

electronic IMAGING 2021

IS&T International Symposium on Electronic Imaging Science and Technology

11–28 January 2021 • Online

PROCEEDINGS

Computational Imaging XIX

Editors: **Charles A. Bouman**, Purdue Univ. (United States),
Gregory T. Buzzard, Purdue Univ. (United States), and
Robert Stevenson, Univ. of Notre Dame (United States)

These papers represent the program of Electronic Imaging 2021, held online 11–28 January 2021.

Copyright 2021

Society for Imaging Science and Technology
7003 Kilworth Lane • Springfield, VA 22151 USA
703/642-9090; 703/642-9094 fax
info@imaging.org; www.imaging.org

All rights reserved. These proceedings, or parts thereof, may not be reproduced in any form without the written permission of the Society.

ISSN 2470-1173

<https://doi.org/10.2352/ISSN.2470-1173.2021.15.COIMGA15>

Manuscripts are reproduced from PDFs as submitted and approved by authors; no editorial changes have been made.

Computational Imaging XIX

Conference overview

More than ever before, computers and computation are critical to the image formation process. Across diverse applications and fields, remarkably similar imaging problems appear, requiring sophisticated mathematical, statistical, and algorithmic tools. This conference focuses on imaging as a marriage of computation with physical devices. It emphasizes the interplay between mathematical theory, physical models, and computational algorithms that enable effective current and future imaging systems. Contributions to the conference are solicited on topics ranging from fundamental theoretical advances to detailed system-level implementations and case studies.

Special Sessions

This year Computational Imaging hosts five special sessions on AI-Driven Imaging Instruments, Imaging Through Turbulent & Scattering Mediums, In Situ Sensing and Analysis for Autonomous Materials Research, Software for Computational Imaging: Open Source Tools and Best Practices, and Computational Imaging for Materials Applications, presented by researchers from academia, national laboratories, and industry.

Conference Chairs: Charles A. Bouman, Purdue University (United States); Gregory T. Buzzard, Purdue University (United States); and Robert Stevenson, University of Notre Dame (United States)

Program Committee: Clem Karl, Boston University (United States); Eric Miller, Tufts University (United States); Joseph A. O'Sullivan, Washington University in St. Louis (United States); Hector J. Santos-Villalobos, Oak Ridge National Laboratory (United States); and Ken D. Sauer, University of Notre Dame (United States)

Community Chair: Begum Gulsoy, Northwestern University (United States)

AI-Driven Imaging Instruments Organizing Chairs: Doga Gursoy, Argonne National Laboratory (United States); Ulugbek S. Kamilov, Washington University in St. Louis (United States); and Singanallur V Venkatakrishnan, Oak Ridge National Laboratory (United States),

Imaging Through Turbulent & Scattering Mediums Organizing Chair: Casey Pellizzari, United States Air Force Academy (United States)

In Situ Sensing and Analysis for Autonomous Materials Research Organizing Chairs: Benji Maruyama, Air Force Research Laboratory (United States); Chiwoo Park, Florida A&M University-Florida State University College of Engineering (United States); and Kristofer Reyes, University at Buffalo (United States)

Software for Computational Imaging: Open Source Tools and Best Practices Organizing Chairs: Brendt Wohlberg and Luke Pfister, Los Alamos National Laboratory (United States)

Computational Imaging for Materials Applications Organizing Chairs: Jeff Simmons, Materials and Manufacturing Directorate, Air Force Research Laboratory (United States); Mary Comer, Purdue University (United States); and Begum Gulsoy, Northwestern University (United States)

Conference Sponsors



LOS ALAMOS
NATIONAL
LABORATORY (LANL)

Paper authors listed as of 1 January 2021; refer to manuscript for final authors. Titles that are not listed with the proceedings files were presentation-only.

