Radiometry And The Detection Of Optical Radiation

A novel method of human presence detection using passive millimeter-wave sensors is presented. The method focuses on detecting a standing human from a moving platform in a cluttered outdoor environment using millimeter-wave radiometry, which has not been attempted before. Ka-band radiometers are used in total power mode as well as correlation mode, which ideally responds well to self-luminous objects such as humans. The intrinsic radiative power from a human is derived as well as the responses of the total power and correlation mode. The application of correlation radiometer theory to the detection of self-luminous objects at close range is presented in the context of human presence detection. Modifications and additions to techniques developed in radio astronomy and remote sensing for close range terrestrial situations are developed and discussed. The correlation radiometer fringe frequency is analyzed in the context of the scanning beam detection system and is estimated using MUSIC and ESPRIT. Detection and classification of humans is accomplished using a Naïve Bayesian classifier. The performance of the classifier is measured using the F1-measure and the receiver operating characteristic.

Comprehensive, accessible, and physically based description of the approaches currently used to detect light, from X-ray to mm-wave.

This book contains a selection of refereed papers presented at the 6 Specialist Meeting on Microwave Radiometry and Remote Sensing of the Environment held in Florence, Italy on March 15-18, 1999. Over the last two decades, passive microwave remote sensing has made considerable progress, and has achieved significant results in the study of the Earth's surface and atmosphere. Many years of observations with ground-based and satellite-borne sensors have made an important contribution to improving our knowledge of many geophysical processes of the Earth's environment and of global changes. The evolution in microwave radiometers aboard satellites has increased steadily over recent years. At the same time, many investigations have been carried out both to improve the algorithms for the retrieval of geophysical parameters and to develop new technologies. The book is divided into four main sections: three of these are devoted to the observation of the Earth's surface and atmosphere, and the fourth, to future missions and new technologies. The first section deals with the study of sea and land surfaces, and reports recent advances in remote sensing of ocean wind, sea ice, soil moisture and vegetation biomass, including electromagnetic modelling and the assimilation of radiometric data in models of land surface

processes. The following two sections are devoted to the measurement of atmospheric quantities which are of fundamental importance in climatology and meteorology, and, since they influence radio-wave propagation, they also impact on several other fields, including geodesy, navigational satellite and radioastronomy. The last section presents an overview of new technologies and plans for future missions.

Passive Infrared Detection

Radiometry for Low Target Detection

Fundamentals and Applications

Feasibility Study of Radiometry for Airborne Detection of Aviation Hazards

Radiometry Detection of Acoustic Signals

Familiarization with the infrared world Thermal imaging systems extend human perception beyond the visible spectrum. Since their principle is based on the natural emission of energy by physical bodies, they represent today the subject of a great deal of interest in many fields, whether in the military field or in industry or in research laboratories. They can be employed to analyse physical properties of objects, such as their energy level or their surface appearance; they are also commonly used to observe scenes in particular conditions like night vision, or in order to increase the visibility range through haze and fogs. All of these applications exploit the properties of infrared radiation whose characteristics are described in this book. This is achieved in a manner which differs from other publications on the same subject in that the book is governed by the intention to progressively lead the reader to a complete understanding of the

infrared. The author intends to link physical theory to each specific aspect of the elements involved in the detection process, from their physical origin up to energy mapping in a two-dimensional picture. However we thought that it was unnecessary to demonstrate again that which the reader will easily find in scientific literature, nor to write another data book. Our aim is to fill the gap between theory and practical application. The subject is vast: infrared systems combines a wide variety of disciplines and image interpretation depends on the precise understanding of various phenomena.

