

# The 7<sup>th</sup> International Meeting on Image Formation in X-Ray Computed Tomography

**CT MEETING 2022**

June 12-16, BALTIMORE, MD, USA

**Proceedings**



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We would like to thank the members of the scientific committee for their contribution to this conference and their assistance in planning and scientific review.

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Yijie Yuan	Johns Hopkins University

## Schedule CT Meeting 2022

	<b>Sunday</b> <i>June 12</i>	<b>Monday</b> <i>June 13</i>	<b>Tuesday</b> <i>June 14</i>	<b>Wednesday</b> <i>June 15</i>	<b>Thursday</b> <i>June 16</i>
7:00		Breakfast	Breakfast	Breakfast	Breakfast
7:20					
7:40					
8:00					
8:20		Welcome + Novel CT Technologies (3 Talks)	Invited Talks on Photon Counting CT	Modeling and Assessment (4 Talks)	Invited Talk on Interventional CT
8:40					
9:00					Interventional Imaging (2 Talks)
9:20					
9:40		Coffee	Coffee	Coffee	Coffee
10:00		Reconstruction and Deep Learning (5 Talks)	Spectral CT (5 Talks)	Invited Talk on Deep Learning	Cardiac CT and Motion Compensation (4 Talks) + Conclusion
10:20					
10:40				Deep Learning Assessment (3 Talks)	
11:00					
11:20					
11:40		Lunch	Lunch	Lunch	Lunch
12:00					
12:20					
12:40					
1:00					
1:20		Monday Poster Session (~25 Posters)	Tuesday Poster Session (~25 Posters)	Wednesday Poster Session (~25 Posters)	Optional Tours JHU Laboratories and Hospital
1:40					
2:00					
2:20					
2:40					
3:00		Coffee	Coffee	Coffee	
3:20	Registration	CT Acquisition (5 Talks)	Artifacts and Sparse CT (5 Talks)	Spectral and Polyenergetic CT Reconstruction (5 Talks)	
3:40					
4:00					
4:20					
4:40					
7:00	Welcome Reception (Great Hall)	Dinner (Charles Commons Banquet Room)	Dinner Out (R. House)	Dinner Out (Ministry of Brewing)	
7:20					
7:40					
8:00					
8:20					
8:40					
9:00					

**Monday, June 13****Welcome Address      08:20 – 08:40      Web Stayman****Oral Session      : Novel CT Technologies****Time                : 08:40 – 09:40****Moderators      : Bruno De Man, Ke Li**

<b>Time</b>	<b>Title</b>	<b>Authors</b>	<b>Page</b>
<b>08:40 – 09:00</b>	Dark-Field Imaging on a Clinical CT System: Realization of Talbot-Lau Interferometry in a Gantry	Manuel Viermetz, Nikolai Gustschin, Clemens Schmid, Jakob Haeusele, Roland Proksa, Thomas Koehler, and Franz Pfeiffer	17
<b>09:00 – 09:20</b>	Dark-Field Imaging on a Clinical CT System: Performance and Potential based on first Results	Nikolai Gustschin, Manuel Viermetz, Clemens Schmid, Jakob Haeusele, Frank Bergner, Tobias Lasser, Thomas Koehler, and Franz Pfeiffer	21
<b>09:20 – 09:40</b>	Non-invasive real-time thermometry via spectral CT physical density quantifications	Nadav Shapira, Leening P. Liu, Johoon Kim, David P. Cormode, Gregory J. Nadolski, Matthew Hung, Michael C. Soulen, Peter B. Noël	25

**Coffee Break      09:40 – 10:00****Oral Session      : Reconstruction and Deep Learning****Time                : 10:00 – 11:40****Moderators      : Marc Kachelrieß, Koen Michielsen****This session is made possible by a generous gift from United Imaging Healthcare**

