Elementary Signal Detection Theory

Signal Detection Theory and ROC-analysisSignal Detection Theory and PsychophysicsDetection TheorySignal Detection TheoryA Primer of Signal Detection TheoryA Primer of Signal Detection TheorySignal Detection Theory and ROC Analysis in Psychology and DiagnosticsSignal Detection TheorySignal DetectionSignal Detection TheoryA Primer of Signal Detection TheoryAdvanced Theory of Signal DetectionElementary Signal Detection TheorySignal Detection Theory and RecallSignal Detection and Recognition by Human ObserversAn Introduction to Signal Detection and EstimationExperimental Methods in PsychologyElements of Signal Detection and EstimationDetection TheorySignal Detection Theory and Psychophysis James P. Egan David M. Green Neil A. Macmillan Vi acheslav Petrovich Tuzlukov Don McNicol D. MacNicol John A. Swets John C. Hancock Michael L. Commons Vyacheslav P. Tuzlukov Iickho Song Thomas D. Wickens Anthony F. Jorm John A. Swets H. Vincent Poor Gustav Levine Carl W. Helstrom Ralph D. Hippenstiel David Marvin Green

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this new text reference is a comprehensive presentation of fundamental problems for the generalized approach to signal detection theory new approaches and methods are discussed as well as experimental results with physical systems an essential resource for professionals and researchers in electrical engineering and working with modern signal detection problems in radar communications wireless communications acoustics remote sensing and geophysical signal processing the problem of noise immunity is a key problem for complex signal processing systems research in science and engineering new approaches and problems of such complexity study allows the development of a better quality of signal detection in noise this book is devoted to a new generalized approach to signal detection theory the main purpose is to present the basic fundamental concepts of the generalized approach to signal processing in noise and to show how it may be applied in various areas of signal processing the generalized approach allows extension of the well known boundaries of the potential noise immunity set up by classical and modern signal detection theories new approaches for construction of detec

a primer of signal detection theory is being reprinted to fill the gap in literature on signal detection theory a theory that is still important in psychology hearing vision audiology and related subjects this book is intended to present the methods of signal detection theory to a person with a basic mathematical background it assumes knowledge only of elementary algebra and elementary statistics symbols and terminology are kept at a basic level so that the eventual and hoped for transfer to a more advanced text will be accomplished as easily as possible intended for undergraduate students at an introductory level the book is divided into two sections the first part introduces the basic ideas of detection theory and its fundamental measures its aim is to enable the reader to be able to understand and compute these measures it concludes with a detailed analysis of a typical experiment and a discussion of some of the problems which can arise for the potential user of detection theory the second section considers three more advanced topics threshold theory the extension of detection theory and an examination of thurstonian scaling procedures

signal detection theory as developed in electrical engineering and based on statistical decision theory was first applied to human sensory discrimination 40 years ago the theoretical intent was to provide a valid model of the discrimination process the methodological intent was to provide reliable measures of discrimination acuity in specific sensory tasks an analytic method of detection theory called the relative operating characteristic roc can isolate the effect of the placement of the decision criterion which may be variable and idiosyncratic so that a pure measure of intrinsic discrimination acuity is obtained for the past 20 years roc analysis has also been used to measure the discrimination acuity or inherent accuracy of a broad range of practical diagnostic systems it was widely adopted by methodologists in the field of information retrieval is increasingly used in weather forecasting and is the generally preferred method in clinical medicine primarily in radiology this book attends to both themes roc analysis in the psychology laboratory and in practical diagnostic settings and to their essential unity the focus of this book is on detection and recognition as fundamental tasks that underlie most complex behaviors as defined here they serve to distinguish between two alternative confusable stimulus categories which may be perceptual or cognitive categories in the psychology laboratory or different states of the world in practical diagnostic tasks this book on signal detection theory in psychology was written by one of the developers of the theory who co authored with d m green the classic work published in this area in 1966 reprinted in 1974 and 1988 this volume reviews the history of the theory in engineering statistics and psychology leading to the separate measurement of the two independent factors in all discrimination tasks discrimination acuity and decision criterion it extends the previous book to show how in several areas of psychology in vigilance and memory what had been thought to be discrimination effects were in reality effects of a changing criterion the book shows that data plotted in terms of the relative operating characteristic have essentially the same form across the wide range of discrimination tasks in psychology it develops the implications of this roc form for measures of discrimination acuity pointing up the valid ones and identifying several common but invalid ones the area under the binormal roc is seen to be supported by the data the popular measures d and percent correct are not an appendix describes the best current programs for fitting rocs and estimating their parameters indices and standard errors the application of roc analysis to diagnostic tasks is also described diagnostic accuracy in a wide range of tasks can be expressed in terms of the roc area index choosing the appropriate decision criterion for a given diagnostic setting rather than considering some single criterion to be natural