Computational Imaging XIX

MONDAY 18 JANUARY 2021

SOFTWARE FOR COMPUTATIONAL IMAGING: OPEN SOURCE TOOLS AND BEST PRACTICES I

Hosts: Charles Bouman, Purdue University (United States) and Gregory Buzzard, Purdue University (United States) /

Session Chair: Brendt Wohlberg, Los Alamos National Laboratory (United States)

10:15 – 11:15

10:15 COIMG-051
ODL - A Python based framework for model and deep learning based methods for image reconstruction, *Ozan Öktem¹, Jonas Adler², and Holger Kohr³; ¹KTH Royal Institute of Technology (Sweden), ²Google DeepMind (United Kingdom), and ³Thermo Fisher Scientific (the Netherlands)*

10:35 COIMG-052
Computational imaging using Julia, *Jeffrey Fessler, University of Michigan (United States)*

10:55 COIMG-053
Reproducible computational imaging of tomographic data, *Marcus Hanwell, Brookhaven National Laboratory (United States)*

PANEL: SOFTWARE FOR COMPUTATIONAL IMAGING: OPEN SOURCE TOOLS AND BEST PRACTICES

Panel Moderator: Charles Bouman, Purdue University (United States)

Panelists: Lawrence Drummy, Air Force Research Laboratory (United States); Doga Gursoy, Argonne National Laboratory (United States); Dilworth Parkinson, Univ. of California, Berkeley (United States); Singanallur Venkatakrishnan, Oak Ridge National Laboratory (United States); and Brendt Wohlberg, Los Alamos National Laboratory (United States)

11:45 – 12:45

Open source software systems such as TensorFlow and SciPy have revolutionized the way that imaging science is done. This will be an interactive session in which both the panel and attendees will discuss how the community can generate and leverage open source tools for lasting impact in computational imaging.

CONFERENCE DEMONSTRATION

12:45 – 13:15

COIMG-025D
COIMG DEMO: "Mask recognition in the covered safe entry scanner", *Henry Dietz, University of Kentucky (United States)*

In the COIMG demo, Henry Dietz will augment the oral presentation of the same title, demonstrating recognizing whether a mask is being properly worn.

FACIAL RECOGNITION AND PROCESSING

Session Chair: Henry Dietz, University of Kentucky (United States)

13:15 – 14:15

13:15

COIMG-023

Extreme face inpainting with sketch-guided conditional GAN, Nilesh Pandey and Andreas Savakis, Rochester Institute of Technology (United States)

13:55

COIMG-025

Mask recognition in the covered safe entry scanner, Henry Dietz, University of Kentucky (United States)

KEYNOTE: SOFTWARE FOR COMPUTATIONAL IMAGING: OPEN SOURCE TOOLS AND BEST PRACTICES

Session Chair: Brendt Wohlberg, Los Alamos National Laboratory (United States)

18:15 – 19:15

18:15

COIMG-032

KEYNOTE: Developing open source scientific software (in Python), Stéfan van der Walt, University of California, Berkeley (United States)

Keynote speaker Stéfan van der Walt is a senior research data scientist at the Berkeley Institute for Data Science (BIDS), where he leads the Software Working Group, and focuses on advancing science at the intersection of domains and computation. He is the founder of scikit-image and co-author of Elegant SciPy. van der Walt has been developing scientific open source software for more than a decade, focusing mainly on Python packages such as NumPy & SciPy. Until May 2014, van der Walt was a lecturer in applied mathematics at Stellenbosch University in the Vision and Learning Group. Most of his software can be found on GitHub, including most of his Python for science lectures. His publications are listed on Google Scholar.

18:55

COIMG-033

Tomopy: A Python framework for tomographic imaging, Doga Gursoy, Argonne National Laboratory (United States)

QUANTA IMAGE SENSING

Session Chair: Stanley Chan, Purdue University (United States)

19:45 – 20:45

19:45

COIMG-046

Dynamic low-light imaging with Quanta Image Sensors, Yiheng Chi¹, Abhiram Gnanasambandam¹, Vladlen Koltun², and Stanley Chan¹; ¹Purdue University and ²Intel Labs (United States)

20:05

COIMG-047

Image classification in the dark using Quanta Image Sensors, Abhiram Gnanasambandam and Stanley Chan, Purdue University (United States)

20:25

COIMG-048

Addressing bottlenecks in algorithms with tensor Kronecker product structure, Charles Colley¹, Huda Nassar², and David Gleich¹; ¹Purdue University and ²Stanford University (United States)

TUESDAY 19 JANUARY 2021

PLENARY: DEEP INTERNAL LEARNING—DEEP LEARNING WITH ZERO EXAMPLES

Session Chair: Charles Bouman, Purdue University (United States)

10:00 – 11:10

Deep internal learning—Deep learning with zero examples

Michal Irani, *professor, Department of Computer Science and Applied Mathematics, Weizmann Institute of Science (Israel)*

Michal Irani is a professor at the Weizmann Institute of Science. Her research interests include computer vision, AI, and deep learning. Irani's prizes and honors include the Maria Petrou Prize (2016), the Helmholtz "Test of Time Award" (2017), the Landau Prize in AI (2019), and the Rothschild Prize in Mathematics and Computer Science (2020). She also received the ECCV Best Paper Awards (2000 and 2002), and the Marr Prize Honorable Mention (2001 and 2005).