<b>Time</b>	<b>Title</b>	<b>Authors</b>	<b>Page</b>
<b>10:00 – 10:20</b>	Cone-beam reconstruction for a circular trajectory with transversely-truncated projections based on the virtual fan-beam method	Mathurin Charles, Rolf Clackdoyle, and Simon Rit	29
<b>10:20 – 10:40</b>	Iterative image reconstruction for CT with unmatched projection matrices using the generalized minimal residual algorithm	Emil Y. Sidky, Per Christian Hansen, Jakob S. Jørgensen, and Xiaochuan Pan	33
<b>10:40 – 11:00</b>	Deep Learning-Based Detector Row Upsampling for Clinical Spiral CT	Jan Magonov, Julien Erath, Joscha Maier, Eric Fourmié, Karl Stierstorfer, and Marc Kachelrieß	37
<b>11:00 – 11:20</b>	DL-Recon: Combining 3D Deep Learning Image Synthesis and Model Uncertainty with Physics-Based Image Reconstruction	Xiaoxuan Zhang, Pengwei Wu, Wojciech B. Zbijewski, Alejandro Sisniega, Runze Han, Craig K. Jones, Prasad Vaghdargi, Ali Uneri, Patrick A. Helm, William S. Anderson, Jeffrey H. Siewerdsen	41
<b>11:20 – 11:40</b>	Learned Cone-Beam CT Reconstruction Using Neural Ordinary Differential Equations	Mareike Thies, Fabian Wagner, Mingxuan Gu, Lukas Folle, Lina Felsner, and Andreas Maier	45

**Lunch 11:40 – 13:20**

**Poster Session 13:20 – 15:00**

The poster session will begin with 30-second teaser presentation given by presented in **the Glass Pavilion**. General presentation and discussion of posters will follow in **the Great Hall**.

	<b>Title</b>	<b>Authors</b>	<b>Page</b>
<b>M1</b>	First results on Compton camera system used for X-ray fluorescence computed tomography	Chuanpeng Wu and Liang Li	70
<b>M2</b>	Iterative grating interferometry-based phase-contrast CT reconstruction with a data-driven denoising prior	Stefano van Gogh, Subhadip Mukherjee, Michał Rawlik, Zhentian Wang, Jinqiu Xu, Zsuzsanna Varga, Carola-Bibiane Schönlieb, Marco Stampanoni	74
<b>M3</b>	A scatter correction method of CBCT via CycleGAN and forward projection algorithm	Tianxu Tang, Wei Zhang, and Weiqi Xiong	78
<b>M4</b>	Design and Optimization of 3D VSHARP® Scatter Correction for Industrial CBCT using the Linear Boltzmann Transport Equation	Kevin Holt, Devang Savaliya, Amy Shiroma, Martin Hu, David Nisius, Steve Hoelzer, Mingshan Sun, Don Vernekohl, Josh Star-Lack	82
<b>M5</b>	Motion Correction Image Reconstruction using NeuralCT Improves with Spatially Aware Object Segmentation	Zhennong Chen, Kunal Gupta, Francisco Contijoch	86
<b>M6</b>	Photon-Counting X-ray CT Perfusion Imaging in Animal Models of Cancer	Darin P. Clark, Alex J. Allphin, Yvonne M. Mowery, and Cristian T. Badea	90
<b>M7</b>	Undersampled Dynamic Tomography with Separated Spatial and Temporal Regularization	Xiufa Cao, Yinghui Zhang, Ran An, Hongwei Li	94
<b>M8</b>	Full-Spectrum-Knowledge-Aware Unsupervised Network for Photon-counting CT Imaging	Danyang Li, Zheng Duan, Dong Zeng, Zhaoying Bian, and Jianhua Ma	98
<b>M9</b>	Soil matrix study using a hybrid a-Se/CMOS pixel detector for CT scanning	Akyl Swaby, Adam S. Wang, Michael G. Farrier, Weixin Cheng, and Shiva Abbaszadeh	102
<b>M10</b>	The Reason of Why Dynamic Dual-Energy CT is Better than Multi-Energy CT in Reducing Statistical Noise	Yidi Yao, Liang Li, and Zhiqiang Chen	106
<b>M11</b>	Cone-Beam X-ray Luminescence Computed Tomography Reconstruction Based on Huber Markov Random Field Regularization	Tianshuai Liu, Junyan Rong, Wenqin Hao, Hongbing Lu	110
<b>M12</b>	Dual-domain network with transfer learning for reducing bowtie-filter induced artifacts in half-fan cone-beam CT	Sungho Yun, Uijin Jeong, Donghyeon Lee, Hyeongseok Kim, and Seungryong Cho	114
<b>M13</b>	Organ-Specific vs. Patient Risk-Specific Tube Current Modulation in Thorax CT Scans Covering the Female Breast	Lucia Enzmann, Laura Klein, Chang Liu, Stefan Sawall, Andreas Maier, Joscha Maier, Michael Lell, and Marc Kachelrieß.	118
<b>M14</b>	An Analytical Prj2CH Covariance Estimation Method for Iterative Reconstruction Methods	Xiaoyue Guo, Li Zhang, Yuxiang Xing	122
<b>M15</b>	Material Decomposition from Photon-Counting CT using a Convolutional Neural Network and Energy-Integrating CT Training Labels	Rohan Nadkarni, Alex Allphin, Darin P. Clark, and Cristian T. Badea	126
<b>M16</b>	Using Tissue-Energy Response to Generate Virtual Monoenergetic Images from Conventional CT for Computer-aided Diagnosis of Lesions	Shaojie Chang, Yongfeng Gao, Marc J. Pomeroy, Ti Bai, Hao Zhang, and Zhengrong Liang	130
<b>M17</b>	Detruncation of Clinical CT Scans Using a Discrete Algebraic Reconstruction Technique Prior	Achim Byl, Michael Knaup, Magdalena Rafecas, Christoph Hoeschen, and Marc Kachelrieß	134
<b>M18</b>	Deep Learning based Respiratory Surrogate Signal Extraction	Jean Radig, Pascal Paysan, Stefan Scheib	138



