# **Pramod K. Varshney**

# Distributed Detection and Data Fusion



# **Distributed Detection And Data Fusion**

**Jean-Louis Lacoume** 

#### **Distributed Detection And Data Fusion:**

Distributed Detection and Data Fusion Pramod K. Varshney, 2012-12-06 This book provides an introductory treatment of the fundamentals of decision making in a distributed framework Classical detection theory assumes that complete observations are available at a central processor for decision making More recently many applications have been identified in which observations are processed in a distributed manner and decisions are made at the distributed processors or processed data compressed observations are conveyed to a fusion center that makes the global decision Conventional detection theory has been extended so that it can deal with such distributed detection problems A unified treatment of recent advances in this new branch of statistical decision theory is presented Distributed detection under different formulations and for a variety of detection network topologies is discussed This material is not available in any other book and has appeared relatively recently in technical journals The level of presentation is such that the hook can be used as a graduate level textbook Numerous examples are presented throughout the book It is assumed that the reader has been exposed to detection theory The book will also serve as a useful reference for practicing engineers and researchers I have actively pursued research on distributed detection and data fusion over the last decade which ultimately interested me in writing this book Many individuals have played a key role in the completion of this book **New Results in Distributed Detection and Data Fusion for Target Tracking** Constantino Rago, 1995 **Distributed Data Fusion for Network-Centric Operations** David Hall, Chee-Yee Chong, James Llinas, Martin Liggins II, 2017-12-19 With the recent proliferation of service oriented architectures SOA cloud computing technologies and distributed interconnected systems distributed fusion is taking on a larger role in a variety of applications from environmental monitoring and crisis management to intelligent buildings and defense Drawing on the work of leading experts around the world Distributed Data Fusion for Network Centric Operations examines the state of the art of data fusion in a distributed sensing communications and computing environment Get Insight into Designing and Implementing Data Fusion in a Distributed Network Addressing the entirety of information fusion the contributors cover everything from signal and image processing through estimation to situation awareness In particular the work offers a timely look at the issues and solutions involving fusion within a distributed network enterprise These include critical design problems such as how to maintain a pedigree of agents or nodes that receive information provide their contribution to the dataset and pass to other network components The book also tackles dynamic data sharing within a network centric enterprise distributed fusion effects on state estimation graph theoretic methods to optimize fusion performance human engineering factors and computer ontologies for higher levels of situation assessment A comprehensive introduction to this emerging field and its challenges the book explores how data fusion can be used within grid distributed and cloud computing architectures Bringing together both theoretical and applied research perspectives this is a valuable reference for fusion researchers and practitioners It offers guidance and insight for those working on the complex issues of

designing and implementing distributed decentralized information fusion 
Distributed Detection Using a Data Fusion 
Center with 2-bit Memory Huang-Hsiao Kao,1995 
Data Fusion for Adaptive Distributed Detection Ari Naim,1989

Distributed Detection Theory and Data Fusion, 1999 This report presents a summary of research results obtained during the course of this grant in the area of distributed signal detection and decision fusion Specifically distributed detection and estimation with fuzzy information intelligent CFAR detection computational algorithms for system design and BDT based signal classification were considered A brief discussion of these results is provided here For more details the reader is referred to the list of published papers <u>Distributed Antenna Systems</u> Yan Zhang, Honglin Hu, Jijun Luo, 2007-06-27 The rapid growth in mobile communications has led to an increasing demand for wideband high data rate communications services In recent years the Distributed Antenna System DAS has emerged as a promising candidate beyond 3G and 4G mobile communications Distributed Antenna Systems Open Architecture for Future Wireless Communications is A Theory for Distributed Signal Detection and Data Fusion, 2000 This research attempts to develop a fundamental understanding of the issues involved in the design and performance analysis of distributed detection schemes Such knowledge is currently lacking This is especially true for cases with statistically dependent observations from sensor to sensor a practical case on which this research focuses Some emphasis is being devoted to developing design algorithms and on applications The goal of these studies is to produce tools and techniques for pressing practical problems. We classify our efforts into four basic areas properties of dependent observations cases design algorithms applications and image fusion **Distributed Data Fusion** and Information Processing in Wireless Sensor Networks Jinjun Xiao, 2006 Distributed Sensor Networks S. Sitharama Iyengar, Richard R. Brooks, 2016-04-19 The best selling Distributed Sensor Networks became the definitive guide to understanding this far reaching technology Preserving the excellence and accessibility of its predecessor Distributed Sensor Networks Second Edition once again provides all the fundamentals and applications in one complete self contained source Ideal as a tutorial for Parallel and Distributed Processing and Applications Yi Pan, Daoxu Chen, Minyi Guo, Jiannong Cao, Jack Dongarra, 2005-10-19 Welcome to the proceedings of ISPA 2005 which was held in the city of Nanjing Parallel computing has become a mainstream research area in computer science and the ISPA conference has become one of the premier forums for the presentation of new and exciting research on all aspects of parallel computing We are pleased to present the proceedings for the 3rd International Symposium on Parallel and Distributed Processing and Applications ISPA 2005 which comprises a collection of excellent technical papers and keynote speeches. The papers accepted cover a wide range of exciting topics including architectures software networking and applications. The conference continues to grow and this year a record total of 968 manuscripts including workshop submissions were submitted for consideration by the Program Committee or workshops From the 645 papers submitted to the main conference the Program Committee selected only 90 long papers and 19 short papers in the program Eight workshops complemented the outstanding paper sessions

