## **PROCEEDINGS OF SPIE**

# Optics for Arts, Architecture, and Archaeology (O3A) IX

Haida Liang Roger Groves Editors

26–27 June 2023 Munich, Germany

Sponsored and Published by SPIE

Volume 12620

Proceedings of SPIE 0277-786X, V. 12620

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 Optics for Arts, Architecture, and Archaeology (O3A) IX, edited by Haida Liang, Roger Groves, Proc. of SPIE 12620, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510664494 ISBN: 9781510664500 (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.



**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

#### v Conference Committee

#### ADVANCED IMAGE PROCESSING AND DATA VISUALISATION

- 12620 02 An integrated multi-modal architecture for the visualization of macro-XRF elemental distribution maps [12620-5]
- 12620 03 Multi-scale convolutional autoencoder network-based implicit information mining of cultural relics [12620-7]
- 12620 04 Multimodal image registration and mosaicking of artworks: an approach based on mutual information [12620-8]
- 12620 05 Intelligent labeling of murals with fragmentation disease based on gradient trainable Gabor and U-Net [12620-10]

#### IMAGING AND SPECTROSCOPY INSTRUMENT AND METHOD DEVELOPMENT

- 12620 06 Non-invasive quantitative characterization of varnish thickness on gilt leather by line-field confocal optical coherence tomography [12620-11]
- 12620 08 Simple smartphone-based artworks diagnostics by Moiré method and a diffractive optical element [12620-14]
- 12620 09 Four-flux model combined with optical coherence tomography technique for non-destructive testing of the colour ground layers of the paintings [12620-15]

#### **3D SURFACES AND STRUCTURAL ANALYSIS**

- 12620 0A Application of shearography with thermal loading for the structural inspection of Rembrandt's Night Watch [12620-16]
- 12620 0B Can we unlock more information from interferometric sensors? feasibility and performance analysis [12620-18]
- 12620 0C Optical surface metrology for heritage science: proof of concept and critical-constructive discussion [12620-20]

#### MULTIMODAL IMAGING AND SPECTROSCOPY

12620 0D Ancient coins' surface inspection with web-based neural RTI visualization [12620-22]

#### APPLICATIONS TO ART, ARCHAEOLOGY AND ARCHITECTURE

- 12620 OE Selection of optimal spectral metrics for classification of inks in historical documents using hyperspectral imaging data [12620-27]
- 12620 OF Comprehensive spectral and imaging studies of marble to assess the environmental damage using ULF Raman and THz absorption studies [12620-28]

#### POSTER SESSION

- 12620 0G **Pulsed infrared thermographic study of a Chinese bronze lei** [12620-29]
- 12620 OH Hyperspectral image fusion based on dual-resolution fusion feature mutual guidance network [12620-32]