IN SITU SENSING AND ANALYSIS FOR AUTONOMOUS MATERIALS RESEARCH

Session Chair: Gregory Buzzard, Purdue University (United States)

11:40 – 13:00

11:40

COIMG-082

Super-resolution for paired electron microscopic images, *Yu Ding, Texas A&M University College Station (United States)*

12:00

COIMG-083

Integrating machine learning and three-dimensional chemical imaging to extract latent features in material structures, *Baishakhi Mazumder, University at Buffalo (United States)*

12:20

COIMG-084

Data-driven approaches for high-throughput experiment and analyses, *Samantha Daly and Zhe Chen, University of California, Santa Barbara (United States)*

12:40

COIMG-085

Automated analysis of transmission electron microscopy images using machine learning methods, *James Horwath¹, Rémi Megré², Dmitri Zakharov³, and Eric Stach¹; ¹University of Pennsylvania (United States), ²University of Puerto Rico, Río Piedras (Puerto Rico), and ³Brookhaven National Laboratory (United States)*

COIMG WINE AND CHEESE SOCIAL

Hosts: Charles Bouman and Gregory Buzzard, Purdue University, and Begum Gulsoy, Northwestern University (United States)

IMAGING THROUGH TURBULENT & SCATTERING MEDIUMS I

Session Chair: Casey Pellizzari, United States Air Force Academy (United States)

18:15 – 19:15

18:15

COIMG-076

Learning deep speckle correlation with an interpretable deep neural network, *Lei Tian, Boston University (United States)*

18:35 COIMG-077
Image reconstruction of static and dynamic scenes through anisoplanatic turbulence, Zhiyuan Mao, Nicholas Chimitt, and Stanley Chan, Purdue University (United States)

18:55 COIMG-078
Simulating anisoplanatic turbulence by sampling inter-modal and spatially correlated Zernike coefficients, Nicholas Chimitt and Stanley Chan, Purdue University (United States)

IMAGING THROUGH TURBULENT & SCATTERING MEDIUMS II

Session Chair: Casey Pellizzari, United States Air Force Academy (United States)

19:45 – 20:45

19:45 COIMG-079
LUCID: Multi-frame blind deconvolution accelerated with graphical processing units, Michael Werth¹, Brandoch Calet¹, Kevin Roe¹, and Amanda Conti²; ¹Boeing Defense Space and Security and ²Air Force Research Laboratory (United States)

20:05 COIMG-080
Recovering atmospheric image motion in the extreme faint limit, Michael Hart, HartSCI LLC (United States)

20:25 COIMG-081
Long range tracking with computational 2.5-D imagery, Jason Schmiat¹, Mitchell Grose¹, Yakov Diskin¹, Joseph Riley¹, Matthias Bane², and James Fienup²; ¹MZA Associates Corporation and ²University of Rochester (United States)

WEDNESDAY 20 JANUARY 2021

IMAGING THROUGH TURBULENT & SCATTERING MEDIUMS III

Session Chair: Casey Pellizzari, United States Air Force Academy (United States)

19:45 – 20:45

19:45 COIMG-125
Single-shot 3D holographic particle localization using deep priors trained on simulated data, Waleed Tahii¹, Simon Gilber¹, Hao Wang¹, Jiabei Zhu¹, Ulugbek Kamilov², and Lei Tian¹; ¹Boston University and ²Washington University in St. Louis (United States)

20:05 COIMG-126
Experiments on active imaging through fog, Samuel Thurman¹, Andrew Bratcher¹, Bruce Tiemann¹, Dawson Chung¹, Samuel Park², James Lindle³, Abbie Watnik², and Paul Lebow⁴; ¹Lockheed Martin Coherent Technologies, ²U.S. Naval Research Laboratory, ³DCS Corporation, and ⁴Alaire Technologies Inc. (United States)

20:25 COIMG-127
Revealing subcellular structures with live-cell and 3D fluorescence nanoscopy, Fang Huang, Purdue University (United States)

