NOISE AND CLUTTER REJECTION IN RADARS AND IMAGING SENSORS

ISNCR-89

NOISE AND CLUTTER REJECTION IN RADARS AND IMAGING SENSORS

Proceedings of the Second International Symposium on Noise and Clutter Rejection in Radars and Imaging Sensors, November 14-16, 1989, Kyoto, Japan

Edited by : T. SUZUKI, H. OGURA, S. FUJIMURA

IEICE North-Holland

1990

ISBN: 4-88552-086-X (IEICE)
ISBN: 0-444-885854 (North-Holland)

Distribution of this book is being handled by:
North-Holland
Elsevier Science Publishers B.V.
P.O. Box 211
1000 AE Amsterdam
The Netherlands

Sole distributors for the U.S.A. and Canada:
Elsevier Science Publishing Company, Inc.
P.O. Box 882
Madison Square Station
New York, NY 10159
U.S.A.

Printed in Japan

ISNCR-89

SPONSORS:

The Technical Group on Space, Aeronautical and Navigational Electronics of the Institute of Electronics, Information and Communication Engineers
The Technical Group on Electromagnetic Theory of the Institute of Electronics, Information and Communication Engineers and the Institute of Electrical Engineers of Japan

COSPONSORS:

Aerospace and Electronics Systems Society of the Institute of Electrical and Electronic Engineers
Professional Group Committee of E15 of the Institution of Electrical Engineers
Radar Society of the Chinese Institute of Electronics

COOPERATIVE ORGANIZATIONS:

The Japan Society of Applied Physics
The Society of Instrument and Control Engineers
The Japan Society of Medical Electronics and Biological Engineering
The Japan Society for Aeronautical and Space Sciences
The Institute of Television Engineers of Japan
The Iron and Steel Institute of Japan
The Remote Sensing Society of Japan
Japan Society of Photogrammetry
Japanese Society of Medical Imaging Technology
The Japanese Society for Non-Destructive Inspection
The Society of Exploration Geophysicists of Japan
Japan Institute of Navigation
Japanese Committee for Radio Aids to Navigation
Electronic Industries Association of Japan
The Society of Information Theory and Its Applications
Tokyo Chapter of IEEE Geoscience and Remote Sensing Society
Tokyo Chapter of IEEE Antenna Propagation Society

ISNCR-89 CHAIRMAN'S OFFICE

Prof Tsutomu Suzuki
Department of Electronics, The University of Electro-Communication
Chofu-shi, Tokyo 182, Japan

PREFACE

The 1989 International Symposium on Noise and Clutter Rejection in Radars and Imaging Sensors aims to exchange information on noise suppression techniques which have been developed in different but related fields of research from radar to medical and industrial imaging. The technical program for ISNCR-89 features both solicited and contributed technical seminars on Noise and Clutter Rejection in Radars and Imaging Sensors, which include a hundred and thirty eight papers authored by our overseas and domestic colleagues from a variety of fields. Special lectures will be given by the three invited speakers, Prof. Fawwaz T. Ulaby of the University of Michigan, U.S.A., Prof. Orhan Nalcioglu of the University of California, Irvine, U.S.A. and Prof. Matsuo Sekine of Tokyo Institute of Technology, Japan, who will present the newest and most sophisticated techniques on noise and clutter rejection in radars and imaging sensors. The contributed papers will be presented in three parallel sessions. We have divided the symposium so that the contributed papers could all be included in the three-day program. As the titles of the sessions suggest, this symposium covers enormously extended areas of research. They are, however, related to each other from the view point of noise and clutter rejection. Participation in this symposium will be rewarded by an ample opportunity for an interdisciplinary exchange of information among the attendees from various fields.