and fixed has a major impact on the efficacy of a diagnostic process or system illustrated here by separate chapters are diagnostic systems in radiology information retrieval aptitude testing survey research and environments in which imminent dangerous conditions must be detected data from weather forecasting blood testing and polygraph lie detection are also reported one of these chapters describes a general approach to enhancing the accuracy of diagnostic systems

written as a second course for graduate students

this volume is based on the 10th annual harvard symposium for the quantitative analysis of behavior the first harvard symposium was devoted to signal detection analyses of reinforcement and choice behavior the present volume reprises the original signal detection theme incorporating additional insights based on experimental and theoretical analyses undertaken during the years separating the two conferences this collection illustrates how signal detection theory first advanced to account for performance in threshold level sensory discrimination has broadened to encompass a variety of psychological problems involving discriminations between confusable stimuli the approach is quantitative in its emphasis on estimation of independent parameters of the discrimination process and analytical in its efforts to separate the determiners of discriminability and bias and to identify the mechanisms of their operation above all the book is broadly integrative in its approach to diverse problems this volume is based on the 10th annual harvard symposium for the quantitative analysis of behavior the first harvard symposium was devoted to signal detection analyses of reinforcement and choice behavior the present volume reprises the original signal detection theme incorporating additional insights based on experimental and theoretical analyses undertaken during the years separating the two conferences

increasing the noise immunity of complex signal processing systems is the main problem in various areas of signal processing at the present time there are many books and periodical articles devoted to signal detection but many important problems remain to be solved new approaches to complex problems allow us not only to summarize investigations but also to improve the quality of signal detection in noise this book is devoted to fundamental problems in the generalized approach to signal processing in noise

based on a seemingly abstract idea the introduction of an additional noise source that does not carry any information about the signal in order to improve the qualitative performance of complex signal processing systems theoretical and experimental studies carried out by the author lead to the conclusion that the proposed generalized approach to signal processing in noise allows us to formulate a decision making rule based on the determi nation of the jointly sufficient statistics of the mean and variance of the likelihood function or functional classical and modern signal detection theories allow us to define only the sufficient statistic of the mean of the likelihood function or functional the presence of additional information about the statistical characteristics of the like lihood function or functional leads to better quality signal detection in comparison with the optimal signal detection algorithms of classical and modern theories

we have some time ago noticed that finding a book dealing with topics in the ad vanced theory and applications of signal detection is not quite an easy matter this is contrasted with that there are numerous books on the more general subject of de tection and estimation frankly ourexperience and expertise is only on some partial portions of the theory and recent topics of signal detection this book is therefore meant to include not all the advanced and interesting topics in the theory and appli cations ofsignal detection butjust onlysome subsets of them some such important and interesting topics and issues as distributed signal detection and sequential de tection are not considered only due to our limited knowledge and capacity the goal we have in mind for this book is to present several advanced topics in signal detection theory and thereby help readers gain novel ideas and insights in this book we have tried to completely present in a unified way the theme oflocally optimum detection ofsignals in generalized observations among our hope is thus that the readers would be able to understand the concepts and fundamentals of a generalized observation model as applied to signal detection problems this book will also allow the readers whether they are students academics practitioners or researchers to have an expanded view on signal detection

signal detection theory as developed in electrical engineering and based on statistical decision theory was first applied to human sensory discrimination about 40 years ago the theory s intent was to explain how humans discriminate and how we might use

reliable measures to quantify this ability an interesting finding of this work is that decisions are involved even in the simplest of discrimination tasks say determining whether or not a sound has been heard a yes no decision detection theory has been applied to a host of varied problems for example measuring the accuracy of diagnostic systems survey research reliability of lie detection tests and extends far beyond the detection of signals this book is a primer on signal detection theory useful for both undergraduates and graduate students

the purpose of this book is to introduce the reader to the basic theory of signal detection and estimation it is assumed that the reader has a working knowledge of applied probabil ity and random processes such as that taught in a typical first semester graduate engineering course on these subjects this material is covered for example in the book by wong 1983 in this series more advanced concepts in these areas are introduced where needed primarily in chapters vi and vii where continuous time problems are treated this book is adapted from a one semester second tier graduate course taught at the university of illinois however this material can also be used for a shorter or first tier course by restricting coverage to chapters i through v which for the most part can be read with a background of only the basics of applied probability including random vectors and conditional expectations sufficient background for the latter option is given for exam pie in the book by thomas 1986 also in this series

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this volume provides an introduction to signal detection theory a subject fundamental to the design of detectors of weak signals in the presence of random noise and in particular to the design of optimal and near optimal receivers of communication radar sonar and optical signals

using simplified notation and a practical approach detection theory applications and digital signal processing introduces the principles of detection theory the necessary mathematics and basic signal processing methods along with some recently developed statistical techniques throughout the book the author keeps the needs of practicing engineers firmly in mind his presentation and

choice of topics allows students to quickly become familiar with the detection and signal processing fields and move on to more advanced study and practice the author also presents many applications and wide ranging examples that demonstrate how to apply the concepts to real world problems

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