THURSDAY 21 JANUARY 2021

PLENARY: THE DEVELOPMENT OF INTEGRAL COLOR IMAGE SENSORS AND CAMERAS

Session Chair: Jonathan B. Phillips, Google Inc. (United States)

10:00 – 11:10

The development of integral color image sensors and cameras

Kenneth A. Parulski, *expert consultant: mobile imaging (United States)*

Kenneth Parulski is an expert consultant to mobile imaging companies and leads the development of ISO standards for digital photography. He joined Kodak in 1980 after graduating from MIT and retired in 2012 as research fellow and chief scientist in Kodak's digital photography division. His work has been recognized with a Technical Emmy and other major awards. Parulski is a SMPTE fellow and an inventor on more than 225 US patents.

AI-DRIVEN IMAGING INSTRUMENTS I

Session Chair: Doga Gursoy, Argonne National Laboratory Advanced Photon Source (United States)

11:40 – 13:00

11:40

COIMG-145

The physical search engine: AI for explorative 3D imaging, *Joost Batenburg, University of Leiden (the Netherlands)*

12:00

COIMG-146

Data versus physical models in computational optical imaging, *Demetri Psaltis, Ecole Polytechnique Federale de Lausanne (Switzerland)*

12:20

COIMG-147

Deep learning and image restoration: A match made in heaven or hell?, *Sabine Süsstrunk, Ecole Polytechnique Federale de Lausanne (Switzerland)*

12:40

COIMG-148

Self-supervised deep learning for ptychography without reference data, *Selin Aslan, Zhengchun Liu, Tekin Bicer, and Doga Gursoy, Argonne National Laboratory (United States)*

IMAGING THROUGH TURBULENT & SCATTERING MEDIUMS IV

Session Chair: Casey Pellizzari, United States Air Force Academy (United States)

13:35 – 14:30

13:35

COIMG-351

Reconstruction problems in medical and optical imaging: Evaluating filters for suppression for Gibbs Ringing, *Yue Wang, University College Dublin (Ireland)*

13:50

COIMG-165

Imaging through deep turbulence using digital holography experiments, *Mark Spencer¹ and Casey Pellizzari²; ¹Air Force Research Laboratory Directed Energy Directorate and ²United States Air Force Academy (United States)*

14:10

COIMG-166

Robustness of Fourier ptychographic imaging to variation of system parameters, Moritz Siegel^{1,2}, Lukas Traxler¹, and Laurin Ginnet¹; ¹AIT Austrian Institute of Technology GmbH and ²Technische Universität Wien (Austria)

AI-DRIVEN IMAGING INSTRUMENTS II

Session Chair: Singanallur Venkatakrisnan, Oak Ridge National Laboratory (United States)

18:35 – 19:15

18:35

COIMG-150

Modeling brain structure and organization across many spatial scales, Eva Dyer, Georgia Institute of Technology (United States)

18:55

COIMG-347

Stability analysis of data and image domain learning-based reconstruction approaches, Muhammad Usman Ghani and W. Clem Karl, Boston University (United States)

KEYNOTE: AI-DRIVEN IMAGING INSTRUMENTS

Session Chair: Gregory Buzzard, Purdue University (United States)

19:45 – 20:25

COIMG-169

KEYNOTE: Deep networks from first principles, Yi Ma, University of California at Berkeley (United States)

Keynote speaker Yi Ma received his BS in automation and applied mathematics from Tsinghua University, China (1995), an MS in EECS (1997), an MA in Mathematics (2000), and a PhD in EECS (2000) all from UC Berkeley. He was on the faculty of ECE Department of the University of Illinois at Urbana-Champaign from 2000 to 2011. He was the manager of the Visual Computing Group and a principal researcher of Microsoft Research in Asia from 2009 to 2013. He was then a founding professor and the executive dean of the School of Information Science and Technology of ShanghaiTech University from 2014 to 2017. He joined the faculty of EECS of UC Berkeley in 2018.