Editors:
Tsutomu SUZUKI
Hisanao OGURA
Sadao FUJIMURA

ISNCR-89 COMMITTEE

ORGANIZING COMMITTEE

Chairman:
T. Suzuki (Univ. of Electro-Comm.)
Vice-Chairmen:
H. Ogura (Kyoto Univ.)
I. Toda (NTT)
Auditors:
M. Hirai (NEC)
K. Aoki (Sasebo College of Tech.)
Secretaries:
M. Sekine (Tokyo Inst. of Tech.)
I. Arai (Univ. of Electro-Comm.)
Honorary Member:
T. Musha (Tokyo Inst. of Tech.)
Members:
S. Adachi (Tohoku Univ., IEIEC)
Y. Akao (Aichi Inst. Tech.)
Y. Aoki (Hokkaido Univ.)
N. Fugono (Comm. Research Lab.)
R. Fukutomi (Hitachi)
K. Funakawa (NASDA)
S. Hasegawa (Univ. of Electro-Comm.)
I. Hatano (Omron)
S. Hayakawa (Matsushita Elect. Ind.)
M. Higashiguchi (Univ. of Tokyo)
Y. Iijima (Tokyo Univ. of Mercantile Marine)
F. Ikegami (Takusyoku Univ.)
Y. Ishii (Univ. of Tokyo)
T. Izumitani (NEC)
T. Kaizuka (JRC)
T. Kaneko (IBM Tokyo Res. Lab.)
H. Kashiwagi (ETL)
S. Kato (Kyoto Univ.)
N. Kodaira (RESTEC)
E. Kohnosu (Oki Elec.)
J. Komai (ERSDAC)
K. Komuro (KDD)
M. Matuo (Fukui Inst. of Tech.)
K. Minohara (Furuno Elec.)
N. Mori (Anritsu)
J. Nakahara (Sumitomo Elect. Ind.)
T. Namekawa (Himeji Dokkyo Univ.)
S. Niwa (Tokai Univ.)
T. Ohmori (Matsushita Comm. Inc.)
E. Ohno (Mitsubishi Elec.)
S. Oka (Shimadzu)
K. Okada (Tokyo Keiki)
T. Okuda (Toshiba)
M. Onoe (Ricoh)
M. Saito (Univ. of Tokyo)
T. Sakata (Tokai Univ.)
T. Sekiguchi (Musashi Inst. Tech.)
M. Sugimoto (NHK)
H. Suzuki (Tokyo Univ. of Fisheries)
I. Tanaka (Koden Elect.)
H. Toyota (Seikei Univ.)
K. Tsuchiya (Chiba Univ.)
S. Tuji (Osaka Univ.)
T. Uehara (NTT)
M. Yamano (Sanyo Elec.)
T. Yamashita (Fujitsu)
Y. Yamazaki (ENRI)

STEERING COMMITTEE

Chairman:
H. Ogura (Kyoto Univ.)
Vice-Chairman:
M. Higashiguchi (Univ. of Tokyo)
Members:
I. Arai (Univ. of Electro-Comm.)
S. Fujimura (Univ. of Tokyo)
M. Fujita (Comm. Research Lab.)
S. Fukao (Kyoto Univ.)
Y. Furuhama (ATR)
M. Hara (Koden Elect.)
S. Hashimoto (ETL)
Y. Hirokawa (Tokyo Keiki)
H. Hirosawa (ISAS)
T. Inouye (Univ. of Tsukuba)
K. Kasamaki (JRC)
T. Katano (ENRI)
H. Kobatake (Tokyo Univ. of Agricul. & Tech.)
M. Kojima (EIAJ)
T. Koshio (NEC)
Y. Masuda (EIAJ)
J. Matsushiro (Oki Elect.)
K. Mayumi (Matsushita Elect.)
T. Michino (RESTEC)
M. Mizumachi (Univ. of Tokyo)
K. Muneyama (JAMSTEC)
S. Nagao (Furuno Elect.)
K. Natio (Tokai Univ.)
J. Nakayama (Kyoto Inst. of Tech.)
S. Ohnaka (Fujitsu)
T. Sano (Anritsu)
M. Sekine (Tokyo Inst. of Tech.)
H. Shimizu (Nat. Inst. for Environ Studies)
M. Shinji (Tokai Univ.)
M. Takagi (Univ. of Tokyo)
K. Takao (Kyoto Univ.)
T. Tamama (Mitsubishi)
H. Tanaka (Hamamatsu Med. College)
M. Tateiba (Kyushu Univ.)
T. Tokuo (Hitachi)
T. Tomitani (NIRS)
M. Yamada (KDD)
F. Yamagishi (TRDI, JDA)
K. Yamamoto (NHK)
K. Yasukawa (ATR)
H. Yamazaki (Toshiba)
Y. Yoshida (Kyoto Inst. of Tech.)

PROGRAM COMMITTEE

Chairman:
S. Fujimura (Univ. of Tokyo)
Vice-Chairmen:
M. Yamada (KDD)
K. Kasamaki (JRC)
Members:
I. Arai (Univ. of Electro-Comm.)
N. Fugono (Comm. Research Lab.)

TABLE OF CONTENTS

INVITED SESSIONS

SESSION E BIO-MEDICAL AND SONAR-1

SESSION F BIO-MEDICAL AND SONAR-2

SESSION J REMOTE SENSING-3

SESSION K ANTENNA-1 —ARRAY TECHNIQUES—