<b>M19</b>	Deep learning enabled wide-coverage high-resolution cardiac CT	Tzu-Cheng Lee, Jian Zhou, John Schuzer, Masakazu Matsuura, Takuya Nemoto, Hiroki Taguchi, Zhou Yu, Liang Cai	142
<b>M20</b>	Preliminary study on image reconstruction for limited-angular-range dual-energy CT using two-orthogonal, overlapping arcs	Buxin Chen, Zheng Zhang, Dan Xia, Emil Y. Sidky, and Xiaochuan Pan	145
<b>M21</b>	Correcting spurious signal using an automated Deep Learning based reconstruction workflow	Matthew Andrew, Andriy Andreyev, Faguo Yang and Lars Omlor	149
<b>M22</b>	Dual-Energy Head Cone-Beam CT Using a Dual-Layer Flat-Panel Detector: Physics-Based Material Decomposition	Zhilei Wang, Hao Zhou, Shan Gu, Hewei Gao	157
<b>M23</b>	Combining Deep Learning and Adaptive Sparse Modeling for Low-dose CT Reconstruction	Ling Chen, Zhishen Huang, Yong Long, Saiprasad Ravishankar	153
<b>M24</b>	X-ray Dissectography Enables Stereotography	Chuang Niu and Ge Wang	161
<b>M25</b>	Mixed coronary plaque characterization with the first clinical dual-source photon-counting CT scanner a phantom study	Thomas Wesley Holmes, Leening P. Liu, Nadav Shapira, Elliot McVeigh, Amir Pourmorteza, Peter B. Noël	165

**Coffee Break 15:00 – 15:20**

**Oral Session : CT Acquisition**  
**Time : 15:20 – 17:00**  
**Moderators : Adam Wang, Rolf Clackdoyle**

<b>Time</b>	<b>Title</b>	<b>Authors</b>	<b>Page</b>
<b>15:20 – 15:40</b>	LaBr3:Ce and Silicon Photomultipliers: Towards the Optimal Scintillating Photon-Counting Detector	Stefan J. van der Sar, David Leibold, Stefan E. Brunner, and Dennis R. Schaart	49
<b>15:40 – 16:00</b>	Preliminary Investigations of a Novel Dynamic CT Collimator	Web Stayman, Nir Eden, Yiqun Q. Ma, Grace J. Gang, Allon Guez	53
<b>16:00 – 16:20</b>	X-ray CT Data Completeness Condition for Sets of Arbitrary Projections	Gabriel Herl, Andreas Maier, and Simon Zabler	66
<b>16:20 – 16:40</b>	CT imaging with truncation data over limited-angular ranges	Dan Xia, Zheng Zhang, Buxin Chen, Emil Y. Sidky, and Xiaochuan Pan	57
<b>16:40 – 17:00</b>	Cone Beam Field of View Extension through Complementary Short Scan Trajectories with Displaced Center of Rotation	Gabriele Belotti, Simon Rit, Guido Baroni	62

**Dinner 19:00 – 21:20**  
**(Charles Commons Banquet Room)**

## Tuesday, June 14

**Oral Session : Invited Talks on Photon Counting CT**

**Time : 08:20 – 09:40**

**Moderator : Web Stayman**

<b>Time</b>	<b>Title</b>	<b>Presenter</b>
<b>08:20 – 09:00</b>	Photon counting detector computed tomography: technical background	Peter Noel
<b>09:00 – 09:40</b>	Photon counting detector computed tomography: clinical applications	Shuai Leng