Two years of research have been conducted to determine the feasibility of using microwave radiometry for the detection, identification, and surveillance of oil pollution. Theoretical studies consisted of a review of contemporary theory concerning parameters that influence microwave emission from both unpolluted and oil-covered seas. Laboratory investigations confirm results obtained from earlier studies and established the response characteristics of the 3.2-mm sensor to continuous oil films. Airborne measurements of controlled spills off the Southern California Coast were performed with dual-polarized 3.2- and 8.1-mm sensors oriented with a forward antenna viewing angle 45 deg above nadir. Four sets of oil spills, or missions, were performed to obtain data over a variety of sea-surface conditions. Pollutants used for the tests included No. 2 diesel fuel, 26.1 and 21.6 API gravity crude oils, and 9.7 API gravity fuel oil. Significant microwave brightness temperature oil slick signatures were noted for a wide range of ocean conditions (sea states 1-4) and oil film thickness (thickness

Classical detection theory is used to provide a framework for the study of the potential of passive detection of metallic targets by millimeter wave radiometry. The target is assumed to be embedded in a foliage environment. The problem is characterized as a two-class detection problem. Class C sub 1 denotes the class of measurements obtained when the field of view V of the radiometer contains some target elements, and C sub 2 represents the class of measurements obtained when V contains no target

elements. Each of the measurement sets is characterized by probability density functions. These functions are used to obtain operating characteristic curves relating alpha and beta errors and to determine discriminant functions for the detection problem. The alpha error is the probability of assigning an observation to class C sub 1 when it belongs to C sub 2, and the beta error is the probability of assigning an observation to class C sub 2 when it belongs to C sub 1. Operating characteristic curves are useful in determining the amount of target obscuration for various alpha and beta errors. (Author).

Remote Detection of Terrain Features from Nimbus I High Resolution Infrared Radiometer Nighttime Measurements

EM Detection of Concealed Targets

Optical Systems Design Detection Essen

Detection and Characterization of Nuclear Clouds

All optical systems have the same basic form consisting of an input source of light carrying information, components and devices that modify the light propagating through the system, and a method of detecting the light that produces an output from the system. The purpose of this textbook is to provide the necessary science overview of optical design detection essentials but in a context of use applied to the design process. Application case studies are included in

most chapters to illustrate one or more practical concepts of a system, device, or measurement. Each chapter contains examples and end-of-chapter problems. Key Features Provides a thorough understanding of all aspects of optical systems. Discusses material from a practical standpoint, helping both students and practicing optical engineers. Provides worked examples to explain various concepts in the text. Presents application focused case studies. Includes end-of-chapter problems to assist the student.

Radiometric sensors for aviation hazards have the potential for widespread and inexpensive deployment on aircraft. This report contains discussions of three aviation hazards - icing, turbulence, and volcanic ash - as well as candidate radiometric detection techniques for each hazard. Dual-polarization microwave radiometry is the only viable radiometric technique for detection of icing conditions, but more research will be required to assess its usefulness to the aviation community. Passive infrared techniques are being developed for detection of turbulence and volcanic ash

by researchers in this country and also in Australia. Further investigation of the infrared airborne radiometric hazard detection approaches will also be required in order to develop reliable detection/discrimination techniques. This report includes a description of a commercial hyperspectral imager for investigating the infrared detection techniques for turbulence and volcanic ash.Gimmestad, Gary G. and Papanicolopoulos, Chris D. and Richards, Mark A. and Sherman, Donald L. and West, Leanne L. and Johnson, James W. (Technical Monitor)Langley Research CenterFLIGHT SAFETY; MICROWAVE RADIOMETERS; REMOTE SENSING; AIRBORNE EQUIPMENT; AIRCRAFT SAFETY; FLIGHT HAZARDS; INFRARED DETECTORS; AVIATION METEOROLOGY; ICE FORMATION; TURBULENCE; VOLCANOES; AERIAL RECONNAISSANCE; INFRARED RADIATION

Presents a treatment of fundamental aspects of the generation, transfer and detection of optical and infra-red radiation. Emphasis placed on practical aspects of radiometry in detection. Discusses formal principles of

radiometry, signal-to-noise considerations in the detection of optical radiation, and the operation of various radiation detectors. Includes tables and graphs of blackbody functions.

Radiometric Detection of Oil Slicks

Microwave Radiometry and Remote Sensing of the Earth's Surface and Atmosphere

Radiometry and the Detection of Optical Radiation

MILLIMETER WAVE RADIOMETRIC DETECTION OF TARGETS OBSCURED BY FOLIAGE.

