

Introduction

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A very good morning to all. It is my great pleasure to welcome you to the Sensors and Electronic Technology Panel Lecture Series 233 on “Knowledge-Based Radar Signal & Data Processing”. To all those who have traveled great distances and taken time from their busy schedules, I would like to extend a special welcome. I am particularly pleased to be here in this beautiful city. This is my first visit and I am very impressed with the friendliness and courtesy shown by everyone I’ve met.

NATO, the Research & Technology Organization (RTO), and the Sensors and Electronic Technology (SET) Panel are proud to sponsor this significant event.

The RTO is a NATO organization and its mission is:

- to conduct and promote co-operative research and information exchange to support the development and effective use of national defense research and technology to meet the military needs of the Alliance;
- to maintain a technological lead;
- and to provide advice to NATO decision makers.

The full range of Research and Technology activities is covered by 6 Panels and a Group, dealing with different subjects. Each of these is made up of national representatives including highly qualified scientific experts. The Panels maintain links with military users and other NATO bodies. The scientific and technological work of the RTO is carried out by Technical Teams created for specific activities and with a specific duration. The Technical Teams organize Workshops, Symposia, Field Trials, Lecture Series and Training Courses and ensure the continuity of the experts’ networks. The 6 Panels and one Group are:

- Studies, Analysis and Simulation; (SAS)
- Systems Concepts and Integration; (SCI)
- Sensors and Electronics Technology; (SET)
- Information Systems Technology; (IST)
- Applied Vehicle Technology; (AVT)
- Human Factors and Medicine; (HFM)
- NATO Modeling and Simulation Group. (NMSG)

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Introduction

The Mission of the Sensors & Electronics Technology (SET) Panel is: to advance technology in electronics and passive/active sensors as they pertain to reconnaissance, surveillance and target acquisition, electronic warfare, communications and navigation; and to enhance sensor capabilities through multi-sensor integration/fusion. This concerns the phenomenology related to target signature, propagation and battlespace environment, EO, RF, acoustic and magnetic sensors, antenna, signal and image processing, components, sensor hardening and electromagnetic compatibility.

The objective of this Lecture Series is to present a state-of-the-art assessment of knowledge-based (expert systems, artificial neural networks) radar signal and data processing techniques, and thereby increase awareness of their value to the NATO scientific community. We will review the current developments in the area and present examples of improved radar performance for augmented and upgraded systems, and project the impact of KB technology on future systems.

The LS team will present all relevant aspects of knowledge-based techniques as they apply to modern radar signal and data processing. The lectures will cover:

- Introduction to Radar Signal & Data Processing;
- Fundamentals of relevant knowledge-based techniques;
- Detailed characterization of the general radar problem in terms amenable to KB solution applications;
- Expert system application to constant false alarm rate processor;
- Knowledge-based control for space time adaptive processing;
- KB techniques applied to performance improvement of existing radar systems;
- Impact of KB techniques for emerging technologies (multi-phased arrays, electronically agile beam forming, waveform diversity); and
- Integrated end-to-end radar signal & data processing with overarching KB control.

I am excited that this lecture Series provides a great opportunity for researchers in this field to exchange ideas and share their discoveries.

We hope to foster synergy between research and industry in order to fine-tune research to the needs of the NATO alliance. This will result in flourishing research and will also generate tangible results for the alliance.

On behalf of the Lecture Series team, I would like to commend Lt. Col. Giuseppe Fiamingo and his predecessor, Lt. Col Arturo Salzano and their colleagues, particularly Jane Brooks and Stephanie Branch, for their energetic efforts in making this Lecture Series possible. A big thank you as well to all local coordinators for their outstanding efforts to make this event a special one. The logistics support and accommodations have been exceptional. I would also like to express my appreciation to all the support personnel participating in the arrangements and operation of the Lecture Series, and to all speakers for coming here to share their ideas with the international community.

We are fortunate to have as speakers for the next two days, men with outstanding reputations and world-class contributors to our area of interest. I believe that the interactions over the next two days will lead to a better understanding and new perspectives, which are critical to the generation of new knowledge and ideas in this field.

I wish one and all a stimulating and rewarding two days. Thank you.

Let me now introduce our distinguished panel of speakers. We are indeed fortunate to have with us today, four of the leading authorities in the area of knowledge-based radar signal processing. In addition to their many contributions to the body of knowledge, they are, as you will see, accomplished lecturers. We hope that this superb combination will allow each of you to achieve the maximum benefit over the next two days.