MONDAY 25 JANUARY 2021

PLENARY: MAKING INVISIBLE VISIBLE

Session Chair: Jonathan B. Phillips, Google Inc. (United States)

10:00 – 11:10

Making invisible visible

Ramesh Raskar, associate professor, MIT Media Lab (United States)

Ramesh Raskar is an associate professor at MIT Media Lab and directs the Camera Culture research group. His focus is on AI and imaging for health and sustainability. They span research in physical (e.g., sensors, health-tech), digital (e.g., automated and privacy-aware machine learning), and global (e.g., geomaps, autonomous mobility) domains. He received the Lemelson Award (2016), ACM SIGGRAPH Achievement Award (2017), DARPA Young Faculty Award (2009), Alfred P. Sloan Research Fellowship (2009), TR100 Award from MIT Technology Review (2004), and Global Indus Technovator Award (2003). He has worked on special research projects at Google [X] and Facebook and co-founded/advised several companies.

IMAGE MODELING FOR INVERSE PROBLEMS

Session Chair: Charles Bouman, Purdue University (United States)

11:40 – 13:00

11:40 COIMG-202

Deep probabilistic imaging: Uncertainty quantification and multi-modal solution characterization for computational imaging, *He Sun and Katherine Bouman, California Institute of Technology (United States)*

12:00 COIMG-200

One size fits all: Can we train one denoiser for all noise levels?, *Abhiram Gnanasambandam and Stanley Chan, Purdue University (United States)*

12:20 COIMG-201

Model-based Bayesian deep learning architecture for linear inverse problems in computational imaging, *Canberk Ekmekci and Mujdat Cetin, University of Rochester (United States)*

12:40 COIMG-199

Plug-and-play and equilibrium methods demystified, *Gregery Buzzara¹, Charles Bouman¹, and Brendt Wohlberg²; ¹Purdue University and ²Los Alamos National Laboratory (United States)*

COMPUTATIONAL IMAGING FOR MATERIALS APPLICATIONS I

Session Chair: Mary Comer, Purdue University (United States)

13:30 – 14:30

13:30 COIMG-187

Self-supervised curriculum learning for fiber tracking in composite materials, *Hongkai Yu, Cleveland State University (United States)*

13:50 COIMG-188

3D fiber detection using deep center regression and geometric clustering, *Camilo Aguilar Herrera¹ and Mary Comer²; ¹INRIA, Sophia Antipolis (France) and ²Purdue University (United States)*

14:10 COIMG-189

Stochastic plug-and-play algorithms for solving image reconstruction problems for analyzing microscope imagery, *Vincent Monardc¹, Sean Donegan², Marc De Grat¹, and Yuejie Chi¹; ¹Carnegie Mellon University and ²Air Force Research Laboratory, Wright-Patterson AFB (United States)*

COMPUTATIONAL IMAGING FOR MATERIALS APPLICATIONS II

Session Chair: Emine Gulsoy, Northwestern University (United States)

18:15 – 19:15

18:15 COIMG-190

Multi-resolution data fusion for transmission electron microscopy, *Emma Reia¹, Gregery Buzzara¹, Lawrence Drummy², and Charles Bouman¹; ¹Purdue University and ²Air Force Research Laboratory (United States)*

18:35 COIMG-191

Physics-regularization in machine learning, *Stephen Niezgod, The Ohio State University (United States)*

18:55 COIMG-192
GANs for synthetic microstructure generation, *Megna Shah, Austin Gerlt, Jeffrey Simmons, and Eric Payton, Air Force Research Laboratory (United States)*

COMPUTATIONAL IMAGING FOR MATERIALS APPLICATIONS III

Session Chair: Jeffrey Simmons, Air Force Research Laboratory (United States)
19:45 – 20:45

19:45 COIMG-193
Computer vision and machine learning for image data in materials science, *Elizabeth Holm, Ryan Cohn, Nan Gao, Katelyn Jones, Bo Lei, and Srjana Yarasi, Carnegie Mellon University (United States)*

20:05 COIMG-194
JST-first: Evaluating the utility of Mueller matrix imaging for diffuse material classification, *Meredith Kupinski and Lisa Li, The University of Arizona (United States)*

20:25 COIMG-195
JST-first: Limitations of CNNs for approximating the ideal observer despite quantity of training data or depth of network, *Khalid Omer, Luca Caucci, and Meredith Kupinski, The University of Arizona (United States)*

TUESDAY 26 JANUARY 2021

CT IMAGING

Session Chair: Selin Aslan, Argonne National Laboratory (United States)
18:15 – 19:15

18:15 COIMG-228
Modular X-ray CT reconstruction with coded exposure, *Soumendu Majee¹, Selin Aslan², Charles Bouman¹, and Doga Gursoy²; ¹Purdue University and ²Argonne National Laboratory (United States)*