Use of Airborne Microwave Radiometry for the Detection and Investigation of Oil Slicks at Sea

Infrared Detectors and Systems offers a deep and detailed examination of the optical detection process and the electronics of mimicking the eye. It further explores recent research in new detector materials and the latest advances in optical detectors. This text covers the range of subjects necessary for the understanding of modern infrared-imaging systems at a level appropriate for seniors or first-year graduate students in

physics or electrical engineering. The first six chapters focus on fundamental background issues of radiation detection, beginning with the basics of geometrical optics and finishing with a discussion of the figures of merit used for describing the signal-to-noise performance of a detector system. Other topics include radiometry and flux-transfer issues, basic radiation-detector mechanisms, and random-process mathematics. The book concludes with a close look at infrared detection systems and related issues. In the discussion of infrared search systems, the range equation is developed in terms of the optical and detector parameters of the system. A separate chapter is devoted to modulation transfer function, a spatial-frequency-domain description of image quality. The final chapter describes the design equations for thermal-imager systems in terms of noise-equivalent temperature difference and minimum resolvable temperature. Supported and clarified by 470 illustrations and accompanied by an extensive glossary of the nomenclature, this is an excellent text for graduate and senior level courses in radiometry and infrared detectors. It is also a valuable reference for practicing engineers involved in the use, design,

analysis, and testing of infrared detector-based systems.
The problem of passive detection by millimeter wave radiometry of metallic targets obscured by foliage and other vegetation is defined and discussed. A model of the foliage obscuration situation is presented and evaluated on the basis of data collected in a field measurement program. Results obtained show the millimeter wave radiometric obscuration to be greater than the optical obscuration. Curve fitting techniques indicate a quadratic relationship between radiometric and optical obscuration; hence, the maximum range of a radiometric system will be reduced linearly with optical obscuration instead of theoretically with a square root relationship. Further refinements of the model are discussed and are to be included in a general foliage penetration model to be evaluated at a later date.
Optical Radiation Measurements, Volume 1: Radiometry is an introduction to the measurement of optical radiant energy, with emphasis on the principles and generally applicable methods of radiometry. Topics range from basic concepts of radiant energy and its transfer to the calibration of instrumentation.

Blackbody radiation and sources of radiation are also discussed, along with detectors and spectral analyzers. Comprised of 10 chapters, this volume begins with an overview of the basic concepts and characteristics of radiometry as well as its applications such as photometry, photography, television, and vision research. The next chapters describe basic concepts such as radiation laws, terminology, and the transfer of radiant energy. The emphasis in these early chapters is on fundamentals. The major components of radiometric systems are then considered. The final three chapters focus on representative techniques, with particular reference to measurements of radiant power and radiant energy; reflectance, transmittance, and absorptance; and standards and calibration. This book is written for students, practitioners, and researchers in physics.

Passive Standoff Detection of Chemical Vapors by Differential FTIR Radiometry

Optical Systems Design Detection Essentials

A Clinical Guide

Detection of Light

Applied Photometry, Radiometry, and Measurements of Optical

Losses

Applied Photometry, Radiometry, and Measurements of Optical Losses reviews and analyzes physical concepts of radiation transfer, providing quantitative foundation for the means of measurements of optical losses, which affect propagation and distribution of light waves in various media and in diverse optical systems and components. The comprehensive analysis of advanced methodologies for low-loss detection is outlined in comparison with the classic photometric and radiometric observations, having a broad range of techniques examined and summarized: from interferometric and calorimetric, resonator and polarization, phase-shift and ring-down decay, wavelength and frequency modulation to pulse separation and resonant, acousto-optic and emissive - subsequently compared to direct and balancing methods for studying free-space and polarization optics, fibers and waveguides. The material is focused on applying optical methods and procedures for evaluation of transparent, reflecting, scattering, absorbing, and aggregated objects, and for determination of power and energy parameters of radiation and color properties of light.