GERARD T. CAPRARO

Gerard T. Capraro, Ph.D. founded Capraro Technologies, Inc. (CTI) in July 1993. He is presently its President and Senior Scientist. Prior to CTI, Dr. Capraro was a Principal Scientist and co-founder of the Utica, New York office of Kaman Sciences. He has more than thirty five years of experience in Electromagnetic Compatibility (EMC), Operations Research, Database Management, Computer Architectures, and Artificial Intelligence. His employment includes nine years as Project Engineer, Division Chief Engineer, Division Manager, and Principal Scientist at Kaman Sciences, eighteen years as a project engineer and task manager for the USAF at the Rome Air Development Center and nine years of university teaching (Adjunct Associate Professor, Adjunct Assistant Professor, Visiting Assistant Professor, and Adjunct Lecturer at Syracuse University-teaching Probability Theory, Statistics, Information Systems, and Database Systems). Dr. Capraro has made contributions in the areas of artificial intelligence (AI), Signal Processing, electromagnetic pulse (EMP), high power microwaves (HPM), Database Management and EMC. He has authored and co-authored over 40 technical publications and is a Fellow of the IEEE.

ALFONSO FARINA

Alfonso Farina received his doctor degree in electronic engineering from the University of Rome "La Sapienza" (I) in 1973.

In 1974 he joined Selenia (now part of Alenia Marcony Systems, a leading European industry implementing complex integrated systems) where he is now a manager in the Radar & Technology Division. Since 1979 until 1985, he has also been Professor of Radar Techniques at the University of Naples; subsequently, He has also given short courses at other Italian as well as foreign Universities.

Working interests span many fields of radar techniques; in particular the following: adaptive array antenna, detection, signal processing, data processing (including multi-target multi-radar and multi-sensor tracking), ECCM and imaging. Radar systems in which he has gained experience are: ground based three-dimensional multi beam, ship borne phased-array, airborne early warning and synthetic aperture.

He has been involved in a number of NATO international working teams and projects, namely: (i) RSG-3 of Panel X on advanced radar techniques including multi-static radar systems; (ii) DART (Demonstration of Advanced Radar Techniques) involving the conception, design, implementation and testing of an LPI radar; (iii) ACCSCO for the analysis and design of the multi-sensor integration study for NADGE upgrade. He has had the technical responsibility of R&D projects in the European Community frame; these projects were devoted to the design of remote sensing SAR based system. He has also had the technical responsibility for several research programs internally funded by the Company. Recently, He is one of the managers that organizes and supervises the R&D programmes at the Company level.

He is the author of more than 200 peer reviewed publications and the author of the following books and monographs: Radar Data Processing (Vol. 1 and 2) (this book is the first written on tracking; it has been translated in Russian and Chinese), 1985-1986; Optimized Radar Processors, 1987; Antenna Based Signal Processing Techniques for Radar Systems, 1992. He is also the only non US author of a chapter of the Radar Handbook (edited by Dr. M. I. Skolnik), Mc Graw Hill, 1990.

He has been session chairman at many international radar conferences; He is invited to give tutorials (on multi-sensor fusion, adaptive signal processing, space-time adaptive processing, and advanced radar detection) and opening lectures at these Conferences. He uses to lecture at universities and research centers in Italy and abroad (UK, France, The Netherlands, Spain, and Portugal). He received the 1987 Radar Systems Panel Award of IEEE-Aerospace and Electronic Systems Society (AESS) for development of radar data processing techniques. Also he is the Italian representative at the International Radar Systems Panel of IEEE-AESS. He is a Fellow of the IEE (UK). Recently He has been nominated Fellow of the IEEE for development and application of adaptive signal processing methods for radar systems. He is in the Board of Directors of the International Society for Information Fusion (ISIF). He serves as reviewer and co-operates with many technical Journals of IEEE, IEE etc.

HUGH GRIFFITHS

Professor Hugh Griffiths is Head of the Department of Electronic and Electrical Engineering at University College London. He graduated from the University of Oxford in 1978, and then worked in industry for three years before joining University College London. He leads a research group working on radar systems and signal processing, with numerous national and international collaborations. He was a recipient of the IEE Mountbatten and Maxwell Premiums, and the IEEE Fred Nathanson Award.

He served for many years on the PG E15 committee, and from 1994 – 1999 as Chairman. He has also been a member of the Radar Systems Panel of the IEEE AESS since 1989, acting as link between IEE and the IEEE on radar matters, and is currently a member of the AESS Board of Governors. He was Chairman of the RADAR 2002 conference held in Edinburgh in October 2002.

MICHAEL C. WICKS

Dr. Michael C. Wicks is currently a Senior Scientist for Sensor Signal Processing in the Sensors Directorate of the Air Force Research Laboratory. He is a Fellow of the IEEE, an AFRL Fellow, a past recipient of the IEEE/AESS Young Engineer of the Year, and the State University of New York Mohawk Valley Community College Alumni of the Year. He has engineering degrees from Mohawk Valley Community College, Rensselaer Polytechnic Institute, and Syracuse University in addition to a Masters of Arts in Public Administration from the Maxwell School. His research interest includes mathematical algorithms, radar systems engineering, remote sensing of the environment, waveform diversity and knowledge base applications to signal and data processing.