Optimization of Distributed Detection Systems in the Presence of Wireless Channel Uncertainty Hamidreza Ahmadi, 2013 We study data fusion in a distributed detection system consisting of several geographically dispersed signal detectors and a fusion center FC that is tasked with solving an underlying binary hypothesis testing problem e q detection of a signal source or a target in a field being monitored Each detector makes a binary local decision based on its local observation where each local decision has a certain reliability index determined by the observation quality These local decisions are digitally modulated and transmitted over wireless channels to neighboring detectors and or the FC The FC is tasked with fusing the data received from the detectors and making a global binary decision. The challenge in data fusion is that the binary local decisions would be corrupted due to wireless channel effects i e additive Gaussian noise and multipath fading These effects further limit the reliability of the global decision This raises a key question Aiming to maximize the reliability of the global decision what is the optimal distributed detection system design in the presence of wireless channel uncertainty To address this question in this thesis we identify and address three subproblems as the following P1 Suppose the topology i e the wireless connections between the local detectors and the FC that are used for transmission of local binary decisions of the distributed detection system is adaptive and can be selected based on the observation and communication channel qualities What are the best network topology and the best signal processing schemes i e local decision rules and data fusion rules How are the best topology and the best signal processing schemes related to the reliability indices of the local decisions channel noise and fading Our results indicate that the optimality of widely used parallel topology in which the local detectors directly communicate with the FC is limited We also demonstrate the average performance gain of topology adaptation compared with a fixed topology system P2 Channel estimation is an integral part of most of today s wireless communication systems Via transmitting known training symbols the local detectors enable the FC to estimate the unknown fading channel which is used for recovering data symbols Considering a distributed detection system with a parallel topology in which the local detectors transmit training symbols followed by their local binary decisions and assuming an average transmit power constraint we ask What is the best data fusion rule at the FC How is this fusion rule affected by channel estimation error transmit power allocation between training and data symbols and the communication reception mode at the FC i e coherent versus noncoherent Our study shows that with noncoherent reception the detection performance of the FC is maximized when no training symbol is transmitted and all transmit power is spent for only data symbols This performance is attainable with statistics based likelihood ratio test LRT rule for random channels and generalized LRT GLRT for deterministic channels With coherent reception however the optimal power allocation depends on the fading model For Rayleigh fading model the total detection probability and error exponent are maximized when half of the transmit power is spent for training symbols Whereas for Rician fading model the optimal power allocation depends on the operating signal to noise SNR and Rice factor P3 Suppose the distributed detection system is tasked with detecting a

Gaussian signal source where in its presence local observations are statistically correlated samples of the signal source corrupted by an additive Gaussian noise We ask What is the best linear data fusion rule at the FC How is this fusion rule affected by the statistical correlation the reliability indices of the local decisions transmit power constraints at the local detectors communication multiple access scheme employed by the local detectors to communicate with the FC the communication reception mode at the FC channel noise and fading We show that statistical correlation degrades the detection probability of the system We also find the optimal power allocation for different communication multiple access schemes subject to several transmit power constraints in terms of observation and wireless channel qualities Pages v vi

**Selected Papers on Sensor and Data Fusion** Firooz A. Sadjadi,1996 This text presents papers covering issues in the field of sensor and data fusion Topics include classifier integration with multiple sensors combining uncertain messages using belief functions decentralized sequential detection and fusion propagation and structuring belief networks

