PROCEEDINGS OF SPIE

Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping VIII

J. Alex Thomasson Christoph Bauer Editors

1–2 May 2023 Orlando, Florida, United States

Sponsored by SPIE

Cosponsored by Syngenta Corp. (United States)

Published by SPIE

Volume 12539

Proceedings of SPIE 0277-786X, V. 12539

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 Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping VIII, edited by J. Alex Thomasson, Christoph Bauer, Proc. of SPIE 12539, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510661943 ISBN: 9781510661950 (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

MACHINE-LEARNING ANALYSIS OF PLANT SPECTRAL DATA FROM AUTONOMOUS SYSTEMS

12539 02	Citrus disease classification with convolution neural network generated features and machine
	learning classifiers on hyperspectral image data
	(Invited Paper, Best Student Paper Award Runner Up) [12539-5]

- 12539 03 A modular artificial neural network technique for early estimation of cotton yield using unmanned aerial system [12539-7]
- 12539 04 Machine learning models for detecting and isolating weeds from strawberry plants using UAVs [12539-8]
- 12539 05 Combining machine learning with a mechanistic model to estimate maize nitrogen content from UAV-acquired hyperspectral imagery [12539-9]

PRECISE CROP MEASUREMENTS FROM UAV REMOTE SENSING

- 12539 06 Comparative leaf area index estimation using multispectral and RGB images from a UAV platform [12539-12]
- 12539 07 Feasibility and accuracy assessment of UAV, aircraft, and satellite-based remote sensing for irrigation management using canopy temperature and NDVI [12539-13]

PRECISE CROP MEASUREMENTS FROM GROUND-BASED PLATFORMS

- 12539 08 Multi-ripeness level blackberry detection using YOLOv7 for soft robotic harvesting (Invited Paper, Best Student Paper Award) [12539-15]
- 12539 09 OpenWeedGUI: an open-source graphical user interface for weed imaging and detection [12539-16]
- 12539 0A Estimating crop stomatal conductance from RGB, NIR, and thermal infrared images [12539-17]

ROBOTIC AND COLLABORATIVE AIR-GROUND PLANT SENSING

12539 OB Evaluating object detection and stereoscopic localization of a robotic cotton harvester under real field conditions (Invited Paper) [12539-19]

12539 OC	Collaboration between UAVs and UGVs for site-specific application of chemicals [12539-20]
12539 OD	Continued development of autonomous mobile ground control point for increasing the accuracy of unmanned aerial-vehicle-based phenotyping [12539-22]
	DIGITAL POSTER SESSION

12539 OF Deep learning-based heterogeneous system for autonomous navigation [12539-21]