**Coffee Break 09:40 – 10:00**

**Oral Session : Spectral CT**

**Time : 10:00 – 11:40**

**Moderators : Kevin Brown, Cristian Badea**

**This session is made possible by a generous gift from Philips Healthcare**

<b>Time</b>	<b>Title</b>	<b>Authors</b>	<b>Page</b>
<b>10:00 – 10:20</b>	Consistency-based auto-calibration of the spectral model in dual-energy CT	J�rome Lesaint, Simon Rit	170
<b>10:20 – 10:40</b>	Direct binning for photon counting detectors	Katsuyuki Taguchi and Scott S. Hsieh	174
<b>10:40 – 11:00</b>	Co-clinical photon counting CT research for multi-contrast imaging	Cristian T. Badea, Darin P. Clark, Alex Allphin, Juan Carlos Ramirez-Giraldo, Prajwal Bhandari, Yvonne M. Mowery, Ketan B. Ghaghada	178
<b>11:00 – 11:20</b>	Reproducibility in dual energy CT: the impact of a projection domain material decomposition method	Viktor Haase, Frederic Noo, Karl Stierstorfer, Andreas Maier, and Michael McNitt-Gray	182
<b>11:20 – 11:40</b>	Dual-source photon-counting CT: consistency in spectral results at different acquisition modes and heart rates	Leening P. Liu, Nadav Shapira, Pooyan Sahbaee, Harold I. Litt, Marcus Y. Chen, Peter B. No�l	186

**Lunch 11:40 – 13:20**

**Poster Session 13:20 – 15:00**

The poster session will begin with 30-second teaser presentation given by presented in **the Glass Pavilion**. General presentation and discussion of posters will follow in **the Great Hall**.

	<b>Title</b>	<b>Authors</b>	<b>Page</b>
<b>T1</b>	Photon Starvation Artifact Reduction by Shift-Variant Processing	Gengsheng L. Zeng	210
<b>T2</b>	Data-driven Metal Artifact Correction in Computed Tomography using conditional Generative Adversarial Networks	Nele Blum, University of Lubeck, Germany, Thorsten M. Buzug and Maik Stille	214
<b>T3</b>	CT-Value Conservation based Spatial Transformer Network for Cardiac Motion Correction	Xuan Xu, Peng Wang, Liyi Zhao, Guotao Quan	218
<b>T4</b>	Exploiting voxel-sparsity for bone imaging with sparse-view cone-beam computed tomography	Emil Y. Sidky, Holly L. Stewart, Christopher E. Kawcak, C. Wayne MacIlwraith, Martine C. Duff, and Xiaochuan Pan	222
<b>T5</b>	Estimation of Contrast Agent Concentration from Pulsed-Mode Projections to Time Contrast-Enhanced CT Scans	Isabelle M. Heukensfeldt Jansen, Eri Haneda, Bernhard Claus, Jed Pack, Albert Hsiao, Elliot McVeigh, and Bruno De Man	226
<b>T6</b>	Time Separation Technique Using Prior Knowledge for Dynamic Liver Perfusion Imaging	Hana Haseljić, Vojtěch Kulvait, Robert Frysč, Fatima Saad, Bennet Hensen, Frank Wacker, Inga Brüsche, Thomas Werncke, and Georg Rose	230
<b>T7</b>	A hybrid neural network combining explicit priors for low-dose CT reconstruction	Xiangli Jin, Yinghui Zhang, Ran An, Hongwei Li	234
<b>T8</b>	High Resolution Cerebral Perfusion Deconvolution via Mixture of Gaussian Model based on Noise Properties	Sui Li, Zhaoying Bian, Dong Zeng, and Jianhua Ma	238
<b>T9</b>	Simulating Arbitrary Dose Levels and Independent Noise Image Pairs from a Single CT Scan	Sen Wang, Adam Wang	242
<b>T10</b>	Dark-Field Imaging on a Clinical CT System: Sample Data Processing and Reconstruction	Jakob Haeusele, Clemens Schmid, Manuel Viermetz, Nikolai Gustschin, Tobias Lasser, Frank Bergner, Thomas Koehler, Franz Pfeiffer	246
<b>T11</b>	S2MC: Self-Supervised Learning Driven Multi-Spectral CT Image Enhancement	Chaoyang Zhang, Shaojie Chang, Ti Bai, and Xi Chen	250
<b>T12</b>	Virtual Non-Metal Network for Metal Artifact Reduction in the Sinogram Domain	Da-in Choi, Taejin Kwon, Jaehong Hwang, Joon Il Hwang, Yeonkyoung Choi and Seungryong Cho	254
<b>T13</b>	Attenuation Image Guided Effective Atom Number Image Calculation Using Image domain Neural Network for MeV Dual-energy Cargo CT Imaging	Wei Fang, Liang Li	258
<b>T14</b>	Residual W-shape Network (ResWnet) for Dual-energy Cone-beam CT Imaging	Xiao Jiang, Hehe Cui, Zihao Liu, Lei Zhu and Yidong Yang	262
<b>T15</b>	Dark-Field Imaging on a Clinical CT System: Modelling of Interferometer Vibrations	Clemens Schmid, Manuel Viermetz, Nikolai Gustschin, Jakob Haeusele, Tobias Lasser, Thomas Koehler, Franz Pfeiffer	266
<b>T16</b>	Fully Utilizing Contrast Enhancement on Lung Tissue as a Novel Basis Material for Lung Nodule Characterization by Multi-energy CT	Shaojie Chang, Yongfeng Gao, Marc J. Pomeroy, Ti Bai, Hao Zhang, and Zhengrong Liang	270
<b>T17</b>	Image Reconstruction in Phase-Contrast CT with Shortened Scans	Zheng Zhang, Buxin Chen, Dan Xia, Emil Y. Sidky, Mark Anastasio, and Xiaochuan Pan	274

