Automatic Object Recognition

Contents

	vii	Institute Participants
	ix	Introduction
Part One **Systems Development and Technology Evolution**	3	**Introduction**
	4	**Development of automatic target recognizers for Army applications** T. L. Jones, U.S. Army Ctr. for Night Vision and Electro-Optics
	14	**Algorithm development and evaluation on the Multifunction Target Acquisition Processor** M. C. Haskett, U.S. Army Ctr. for Night Vision and Electro-Optics; S. L. Lidke, Alliant Techsystems
	24	**IR/MMW fusion ATR** E. C. Thiede, Honeywell Inc.
Part Two **Modeling and Phenomenology**	39	**Introduction**
	40	**Issues in automatic object recognition: linking geometry and material data to predictive signature codes** P. Deitz, M. J. Muuss, E. O. Davisson, U.S. Army Ballistic Research Lab.
	57	**Unified approach to multisensor simulation of target signatures** S. R. Stewart, I. J. LaHaie, J. T. Lyons, Environmental Research Institute of Michigan
	98	**Signature prediction models for FLIR target recognition** V. J. Velten, Wright Research and Development Ctr.
Part Three **Model-Based Systems**	111	**Introduction**
	112	**Importance of sensor models to model-based vision applications** E. G. Zelnio, Wright Research and Development Ctr.
	122	**Knowledge- and model-based ATR (automatic target recognition) algorithms adaptation** H. N. Nasr, M. E. Bazakos, F. A. Sadjadi, H. Amehdi, Honeywell Inc.
	130	**Model-based ATR (automatic target recognition) systems for the military** W. F. Tatum, Texas Instruments Inc.

Automatic Object Recognition, edited by Hatem N. Nasr, Proc. of SPIE Vol. 10307 (Vol. MS41), 1030701 · © (1991) 2017 SPIE · CCC code: 0277-786X/17/$18 · doi: 10.1117/12.2283642

Part Four
Performance Evaluation

143 **Introduction**

144 **Development and use of confidence intervals for automatic target recognition evaluation**
J. W. Sherman, Environmental Research Institute of Michigan

170 **System transfer modeling for automatic target recognizer evaluations**
L. G. Clark, Wright Research and Development Ctr.

181 **Development of an electronic terrain board as a processor test and evaluation tool**
C. P. Walters, M. Lorenzo, U.S. Army Ctr. for Night Vision and Electro-Optics

202 **Automated instrumentation, evaluation, and diagnostics of automatic target recognition systems**
H. N. Nasr, Honeywell Inc.

Part Five
Novel Approaches

217 **Introduction**

218 **Multispectral and multisensor adaptive automatic object recognition**
F. A. Sadjadi, Honeywell Inc.

231 **Artificial neural networks for automatic object recognition**
S. K. Rogers, D. W. Ruck, M. Kabrisky, G. L. Tarr, M. E. Oxley, Air Force Institute of Technology

244 Author Index

Proc. of SPIE Vol. 10307 1030701-2

Institute Participants

Lloyd G. Clark
205 Allen Street
Yellow Springs, OH 45387-1303

Paul Deitz
U.S. Army Ballistic Research Lab.
ATTN: SLCBR-VL-V
Aberdeen Proving Ground, MD 21005-5066

Michael C. Haskett
U.S. Army CECOM Ctr. for Night Vision and Electro-Optics
AMSEL-RD-NV-ISPD/APDT
Ft. Belvoir, VA 22062

Terry L. Jones
U.S. Army Night Vision & Electro-Optics Lab.
DEL-NV-AC
Ft. Belvoir, VA 22060-5001

Hatem N. Nasr
Honeywell Inc.
Suite 1500
2525 Bay Area Boulevard
Houston, TX 77058

Roy Potter
SPIE
P.O. Box 10
Bellingham, WA 98227

Steven K. Rogers
Air Force Institute of Technology
Dept. of E&CE
Bldg. 640, Area B., Rm. 218
Wright-Patterson AFB, OH 45433-6583

Firooz A. Sadjadi
3400 Highcrest Road
St. Anthony, MN 55418-1757

James W. Sherman
Environmental Research Institute of Michigan
Image Processing Technology Lab.
P.O. Box 8618
Ann Arbor, MI 48107-8618

Lee A. Slutz
Booz-Allen & Hamilton, Inc.
1725 Jefferson Davis Hwy #1100
Arlington, VA 22202

Stephen R. Stewart
Environmental Research Institute of Michigan
P.O. Box 8618
Ann Arbor, MI 48107-8618

William F. Tatum
2400 Rockbrook Ct.
Plano, TX 75074-4672

Edwin C. Thiede
Honeywell Inc.
MN38-2100
10400 Yellow Circle Dr.
Minnetonka, MN 55343

Vincent J. Velten
Wright Research and Development Ctr.
ATR Branch AARA
Wright Patterson AFB, OH 45433

Clarence P. Walters
U.S. Army Ctr. for Night Vision and Electro-Optics
ATTN: AMSEL-RD-NV-V-LET
Ft. Belvoir, VA 22060

Marshall R. Weathersby
Nichols Research Corp.
3007 Barcody Road
Huntsville, AL 35802

Edmund G. Zelnio
Wright Research & Development Ctr.
Target Recognition Branch
WRDC/AARA
Wright-Patterson AFB, OH 45433-6543

Introduction

Automatic object recognition (AOR) is a challenging field which has been evolving over decades. The application areas span many domains such as robotics inspection, medical imaging, military targeting, and reconnaissance. Some of the most concentrated efforts in AOR have been in the military domain, where most of the problems deal with recognition of targets and scene analysis in the outdoors using a variety of sensors; the papers presented in this Institute were consequently more focused on military applications. However, the progress reported in the papers goes beyond their military domain and has unquestionably a variety of other applications.

In this SPIE Institute we gathered some expert and well-informed individuals on the subject of AOR and discussed some of the advances, issues, and trends in the field. The papers, as well as the discussions during the Institute, focused on many subjects, including model-based approaches, modeling, evaluation, neural networks, real-time systems, and technology evolution.

AOR techniques initially relied on statistical pattern recognition methods, which have shown their limitations. Artificial intelligence techniques have been widely investigated and have shown to be promising. Neural-network applications have also been emerging and have shown some promise. During the Institute, neural-net applications were discussed with the emphasis on their effectiveness in solving vision problems. Model-based object recognition appears to be one of the most promising paradigms, and it is the focus of attention of many researchers in the field. During the Institute, the model-based paradigm provoked many interesting discussions and challenging questions about the general problem of machine vision.

Among the most challenging issues in model-based recognition has been object modeling and the phenomenology of the scene, which were also widely discussed topics. Phenomenology studies have proven to be extremely critical, especially in certain sensor domains such as infrared, where the object signature can significantly vary because of the environment and object-state parameters. Because phenomenology studies have transformed AOR discipline from an art to a near-science, researchers are now looking more closely at the fundamental physical laws behind a given object signature. AOR system and algorithm evaluation has been another area of active research and development. Evaluation of AOR systems has proven to be a complex task due to the complexity and enormous variation of the signal/image data, among many other reasons. The evaluation topic was also discussed, especially in its relation to robust systems development.

Hatem Nasr
Honeywell Inc.