Proceedings of the 26th IEEE Conference on Decision and Control ,1987 Data Fusion in Wireless Sensor Networks Domenico Ciuonzo, Pierluigi Salvo Rossi, 2019-03-11 The role of data fusion has been expanding in recent years through the incorporation of pervasive applications where the physical infrastructure is coupled with information and communication technologies such as wireless sensor networks for the internet of things IoT e health and Industry 4 0 In this edited reference the authors provide advanced tools for the design analysis and implementation of inference algorithms in Distributed Detection and Fusion in Parallel Sensor Architectures Savandeep wireless sensor networks Acharya, 2014 Parallel distributed detection system consists of several separate sensor detector nodes separated spatially or by their principles of operation each with some processing capabilities These local sensor detectors send some information on an observed phenomenon to a centrally located Data Fusion Center for aggregation and decision making Often the local sensors use electro mechanical optical or RF modalities and are known as hard sensors For such data sources the sensor observations have structure and often some tractable statistical distributions which help in weighing their contribution to an integrated global decision In a distributed detection environment we often also have humans in the loop Humans provide their subjective opinions on these phenomena These opinions are labeled soft data It is of interest to integrate soft decisions mostly assessments provided by humans with data from the hard sensors in order to improve global decision reliability Several techniques were developed to combine data from traditional hard sensors and a body of work was also created about integration of soft data However relatively little work was done on combining hard and soft data and decisions in an integrated environment Our work investigates both hard and hard soft fusion schemes and proposes data integration architectures to facilitate heterogeneous sensor data fusion In the context of hard fusion one of the contributions of this thesis is an algorithm that provides a globally optimum solution for local detector hard sensor design that satisfies a Neyman Pearson criterion maximal probability of detection under a fixed upper bound on the global false alarm rate at the fusion

center Furthermore the thesis also delves into application of distributed detection techniques in both parallel and sequential frameworks Specifically we apply parallel detection and fusion schemes to the problem of real time computer user authentication and sequential Kalman filtering for real time hypoxia detection In the context of hard soft fusion we propose a new Dempster Shafer evidence theory based approach to facilitate heterogeneous sensor data fusion Application of the framework to a number of simulated example scenarios showcases the wide range of applicability of the developed approach We also propose and develop a hierarchical evidence tree based architecture for representing nested human opinions The proposed framework is versatile enough to deal with both hard and soft source data using the evidence theory framework it can handle uncertainty as well as data aggregation Signal Processing IV Jean-Louis Lacoume, 1988 This was the fourth in a sequence of international conferences promoted and organized by the European Association for Signal Processing EURASIP This book in three volumes presents the proceedings of that conference EUSIPCO 88 comprised 47 separate sessions organized in 7 parallel programs Each of the 438 papers that were presented at the conference were reviewed by at least two referees from two independent institutions In addition 8 tutorials were contributed by experts in a large field of topics from Hidden Markov Fields to High Definition TV Systems The new technical potential of the DSP opening new frontiers was evidenced by the plenary session on Cheap and Powerful DSP Technologies A Challenge The contributions are grouped by topic in the contents in order to facilitate easy access The diversity of the topics as well as the extraordinary tempo at which Signal Processing has progressed since the first conference in Lausanne 1980 attest to the permanent vitality of this field of research and development Due to the extensive length of the contents only the number of papers presented per session is listed below International Conference Radar 87,1987 **Resource-Aware Data Fusion Algorithms for** Wireless Sensor Networks Ahmed Abdelgawad, Magdy Bayoumi, 2012-02-15 This book introduces resource aware data fusion algorithms to gather and combine data from multiple sources e g sensors in order to achieve inferences These techniques can be used in centralized and distributed systems to overcome sensor failure technological limitation and spatial and temporal coverage problems The algorithms described in this book are evaluated with simulation and experimental results to show they will maintain data integrity and make data useful and informative Describes techniques to overcome real problems posed by wireless sensor networks deployed in circumstances that might interfere with measurements provided such as strong variations of pressure temperature radiation and electromagnetic noise Uses simulation and experimental results to evaluate algorithms presented and includes real test bed Includes case study implementing data fusion algorithms on a remote monitoring framework for sand production in oil pipelines 30th Midwest Symposium on Circuits and Systems Kamal Jabbour, 1988

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