18:35 COIMG-229
Enhanced material estimation with multi-spectral CT, *Sandamali Devadithya and David Castañón, Boston University (United States)*

18:55 COIMG-230
Sparse view CT with total variation priors in cylindrical coordinates, *Maliha Hossain¹, Charles Bouman¹, Marc Klasky², and Brendt Wohlberg²; ¹Purdue University and ²Los Alamos National Laboratory (United States)*

PHYSICS-INFORMED RECONSTRUCTION I

Session Chair: Katherine Bouman, California Institute of Technology (United States)
19:45 – 20:45

19:45 COIMG-249
Diffusion imaging by Fourier transform fluorescence recovery after photobleaching, *Andreas Geiger, Randy Akrofi, and Garth Simpson, Purdue University (United States)*

20:05 COIMG-250
Large-scale holographic 3D particle localization based on the multi-slice beam propagation model, *Hao Wang, Waleed Tahir, Jiabei Zhu, and Lei Tian, Boston University (United States)*

20:25 COIMG-251
Imaging fluid-dynamics by stochastic model fitting, *Aviad Levis¹, Daeyoung Lee², Charles Gammie², and Katherine Bouman¹; ¹California Institute of Technology and ²University of Illinois Urbana-Champaign (United States)*

WEDNESDAY 27 JANUARY 2021

PLENARY: REVEALING THE INVISIBLE TO MACHINES WITH NEUROMORPHIC VISION SYSTEMS: TECHNOLOGY AND APPLICATIONS OVERVIEW

Session Chair: Radka Tezaur, Intel Corporation (United States)
10:00 – 11:10

Revealing the invisible to machines with neuromorphic vision systems: Technology and applications overview
Luca Verre, CEO and co-founder, Prophesee (France)

Luca Verre is co-founder and CEO of Prophesee, the inventor of the world's most advanced neuromorphic vision systems. Verre is a World Economic Forum technology pioneer. His experience includes project and product management, marketing, and business development roles at Schneider Electric. Prior to Schneider Electric, Verre worked as a research assistant in photonics at the Imperial College of London. Verre holds a MSc in physics, electronic and industrial engineering from Politecnico di Milano and Ecole Centrale and an MBA from Institut Européen d'Administration des Affaires, INSEAD.

PHYSICS-INFORMED RECONSTRUCTION II

Session Chair: Zachary Levine, National Institute of Standards and Technology (United States)
18:15 – 19:15

18:15 COIMG-288
Leveraging multi-agent consensus equilibrium for quantum chemistry, *James Ulcickas¹, Ziyi Cao², Jiayue Rong², Charles Bouman², Lyudmila Slipchenko², Gregory Buzzara², and Garth Simpson²; ¹Northrop Grumman Corporation and ²Purdue University (United States)*

18:35 COIMG-289
Physics-embedded deep learning for intensity diffraction tomography under multiple scattering, *Alex Matlock and Lei Tian, Boston University (United States)*

18:55 COIMG-290
Deep learning approach for dynamic sparse sampling in mass spectrometry imaging, *David Helminiak¹, Hang Hu², Julia Laskin², and Dong Hye Ye¹; ¹Marquette University and ²Purdue University (United States)*

PHYSICS-INFORMED RECONSTRUCTION III

Session Chair: Garth Simpson, Purdue University (United States)

19:45 – 20:45

19:45

COIMG-291

Testing the goodness of model fit in tunable diode laser absorption tomography, *Zeeshan Nadi¹, Kristin Rice², Michael Brown², and Charles Bouman³; ¹Samsung Research America, ²Air Force Research Labs, and ³Purdue University (United States)*

20:05

COIMG-292

X-ray computed tomography using partially coherent Fresnel diffraction with application to an optical fiber, *Zachary Levine, National Institute of Standards and Technology (United States)*

20:25

COIMG-293

Reducing motion artifact in sequential-scan dual-energy CT imaging by incorporating deformable registration within joint statistical image reconstruction, *Tao Ge¹, Rui Liac¹, David Politte², Maria Medranc¹, Jeffrey Williamson¹, Bruce Whiting³, Tianyu Zhac², and Joseph O'Sullivan¹; ¹Washington University in St. Louis, ²Washington University School of Medicine, and ³University of Pittsburgh (United States)*