<b>T18</b>	Self-trained Deep Convolutional Neural Network for Noise Reduction in CT	Zhongxing Zhou, Akitoshi Inoue, Cynthia McCollough, and Lifeng Yu	279
<b>T19</b>	2D-3D motion registration of rigid objects within a soft tissue structure	Nargiza Djurabekova, Andrew Goldberg, David Hawkes, Guy Long, Felix Lucka and Marta M. Betcke	283
<b>T20</b>	Gas Bubble Motion Artifact Reduction through Simultaneous Motion Estimation and Image Reconstruction	Kai Wang, Hua-Chieh Shao, You Zhang, Chunjoo Park, Steve Jiang, Jing Wang	288
<b>T21</b>	Comparing One-step and Two-step Scatter Correction and Density Reconstruction in X-ray CT	Alexander N. Sietsema, Michael T. McCann, Marc L. Klasky, and Saiprasad Ravishankar	292
<b>T22</b>	Material decomposition from unregistered dual kV data using the cOSSCIR algorithm	Benjamin M. Rizzo, Emil Y. Sidky, and Taly Gilat Schmidt	296
<b>T23</b>	PixelPrint: Three-dimensional printing of patient-specific soft tissue and bone phantoms for CT	Kai Mei, Michael Geagan, Nadav Shapira, Leening P. Liu, Pouyan Pasyar, Grace J. Gang, Web Stayman, and Peter B. Noël	300
<b>T24</b>	Practical Workflow for Arbitrary Non-circular Orbits for CT with Clinical Robotic C-arms	Yiqun Ma, Grace J. Gang, Tess Reynolds, Tina Ehtiati, Junyuan Li, Owen Dillon, Tom Russ, Wenying Wang, Clifford Weiss, Nicholas Theodore, Kelvin Hong, Ricky O'Brien, Jeffrey Siewerdsen, Web Stayman	304
<b>T25</b>	Rigid motion correction based on locally linear embedding for helical CT scans with photon-counting detectors	Mengzhou Li, Chiara Lowe, Anthony Butler, Phil Butler, and Ge Wang	308

