PROCEEDINGS OF SPIE

Anomaly Detection and Imaging with X-Rays (ADIX)

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Editors

19–20 April 2016
Baltimore, Maryland, United States

Sponsored and Published by
SPIE

Volume 9847

Proceedings of SPIE 0277-786X, V. 9847

Anomaly Detection and Imaging with X-Rays (ADIX), edited by
Amit Ashok, Mark A. Neifeld, Michael E. Gehm, Proc. of SPIE Vol. 9847,
984701 · © 2016 SPIE · CCC code: 0277-786X/16/$18 · doi: 10.1117/12.2244794

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.

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Please use the following format to cite material from these proceedings:
Author(s), "Title of Paper," in *Anomaly Detection and Imaging with X-Rays (ADIX)*, edited by Amit Ashok, Mark A. Neifeld, Michael E. Gehm, Proceedings of SPIE Vol. 9847 (SPIE, Bellingham, WA, 2016) Six-digit Article CID Number.

ISSN: 0277-786X
ISSN: 1996-756X (electronic)
ISBN: 9781510600881

Published by
SPIE
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445
SPIE.org

Printed in the United States of America.

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

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Introduction

We would like to begin by thanking everyone who participated in the inaugural SPIE Anomaly Detection and Imaging with X-Rays (ADIX) conference. It is our hope that this will be the first of many such meetings that can bring together the broad range of expertise/interest characterizing this important discipline. Indeed, this first meeting involved participation by all segments of the community, government, industry, and academia, resulting in a vibrant and intellectually rewarding forum for exchange of ideas.

Although x-ray imaging has its roots in medical imaging, advances in x-ray component technology coupled with the exponential growth in computational capability has fueled the expansion of x-ray imaging to numerous defense and security applications. For example, x-ray based imaging systems are now widely deployed at security checkpoints for explosive and contraband detection at airports, seaports, commercial and military building and installations. Another modern application of x-ray imaging is non-destructive part inspection for industrial and aviation safety. While the application base for X-ray based anomaly detection and imaging continues to grow, the x-ray imaging system architecture (inspired by medical CT) has remained largely unchanged. However, recently non-traditional x-ray imaging architectures and sophisticated post-processing algorithms have begun to emerge which leverage advances in mathematical theory of sampling (e.g. compressive sensing) together with increased exploitation of available signal and task prior information.

Reviewing the collection of excellent talks that were presented at the meeting, it was clear that the conference provided a much needed venue for researchers to address current and future challenges through advances in all aspects of x-ray based anomaly detection and imaging: ranging from component technology, reconstruction and data exploitation algorithms, imaging/sensing system architectures to system performance metrics and novel defense and security applications.

The conference began with a very engaging keynote address [9847-2] by Dr. Eric Houser from the United States Transportation Security Administration (TSA) who described not only the substantial technical challenges associated with explosive threat detection in airports, but also the regulatory, administrative; and 'ecosystem' challenges that arise from the combination of government, industry, and academic participants in this important enterprise.

Following the keynote address, the ADIX conference was organized into four Session Topic Areas (STAs), the first of which was X-Ray Scatter and Phase Anomaly Imaging and Detection. A plurality of papers in this STA describe research projects

related to novel measurement architectures and reconstruction methods for exploiting Raleigh scattering for materials identification and liquid/low-density threat detection. Taken together these papers illuminate some of the tradeoffs associated with scatter-based x-ray measurements in both the scanning and snapshot modalities. Also in this STA we find several excellent papers on the topic of x-ray phase measurement presenting new ideas about sources, detectors, and phase retrieval algorithms and the information theoretic limits of this novel modality.

The next STA on day one was X-ray Photoabsorption Anomaly Imaging and Detection and these papers described various refinements for improving the performance of dual-energy, multi-energy, multi-angle, and/or adaptive measurements in the photo-absorption modality.

On day two of ADIX we began with the STA X-ray CT Reconstruction and Exploitation Algorithms. The ten papers in this STA described how the latest advances in nonlinear optimization, machine learning, and graphical inference can be applied to all of the modalities discussed during day one. As a testament to the importance of these advanced algorithms, many of these papers describe numerical acceleration to enable real-time operation.

Our last STA was X-ray System Design/Analysis and Forward-model and the six paper in this STA addressed a multitude of important topics related to the rapid simulation of x-ray/matter interaction physics, development and application of system design and decision metrics.

From this brief overview of the papers presented at the inaugural ADIX conference, it was clear that the field of Anomaly Detection and Imaging with X-Rays is currently experiencing significant innovation. The papers included in this volume describe important advances on many of the topics described in our original call for papers such as coded-apertures designs, non-traditional system architectures, coherent and incoherent scatter, phase-contrast based x-ray imaging/sensing systems, adaptive measurement, task-specific system design, and compressive scan geometries for direct and reconstruction-based anomaly detection/estimation.

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