405 44 **Two-stage convolutional neural network for breast CT reconstruction** [13405-153]

- 13405 45 **Pipeline to generate synthesized mammographic images: reliability of a new framework for data augmentation-based ray-tracing method, Monte Carlo simulation, and deep learning scatter estimation** [13405-154]
- 13405 46 **Characterization of breast samples via basis function methods using differential linear x-ray scattering coefficients** [13405-155]
- 13405 47 **Evaluation of deep learning-based scatter correction in x-ray breast imaging: across image domains and downsampling ratios** [13405-156]
- 13405 48 **Objectivity of a quality assurance phantom for mammography and tomosynthesis** [13405-157]

POSTER SESSION: CT IMAGE QUALITY

- 13405 49 **Deep scatter estimation for static CT using multiple projections** [13405-158]
- 13405 4A **Investigating the effects of non-uniqueness in dual-energy CT for an object containing k-edge contrast agent** [13405-159]
- 13405 4B **Quantitative accuracy of CT protocols for cross-sectional and longitudinal assessment of COPD: a virtual imaging study** [13405-160]
- 13405 4C **Intra- and inter-scanner CT variability and their impact on diagnostic tasks** [13405-161]
- 13405 4D **Impact of beam hardening on CT attenuation values of the lung parenchyma: analysis using computer simulations with voxelized patient models** [13405-162]
- 13405 4E **A diffusion model-based dual domain approach for CT metal artifact reduction** [13405-164]
- 13405 4F **Noise power spectrum analysis in CT for improved patient-specific image optimization: a shift from phantom model to clinical scan** [13405-165]
- 13405 4G **A weighted multi-ray model for penumbra effects induced spectral mixing in x-ray CT** [13405-166]
- 13405 4H **A hybrid spatial resolution CT architecture and its super-resolution reconstruction using diffusion model** [13405-167]
- 13405 4I **Enhancing clinical CT image quality assessment: adapting no-reference methods NIQE and BRISQUE** [13405-168]
- 13405 4J **Exploring bias in spectral CT material decomposition: a simulation-based approach** [13405-169]
- 13405 4K **Trainable spatio-temporal bilateral filters: 4D-filtering for 4DCT denoising** [13405-170]

- 13405 4L **Image quality assessment of computed tomography images using uncertainty estimation** [13405-171]
- 13405 4M **Variability in patient CT radiation dose and image quality: the impact of positioning and body habitus via a virtual imaging trial study** [13405-172]
- 13405 4N **Feasibility of scatter correction in triple-source CT with 1D anti-scatter grid and beam blockers** [13405-173]
- 13405 4O **Characterization of x-ray tomography based on a novel continuous projection functor** [13405-174]
- 13405 4P **Robust calibration of a dynamic model for a high-resolution microCT scanner** [13405-175]

DIGITAL POSTER SESSION

- 13405 4Q **LM-SPD-Net: list-mode TOF-PET image reconstruction using stochastic primal-dual network** [13405-73]
- 13405 4R **A CT metal artifact reduction method driven by implicit neural representation and dual-domain regularization** [13405-163]