Over The Horizon Radar (*see special offer below)

Fundamental Principles, Signal Processing, and Practical Applications

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Tutorial Summary

Skywave over-the-horizon (OTH) radars operating in the HF band (3-30 MHz) exploit signal reflection from the ionosphere to detect and track airborne and surface targets at ranges an order of magnitude greater than conventional line-of-sight radars. A chief advantage of OTH radar systems is their ability to persistently monitor remote geographical regions where microwave radar coverage is either not feasible or convenient. For over four decades, OTH radars have been used to provide cost-effective early-warning surveillance over wide areas at ground distances of up to 3000 km.

The tutorial provides an introduction to the key principles that underpin OTH radar design and operation for both skywave and surface-wave systems. The unique challenges of operating in the HF environment are described and connected to motivate and explain the architecture of modern operational OTH radars. The essential characteristics and capabilities of various OTH radar subsystems, including the antenna arrays, transmit and receive subsystems, as well as sensors used for frequency management, are described. The properties of the ionosphere and HF signal environment will also be covered in detail.

The tutorial then describes conventional and adaptive signal processing methods used in OTH radar and their application to real-world systems. A highlight of the tutorial is the prolific inclusion of practical examples that show experimental results obtained from processing field-data acquired by actual HF radar systems. The tutorial also provides insights for the way ahead and a comprehensive list of references. For these reasons, it is expected to benefit scientists, engineers and students, either starting out in this field, or those wishing to gain further understanding of the most important OTH radar concepts.

Topics Covered

1. Fundamental Principles
   - OTH radar concept of operation
   - System design and practical applications
   - Nominal capabilities and limitations
2. HF Propagation
   - Characteristics of the ionosphere
   - Skywave and surface-wave modes
   - Mechanisms causing signal distortion
3. Signal Environment
   - Clutter from land and sea surfaces
   - Target echoes and multipath propagation
   - HF noise sources and man-made interference
4. Frequency Selection
   - Aircraft and ship detection missions
   - SNR and SCR performance metrics
   - Waveform design for OTH radar
5. Radar Subsystems
   - Wide aperture HF antenna arrays
   - Transmit and receive subsystems
   - Frequency Management System
6. Signal Processing
   - Azimuth-range-Doppler processing
   - CFAR and tracking techniques
   - Adaptive Beamforming and STAP
About the Speaker

Giuseppe A. Fabrizio received his B.E. and Ph.D. degrees from the Department of Electrical and Electronic Engineering at the Adelaide University, Australia, in 1992 and 2000. Since 1993, Dr Fabrizio has been with the Defence Science and Technology Organization (DSTO), Australia, where he leads the EW and adaptive signal processing section of the high frequency radar branch. Dr Fabrizio is responsible for the development and practical implementation of innovative and robust adaptive signal processing techniques used to enhance the operational performance of modern OTH radar systems. Dr Fabrizio is the principle author of over 50 peer-reviewed journal and conference publications, and is a co-recipient of the prestigious M. Barry Carlton Award for the best paper published in the IEEE Transactions on Aerospace and Electronic Systems (AES) on two occasions - 2003 and 2004. In 2007, he received the DSTO Science Excellence award recognizing his contributions to adaptive signal processing for the JORN OTH radar system. In the same year, he was granted the coveted DSTO Defence Science Fellowship to pursue collaborative research at La Sapienza University in Rome, Italy. Dr Fabrizio has delivered OTH radar tutorials at the 2008 IEEE Radar Conference, held in Rome, and at the 2010 IEEE International Radar Conference in Washington DC. He is an Australian representative on the IEEE International Radar Systems Panel, and is currently serving as the VP for Education on the AESS Board of Governors. Dr. Fabrizio was selected as the recipient of the distinguished IEEE Fred Nathanson Memorial Radar Award in 2011 for his contributions to OTH radar and radar signal processing. He is the author of a text book entitled “High Frequency Over-the-Horizon Radar – Fundamental Principles, Signal Processing, Practical Applications”, to be published by McGraw-Hill Education (July 2013).

*All participants registered for the OTHR tutorial will receive a FREE copy of the book: