## PROCEEDINGS OF SPIE

## Bioinspiration, Biomimetics, and Bioreplication IX

Raúl J. Martín-Palma Mato Knez Akhlesh Lakhtakia Editors

4–5 March 2019 Denver, Colorado, United States

Sponsored by SPIE

Cosponsored by OZ Optics, Ltd. (United States) Polytec, Inc. (United States)

Cooperating Organizations
Jet Propulsion Laboratory (United States)
Colorado Photonics Industry Association (United States)

Published by SPIE

Volume 10965

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 SPIEDigital Library.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 *Bioinspiration, Biomimetics, and Bioreplication IX*, edited by Raúl J. Martín-Palma, Mato Knez, Akhlesh Lakhtakia, Proceedings of SPIE Vol. 10965 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510625853

ISBN: 9781510625860 (electronic)

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

Copyright © 2019, Society of Photo-Optical Instrumentation Engineers.

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 copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online 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. The CCC fee code is 0277-786X/19/\$18.00.

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:** Proceedings of SPIE follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article 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 vii	Authors Conference Committee
	ROBOTICS I
10965 04	Robotic jellyfish actuated with a shape memory alloy spring [10965-2]
10965 05	Variable stiffness soft robotics using pennate muscle architecture [10965-4]
10965 06	An information-theoretic approach to study hydrodynamic interactions in schooling fish [10965-5]
	ROBOTICS II
10965 07	Humanlike robots: state of the art and challenges (Keynote Paper) [10965-6]
	ENVIRONMENTAL BIOMIMETICS
10965 09	Evomimetics: the biomimetic design thinking 2.0 (Invited Paper) [10965-8]
10965 0A	Biomimicry of school of fish for community windstorm design [10965-9]
10965 OB	Can robotic fish help zebrafish learn to open doors? [10965-10]
	BIOMIMETIC OPTICS
10965 OC	Colour and fluorescence emission of Euchroea auripigmenta beetle (Invited Paper) [10965-11]
10965 OE	Towards biomimetic red solar cells [10965-13]
	BIOMIMETIC MATERIALS AND STRUCTURES I
10965 OH	Development of a conceptual demonstrator of a SMA-based Rotorcraft blade twist system [10965-16]

10965 OJ	Adaptive and compliant wingtip devices enabled by additive manufacturing and multistable structures [10965-18]
10965 OK	Implementation and evaluation of an algorithm determining robot movement for home robot in living space [10965-3]
	BIOMIMETIC MATERIALS AND STRUCTURES II
10965 ON	Time-Lapse imaging of bactericidal effect on nanostructural surface [10965-21]
	BIOMIMETIC ACTUATORS
1096500	Actuation simplification for grippers based on bioinspired spring origami [10965-22]
10965 OP	Bio-inspired orderly recruitment valve for fluidic artificial muscles [10965-23]
	SENSORS
10965 OR	Digitization of biomimetic vision sensor based on the common housefly (Musca Domestica) [10965-25]
10965 OS	Finite element analysis of smart structural implications of a beam-type artificial basilar membrane inspired sensor [10965-26]
10965 OT	Liquid metal-based bio-inspired capacitive flow sensor [10965-27]
10965 OU	Behavior prediction for several seconds using human body model and non-contact sensor [10965-28]
10965 OV	The structural colors of the blue butterflies: from sexual signaling to chemically selective vapor sensing $[10965-29]$
10965 OW	Breathing skins workshop: A hands-on investigation of bio-inspired foldable structures for temperature and humidity control in buildings [10965-34]
	POSTER SESSION
10965 OX	Strain-induced crystallization to prolong the lifetime of pneumatic artificial muscles [10965-30]
10965 OY	Lighting control using natural gestures of residents [10965-31]