**Coffee Break 15:00 – 15:20**

**Oral Session : Artifacts and Sparse CT**

**Time : 15:20 – 17:00**

**Moderators : Xiaochuan Pan, Jerome Z. Liang**

<b>Time</b>	<b>Title</b>	<b>Authors</b>	<b>Page</b>
<b>15:20 – 15:40</b>	Deep Scatter Estimation for Coarse Anti-Scatter Grids as used in Photon-Counting CT	Julien Erath, Jan Magonov, Joscha Maier, Eric Fournié, Martin Petersilka, Karl Stierstorfer, and Marc Kachelrieß	190
<b>15:40 – 16:00</b>	Cross-Domain Metal Segmentation for CBCT Metal Artifact Reduction	Maximilian Rohleder, Tristan M. Gottschalk, Andreas Maier and, Bjoern W. Kreher	194
<b>16:00 – 16:20</b>	Sparsier2Sparse: Weakly-supervised learning for streak artifacts reduction with unpaired sparse view CT data	Seongjun Kim, Byeongjoon Kim, and Jongduk Baek	198
<b>16:20 – 16:40</b>	Dual Domain Closed-loop Learning for Sparse-view CT Reconstruction	Yi Guo, Yongbo Wang, Manman Zhu, Dong Zeng, Zhaoying Bian, Xi Tao and Jianhua Ma	202
<b>16:40 – 17:00</b>	Hybrid Reconstruction Using Shearlets and Deep Learning for Sparse X-Ray Computed Tomography	Andi Braimllari, Theodor Cheslerean-Boghiu, Tobias Lasser	206

**Dinner 19:00 – 21:20**  
**(R. House)**

**Wednesday, June 15****Oral Session : Modeling and Assessment****Time : 08:20 – 09:40****Moderators : Grace J. Gang, Kirsten L. Boedeker**

<b>Time</b>	<b>Title</b>	<b>Authors</b>	<b>Page</b>
08:20 – 08:40	Trade-offs between redundancy and increased rank for tomographic system matrices	Feriel Khellaf and Rolf Clackdoyle	414
08:40 – 09:00	Stationary X-ray Tomography for Hemorrhagic Stroke Imaging - Sampling and Resolution Properties	A. Lopez-Montes, T. McSkimming, W. Zbijewski, J. H. Siewerdsen, A. Skeats, B. Gonzales, A. Sisniega	418
09:00 – 09:20	Angular normalized glandular dose coefficient in breast CT: clinical data study	Hsin Wu Tseng, Andrew Karellas, and Srinivasan Vedantham	422
09:20 – 09:40	Estimating the accuracy and precision of quantitative imaging biomarkers as endpoints for clinical trials using standard-of-care CT	Paul Kinahan, Darrin Byrd, Hao Yang, Hugo Aerts, Binzhang Zhao, Andrey Fedorov, Lawrence Schwartz, Tavis Allison, Chaya Moskowitz	426

**Coffee Break 09:40 – 10:00****Oral Session : Invited Talk on Deep Learning****Time : 10:00– 10:40****Moderator : Web Stayman**

<b>Time</b>	<b>Title</b>	<b>Presenter</b>
10:00 – 10:40	Hallucinations and objective assessments of deep learning technologies for image formation	Mark Anastasio

**Oral Session : Deep Learning Assessment****Time : 10:40 – 11:40****Moderators : Saiprasad Ravishankar, Rongping Zeng**

<b>Time</b>	<b>Title</b>	<b>Authors</b>	<b>Page</b>
10:40 – 11:00	Reconstructing Invariances of CT Image Denoising Networks using Invertible Neural Networks	Elias Eulig, Björn Ommer, and Marc Kachelrieß	430
11:00 – 11:20	Local Linearity Analysis of Deep Learning CT Denoising Algorithms	Junyuan Li, Wenying Wang, Matt Tivnan, Jeremias Sulam, Jerry L Prince, Michael McNitt-Gray, Web Stayman and Grace J. Gang	434
11:20 – 11:40	Evaluation of deep learning-based CT reconstruction with a signal-Laplacian model observer	Gregory Ongie, Emil Y. Sidky, Ingrid S. Reiser, & Xiaochuan Pan	438

**Lunch 11:40 – 13:20**

**Poster Session 13:20 – 15:00**

The poster session will begin with 30-second teaser presentation given by presented in **the Glass Pavilion**. General presentation and discussion of posters will follow in **the Great Hall**.

