PROCEEDINGS OF SPIE

Fifth International Conference on Telecommunications, Optics, and Computer Science (TOCS 2024)

Witold Pedrycz
Sos S. Agaian
Editors

27–29 December 2024
Guangzhou, China

Organized by
Guangdong Polytechnic Normal University (China)
Zhengzhou University (China)

Sponsored by
Guangdong Society of Automotive Engineering (China)
International Artificial Intelligence Industry Alliance (China)
International Association of Applied Science and Technology (China)
Guangdong Promotion Association for Intelligent Connected Vehicle E/E Industry (China)

Published by
SPIE

Volume 13629

Proceedings of SPIE 0277-786X, V. 13629

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 *Fifth International Conference on Telecommunications, Optics, and Computer Science (TOCS 2024)*, edited by Witold Pedrycz, Sos S. Agaian, Proc. of SPIE 13629, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510691667
ISBN: 9781510691674 (electronic)

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

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.

SPIE. DIGITAL LIBRARY
SPIEDigitalLibrary.org

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

COMPUTER SCIENCE AND COMMUNICATION TECHNOLOGY