A study has been performed to assess the feasibility of using microwave radiometry for detection of oil pollution. The investigation stems from the U.S. Coast Guard's requirement for an airborne surveillance system which can detect oil pollution during inclement weather and during the hours of darkness. Laboratory and airborne

measurements were made of a variety of oil base pollutants. Laboratory investigations included microwave response as a function of oil film thickness, physical temperature of the oil-water system, pollutant type sensor wavelength, antenna polarization, and observation angle. These studies consisted of dual-polarization radiometric measurements (observational wavelengths of 0.8cm and 2.2cm) of Bunker C fuel oil, gasoline, and 20, 30, and 40 API gravity crude oil. The dielectric properties of these pollutants were also measured by means of a 0.81 cm ellipsometer. The results of the laboratory measurements were used to select the most suitable microwave radiometer for the airborne measurements. The airborne measurements were of small oil slicks on the open ocean off the Southern California Coast. Measurements were made from an aircraft instrumented with a dual-polarized 0.81 cm radiometer oriented with a forward antenna viewing angle of 45 deg from nadir. Pollutants examined during the tests include marine diesel fuel; 20, 30, and 40 API gravity crude oils; and a mixture of diesel fuel and 20-gravity oil. Measurements were made under various atmospheric and low sea state conditions, including several at night. (Author).

This book explains how to optimize clinical conditions for detection of the earliest visible signs of dental caries and how best to assess caries activity as a basis for effective management. The available evidence from the literature on detection criteria and methods is distilled and placed in a clinical context to facilitate implementation in clinical

practice. Guidance is offered on removal of the dental biofilm and the potential impact of various factors on the performance of different caries detection devices. The histological changes that occur during the caries process and their effect on the clinical appearance of caries lesions are explained. In addition, several caries classification systems based on visual detection criteria and designed to allow staging are presented. Consideration is also given to currently marketed detection aids, including methods involving light fluorescence, transillumination, and radiography. In each case, a summary of the detection performance, based on available supporting evidence, is tabulated together with advice on appropriate clinical application. The reader will find the text to be clearly written and informative, with many supporting clinical images.

Clinical Application of Microwave Radiometry Techniques in the Detection of Cancer

Microwave Radiometric Studies in Relation to Mine Detection

The Art of Radiometry

Safeguards Applications of Far Infrared Radiometric Techniques for the Detection of Contraband

Theory and Applications

Radiometry is a fascinating, fast growing research area, and there are many interesting real life applications. This book is intended to provide readers the theoretical background of radiometry, a resource of the latest radiometry technology, as well as the latest research in

radiometry. It is aimed at university/college students, researchers and engineers. It assumes readers have basic knowledge and skills concerning electronics, physics and mathematics at the university level. This book is divided into three parts. Part I is the Introduction to Radiometry, which includes the theoretical background of radiometry, radiometry sources, radiometry detectors, and radiometry optical systems. This part also includes the latest technologies available, such as different Quantum Cascade Lasers, wavelength tuneable detectors, thermal electric cooled and Stirling cooled detectors, multispectral and hyperspectral thermal cameras, high resolution and high speed thermal cameras, and various radiometry optical detection systems. Part II is called the Advances in Radiometry Research, which contains the development of the latest research in areas of biomedical applications, industrial applications, non-destructive testing, astronomy and environmental applications. This is the core part of the book, and provides a review of the latest research trends in radiometry in different application areas. It also includes a chapter on prototyping low cost radiometry devices, which provides a list of low cost lasers and detectors, low cost and compact thermal cameras, low cost optics, low cost PCB making, and finally low cost 3D printers and CNC machines. Part III is the Appendices, which includes symbols used in the book, some MATLAB example codes including least squares fitting and the latest deep learning GoogLeNet, the introduction to WolframAlpha, a list of optical, infrared and laser components suppliers, and radiometry books. This book can be used as a textbook as well as

a background reading textbook, or as a resource book.