	<b>Title</b>	<b>Authors</b>	<b>Page</b>
<b>W1</b>	An Attempt of Directly Filtering the Sparse-View CT Images by BM3D	Larry Zeng	313
<b>W2</b>	Assessment of perceptual quality measures for multi-exposure radiography and tomography	Joaquim G. Sanctorum, Sam Van der Jeught, Sam Van Wassenbergh, Joris J. J. Dirckx	317
<b>W3</b>	Geometric calibration of seven degree of freedom Robotic Sample Holder for X-ray CT	Erdal Pekel, Florian Schaff, Martin Dierolf, Franz Pfeiffer, and Tobias Lasser	321
<b>W4</b>	A generalized total-variation-based image reconstruction method for limited-angle computed tomography	Xin Lu, Yunsong Zhao, and Peng Zhang	325
<b>W5</b>	Comparison of Energy Bin Compression Strategies for Photon Counting Detectors	Yirong Yang, Sen Wang, Debashish Pal, Norbert J. Pelc, Adam S. Wang	329
<b>W6</b>	A visible edge aware directional total variation model for limited-angle reconstruction	Yinghui Zhang, Ke Chen, Xing Zhao, Hongwei Li.	333
<b>W7</b>	Dual-task Learning For Low-Dose CT Simulation and Denoising	Mingqiang Meng, Yongbo Wang, Manman Zhu, Xi Tao, Zhaoying Bian, Dong Zeng, and Jianhua Ma	337
<b>W8</b>	Statistical Iteration Reconstruction based on Gaussian Mixture Model for Photon-counting CT	Danyang Li, Zheng Duan, Dong Zeng, Zhaoying Bian, and Jianhua Ma	341
<b>W9</b>	Deep Learning Ring Artifact Correction in Photon-Counting Spectral CT with Perceptual Loss	Dennis Hein, Konstantinos Liappis, Alma Eguizabal, and Mats Persson	345
<b>W10</b>	Photon Counting Detector-based Multi-energy Cone Beam CT Platform for Preclinical Small Animal Radiation Research	Xiaoyu Hu, Yuncheng Zhong, Kai Yang, and Xun Jia	349
<b>W11</b>	Design of Novel Loss Functions for Deep Learning in X-ray CT	Obaidullah Rahman, Ken D. Sauer, Madhuri Nagare, Charles A. Bouman, Roman Melnyk, Jie Tang, Brian Nett	353
<b>W12</b>	Effect of Attenuation Model on Iodine Quantification in Contrast-Enhanced Breast CT	Mikhail Mikerov, Koen Michielsen, James G. Nagy, and Ioannis Sechopoulos	357
<b>W13</b>	Motion Compensated Weighted Filtered Backprojection Considering Rebinning Process	Nora Steinich, Johan Sunnegårdh, and Harald Schöndube	362
<b>W14</b>	On the use of voxel-driven backprojection and iterative reconstruction for small ROI CT imaging	Leonardo Di Schiavi Trotta, Dmitri Matenine, Margherita Martini, Yannick Lemaréchal, Pierre Francus, and Philippe Després	366
<b>W15</b>	A Decomposition Method for Directional Total Variation With Application to Needle Reconstruction in Interventional Imaging	Marion Savanier, Cyril Riddell, Yves Troussel, Emilie Chouzenoux and Jean-Christophe Pesquet	370
<b>W16</b>	New Reconstruction Methodology for Chest Tomosynthesis based on Deep Learning	F Del Cerro. C, Galán. A, García-Blas. J, Descó. M, Abella M.	374
<b>W17</b>	Iterative Intraoperative Digital Tomosynthesis Image Reconstruction using a Prior as Initial Image	Fatima Saad, Robert Frysch, Tim Pfeiffer, Sylvia Saalfeld, Jessica Schulz, Jens-Christoph Georgi, Andreas Nürnberger, Guenter Lauritsch, and Georg Rose	378
<b>W18</b>	Learning CT Scatter Estimation Without Labeled Data - A Feasibility Study	Joscha Maier, Luca Jordan, Elias Eulig, Fabian Jäger, Stefan Sawall, Michael Knaup, and Marc Kachelrieß	382
<b>W19</b>	Implementations of Statistical Reconstruction Algorithm for CT Scanners with Flying Focal Spot	Robert Cierniak and Jarosław Bilski and Piotr Pluta	386
<b>W20</b>	Multiple Linear Detector Off-Line Calibration	Sasha Gasquet, Laurent Desbat, and Pierre-Yves Solane	390

<b>W21</b>	Iodine-enhanced Liver Vessel Segmentation in Photon Counting Detector-based Computed Tomography using Deep Learning	Sumin Baek, Okkyun Lee, and Dong Hye Ye	394
<b>W22</b>	Optimization of Empirical Beamhardening Correction Algorithm	Andriy Andreyev, Faguo Yang, Lars Omlor, and Matthew Andrew	402
<b>W23</b>	Deep Learning-based Prior toward Normalized Metal Artifact Reduction in Computed Tomography	Jeonghyeon Nam, Dong Hye Ye, and Okkyun Lee	398
<b>W24</b>	On use of augmentation for the DNN-based CT	Prabhat Kc, Kyle J. Myers, M. Mehdi Farhangi, Rongping Zeng	406
<b>W25</b>	Joint Multi-channel Total Generalized Variation Minimization and Tensor Decomposition for Spectral CT Reconstruction	Huihua Kong, Xiangyuan Lian, Jinxiao Pan, and Hengyong Yu	410

**Coffee Break 15:00 – 15:20**

**Oral Session : Spectral and Polyenergetic CT Reconstruction**

**Time : 15:20 – 17:00**

**Moderators : Emil Sidky, Johan Sunnegaardh**

<b>Time</b>	<b>Title</b>	<b>Authors</b>	<b>Page</b>
<b>15:20 – 15:40</b>	Tunable Neural Networks for Multi-Material Image Formation from Spectral CT Measurements	Matthew Tivnan, Grace Gang, Peter Noël, Jeremias Sulam, and J. Webster Stayman	442
<b>15:40 – 16:00</b>	Self-supervised nonlocal spectral similarity induced material decomposition network	Lei Wang, Yongbo Wang, Zhaoying Bian, Dong Zeng, and Jianhua Ma	446
<b>16:00 – 16:20</b>	Likelihood-based bilateral filtration in material decomposition for photon counting CT	Okkyun Lee	450
<b>16:20 – 16:40</b>	Experimental Evaluation of Polychromatic Reconstruction for Quantitative CBCT	Michał Walczak, Pascal Paysan, Mathieu Plamondon, Stefan Scheib	454
<b>16:40 – 17:00</b>	Dual-energy cone-beam CT with three-material decomposition for bone marrow edema imaging	Stephen Z. Liu, Magdalena Herbst, Thomas Weber, Sebastian Vogt, Ludwig Ritchl, Steffen Kappler, Jeffrey H. Siewerdsen, and Wojciech Zbijewski	458

**Dinner 19:00 – 21:20**  
**(Ministry of Brewing)**

**Thursday, June 16****Oral Session : Invited Talk on Interventional CT****Time : 08:20 – 09:00****Moderator : Web Stayman**

<b>Time</b>	<b>Title</b>	<b>Presenter</b>
08:20 – 09:00	Engineering the Future of Spine Surgery	Nick Theodore

**Oral Session : Interventional Imaging****Time : 09:00 – 09:40****Moderator : Cyrill Riddell**

<b>Time</b>	<b>Title</b>	<b>Authors</b>	<b>Page</b>
09:00 – 09:20	Real-time Liver Tumor Localization via a Single X-ray Projection Using Deep Graph Network-assisted Biomechanical Modeling	Hua-Chieh Shao, Jing Wang, and You Zhang	464
09:20 – 09:40	3D Reconstruction of Stents and Guidewires in an Anthropomorphic Phantom From Three X-Ray Projections	Tim Vöth, Thomas König, Elias Eulig, Michael Knaup, Veit Wiesmann, Klaus Hörndler, and Marc Kachelrieß	468

**Coffee Break 09:40 – 10:00****Oral Session : Cardiac CT and Motion Compensation****Time : 10:00 – 11:20****Moderators : Ken Taguchi, Simon Rit**

<b>Time</b>	<b>Title</b>	<b>Authors</b>	<b>Page</b>
10:00 – 10:20	Context-Aware, Reference-Free Local Motion Metric for CBCT Deformable Motion Compensation	H. Huang, J.H. Siewerdsen, W. Zbijewski, C.R. Weiss, M. Unberath, and A. Sisniega	472
10:20 – 10:40	Simulation of Random Deformable Motion in Soft-Tissue Cone-Beam CT with Learned Models	Y. Hu, H. Huang, J. H. Siewerdsen, W. Zbijewski, M. Unberath, C. R. Weiss, and A. Sisniega	476
10:40 – 11:00	A five-dimensional cardiac CT model for generating virtual CT projections for user-defined bolus dynamics and ECG profiles	Eri Haneda, Bernhard Claus, Jed Pack, Darin Okerlund, Albert Hsiao, Elliot McVeigh, and Bruno De Man	480
11:00 – 11:20	A Virtual Imaging Trial Framework to Study Cardiac CT Blooming Artifacts	Ying Fan, Jed Pack, and Bruno De Man	484

**Conclusion 11:20 – 11:40 Web Stayman****Lunch 11:40 – 13:20****Optional Tours 13:20 – 15:00 (JHU Laboratories and Hospital)**