The latest EM techniques for detecting concealed targets, whether explosives, weapons, or people Extensively illustrated from basic principles to system design, the fundamental concepts of RF, microwave, millimeter wave, and terahertz detection systems and techniques to find concealed targets are explained in this publication. These concealed targets may be explosive devices or weapons, which can be buried in the ground, concealed in building structures, hidden under clothing, or inside luggage. Concealed targets may also be people who are stowaways or victims of an avalanche or earthquake. Although much information is available in conference proceedings and professional society publications, this book brings all the relevant information in a single, expertly written and organized volume. Readers gain an understanding of the physics underlying electromagnetic (EM) detection methods, as well as the factors that affect the performance of EM detection equipment, helping them choose the right type of equipment and techniques to meet the demands of particular tasks. Among the topics covered are: Ultra-wideband radar and ground-penetrating radar Millimeter, sub-millimeter, and terahertz systems Radar systems including Doppler, harmonic, impulse, FMCW, and holographic Radiometric systems Nuclear quadrupole resonance systems Author David Daniels has many years of experience designing and deploying EM systems to detect concealed targets. As a result, this publication is essential for scientists and engineers who are developing or using EM equipment and techniques for a diverse range of purposes,

including homeland security, crime prevention, or the detection of persons.
This second edition of an Artech House classic title describes in detail the relationship between radiometry and photometry. It covers information needed to solve problems in radiation transfer and detection, detectors, measuring instruments, and concepts in colorimetry. This revised second edition presents an updated treatment of modern radiometry and photometry, including brand new sections on applications and developments in light sources and scientific instruments for measuring radiation and light. Engineers are also provided with an exciting new chapter on the use of computerized optical ray tracing for "virtual" experiments on optical systems.
Detection and Assessment of Dental Caries
Contrast radiometry
Advances in Radiometry Research
Radiometry, Photometry, Colorimetry, Noise, and Measurements
Introduction to Radiometry and Photometry, Second Edition
Radiometric sensors for aviation hazards have the potential for widespread and inexpensive deployment on aircraft. This report contains discussions of three aviation hazards - icing, turbulence, and volcanic ash - as well as candidate radiometric detection techniques for each hazard. Dual-polarization microwave radiometry is

the only viable radiometric technique for detection of icing conditions, but more research will be required to assess its usefulness to the aviation community. Passive infrared techniques are being developed for detection of turbulence and volcanic ash by researchers in this country and also in Australia. Further investigation of the infrared airborne radiometric hazard detection approaches will also be required in order to develop reliable detection/discrimination techniques.

Radiometry and the Detection of Optical RadiationWiley-Interscience

*Optical Sources, Detectors, and Systems presents a unified approach, from the applied engineering point of view, to radiometry, optical devices, sources, and receivers. One of the most important and unique features of the book is that it combines modern optics, electric circuits, and system analysis into a unified, comprehensive treatment. The text provides physical concepts together with numerous data for sources and systems and offers basic analytical tools for a host of practical applications. Convenient reference sources, such as a glossary with explanatory text for specialized optical terminology, are included. Also, there are many illustrative examples and problems with solutions. The book covers many important, diverse areas such as medical thermography, fiber optical communications, and CCD cameras. It also explains topics such asD *, NEP, f number, RA product, BER,*

shot noise, and more. This volume can be considered an essential reference for research and practical scientists working with optical and infrared systems, as well as a text for graduate-level courses on optoelectronics, optical sources and systems, and optical detection. Aproblem solution manual for instructors who wish to adopt this text is available. Provides a unified treatment of optical sources, detectors, and applications Explains D *, NEP, f number, RA product, BER, shot noise, and more Contains numerous illustrative examples and exercises with solutions Extensively illustrated with more than 90 drawings and graphs

An Application of Pattern Recognition to Radiometric Target Detection

Infrared Detectors and Systems

Detection of Greenbug Infestation Using Ground-based Radiometry

Laser Photothermal Radiometry for the Detection of Early Enamel Demineralization

Detection of Optical Signals

This report presents a novel method for the passive standoff detection of chemical vapors by differential Fourier Transforn Infrared (FTIR) radiometry. The originality of the method lies on the use of a double-input beam FTIR interferometer optimized for optical subtraction. For implementing this method, a radiative transfer model is formulated for the general case of slant path scenarios containing any type of background scenes. A procedure of radiometric

calibration adapted for differential detection with a double-input beam FTIR interferometer is developed. A detection algorithm (GASEM) that controls the interferometer data acquisition and performs the on-line monitoring of chemical vapor parameters is described and validated. The differential detection method has been successfully tested in the field on several chemical vapors.

Optical Radiation Detectors, Eustace L. Dereniak and Devon G.Crowe Offers a comprehensive, integrated treatment of optical radiationdetectors, discussing their capabilities and limitations.Background material on radiometry, noise sources, and detectorphysics is introduced, followed by more detailed discussions ofphoton detectors, thermal detectors, and charge transfer arrays ofdetectors.

The material from this book was derived from a popular first-year graduate class taught by James M. Palmer for over twenty years at the University of Arizona College of Optical Sciences. This text covers topics in radiation propagation, radiometric sources, optical materials, detectors of optical radiation, radiometric measurements, and calibration.

Radiometry forms the practical basis of many current applications in aerospace engineering, infrared systems engineering, remote sensing systems, displays, visible and ultraviolet sensors, infrared detectors of optical radiation, and many other areas. While several texts individually cover topics in specific areas, this text brings the underlying principles together in a manner suitable for both classroom teaching and a reference volume that the practicing engineer can use. The level of discussion of the material is suitable for a class taught to advanced

undergraduate students or graduate students. Although this book is not a theoretical treatment, the mathematics required to understand all equations include differential and integral calculus. This text should be foremost in the toolkit of the practicing engineer or scientist working on radiometric problems in areas of optical engineering, electro-optical engineering, systems engineering, imagery analysis, and many others, allowing the technical professional to successfully apply radiometric principles in his or her work.

Human Presence Detection Using Millimeter-wave Radiometry

Optical Radiation Detectors

Optical Sources, Detectors, and Systems

Millimeter Wave Radiometric Detection of Ice on Aircraft

Radiometry

Field investigations over clay-type soils of the Fort Belvoir area indicated that microwave radiometry is highly unsuitable for mine detection for the following reasons: (1) Numerous strong and highly variable radiation signals from soils almost completely mask mine detection signals even under the most favorable summer conditions. (During moist soil and thermally neutral conditions which prevail during much of the spring, fall, and winter, detection performance can be expected to deteriorate even more.) (2) Microwave radiation originates in upper 2 in. to 4 in. of soil of moderate moisture content (13 to 20 percent) because of soil attenuation. When soil moisture approaches saturation conditions (30 to 40 percent), emitted radiation is confined to surface. (3) Strong similarity exists between thermal responses of microwave radiometer and typical infrared detector to mine signals.

Infrared detector offers greater potential promise because of image-forming capability obtainable with high inherent resolution of infrared compared to microwave frequencies. (Author).

All optical systems have the same basic form consisting of an input source of light carrying information, components and devices that modify the light propagating through the system, and a method of detecting the light that produces an output from the system. The purpose of this textbook is to provide the necessary science overview of optical design detection essentials but in a context of use applied to the design process. Application case studies are included in most chapters to illustrate one or more practical concepts of a system, device, or measurement. Each chapter contains examples and end-of-chapter problems. Part of IOP Series in Emerging Technologies in Optics and Photonics.

Detection of Optical Signals provides a comprehensive overview of important technologies for photon detection, from the X-ray through ultraviolet, visible, infrared to far-infrared spectral regions. It uniquely combines perspectives from many disciplines, particularly within physics and electronics, which are necessary to have a complete understanding of optical receivers. This interdisciplinary textbook aims to: • Guide readers into more detailed and technical treatments of readout optical signals • Give a broad overview of optical signal detection including terahertz region and two-dimensional material • Help readers further their studies by offering chapter-end problems and recommended reading. This is an invaluable resource for graduate students in physics and engineering, as well as a helpful refresher for those already working with aerospace sensors and systems, remote sensing, thermal imaging, military imaging, optical telecommunications, infrared

spectroscopy, and light detection.
Microwave Radiometric Detection of Oil Slicks
Radio Frequency Radiometry for the Remote Airborne Detection of Small Forest Fir