Multiuser Detection (MUD)

- Multiuser detection considers all users as signals for each other
  - → joint detection
    - Reduced interference leads to capacity increase
    - Alleviates the "near-far" problem
- MUD can be implemented in the BS or mobile, or both
- In a cellular system, base station (BS) has knowledge of all the chip sequences
- Size and weight requirement for BS is not stringent
- Therefore MUD is currently being envisioned for the uplink (mobile to BS)

Multiuser Detection

Sergio Verdú

Multiuser Detection:

Advances in Multiuser Detection Michael L. Honig,2009-08-31 A Timely Exploration of Multiuser Detection in Wireless Networks During the past decade the design and development of current and emerging wireless systems have motivated many important advances in multiuser detection This book fills an important need by providing a comprehensive overview of crucial recent developments that have occurred in this active research area Each chapter is contributed by noted experts and is meant to serve as a self contained treatment of the topic Coverage includes Linear and decision feedback methods Iterative multiuser detection and decoding Multiuser detection in the presence of channel impairments Performance analysis with random signatures and channels Joint detection methods for MIMO channels Interference avoidance methods at the transmitter Transmitter precoding methods for the MIMO downlink This book is an ideal entry point for exploring ongoing research in multiuser detection and for learning about the field s existing unsolved problems and issues It is a valuable resource for researchers engineers and graduate students who are involved in the area of digital communications

Multiuser Detection Sergio Verdú,1998-08-13 Originally published in 1998 Multiuser Detection provides a comprehensive treatment of the subject of multiuser digital communications   Multiuser Detection Sergio Verdú,2011-07-21 Multiuser Detection provides the first comprehensive treatment of the subject of multiuser digital communications Multiuser detection deals with demodulation of the mutually interfering digital streams of information that occur in areas such as wireless communications high speed data transmission satellite communication digital television and magnetic recording The development of multiuser detection techniques is one of the most important recent advances in communications technology and this self contained book gives a comprehensive coverage of the design and analysis of receivers for multiaccess channels while focusing on fundamental models and algorithms The author begins with a review of multiaccess communications dealing in particular with code division multiple access CDMA channels Background material on hypothesis testing and the effect of multiuser interference on single user receivers are discussed next This is followed by the design and analysis of optimum and linear multiuser detectors Also covered in detail are topics such as decision driven multiuser detection and noncoherent multiuser detection The elements of multiuser detection are clearly and systematically presented along with more advanced recent results some of which are published here for the first time The extensive set of references and bibliographical notes offer a comprehensive account of the state of the art in the subject The only prerequisites assumed are undergraduate level probability linear algebra and introductory digital communications The book contains over 300 exercises and is a suitable textbook for practicing engineers as well as a valuable reference volume for researchers in communications and signal processing   **Wireless Communication Systems** Xiaodong Wang,H. Vincent Poor,2004 Wireless Communication Systems Advanced Techniques for Signal Receptionoffers a unified frameworkfor understanding today s newest techniques for signal processing in communication systems andusing them to design receivers

for emerging wireless systems Two leading researchers cover a fullrange of physical layer issues including multipath dispersion interference dynamism andmultiple antenna systems Topics include blind group blind space time and turbo multiuserdetection narrowband interference suppression Monte Carlo Bayesian signal processing fast fadingchannels advanced signal processing in coded OFDM systems and more   Coordinated Multiuser Communications CHRISTIAN SCHLEGEL,Alex Grant,2006-07-10 Coordinated Multiuser Communications provides for the first time a unified treatment of multiuser detection and multiuser decoding in a single volume Many communications systems such as cellular mobile radio and wireless local area networks are subject to multiple access interference caused by a multitude of users sharing a common transmission medium The performance of receiver systems in such cases can be greatly improved by the application of joint detection and decoding methods Multiuser detection and decoding not only improve system reliability and capacity they also simplify the problem of resource allocation Coordinated Multiuser Communications provides the reader with tools for the design and analysis of joint detection and joint decoding methods These methods are developed within a unified framework of linear multiple access channels which includes code division multiple access multiple antenna channels and orthogonal frequency division multiple access Emphasis is placed on practical implementation aspects and modern iterative processing techniques for systems both with and without integrated error control coding Focusing on the theory and practice of unifying accessing and transmission aspects of communications this book is a valuable reference for students researchers and practicing engineers   **Wireless Networks: Multiuser Detection in Cross-Layer Design** Christina Comaniciu,Narayan B. Mandayam,H. Vincent Poor,2005-04-13 Cross layer design seeks to enhance the capacity of wireless networks significantly through the joint optimization of multiple layers in the network primarily the physical PHY and medium access control MAC layers Although there are advantages of such design in wireline networks as well this approach is particularly advantageous for wireless networks due to the properties such as mobility and interference that strongly affect performance and design of higher layer protocols This unique monograph is concerned with the issue of cross layer design in wireless networks and more particularly with the impact of node level multiuser detection on such design It provides an introduction to this vibrant and active research area insufficiently covered in existing literature presenting some of the principal methods developed and results obtained to date Accompanied by numerous illustrations the text is an excellent reference for engineers researchers and students working in communication networks   *WCDMA* Tero Ojanperä,Ramjee Prasad,2001 While covering the basics of wideband CDMA the key UMTS technology this major revision of the best selling Wideband CDMA for Third Generation Mobile Communications brings you up to date with all the latest developments in third generation mobile communications New sections cover fundamental IP concepts All IP core networks and WCDMA EDGE and cdma2000 technologies including their future developments WCDMA HSPA and 1XEV The book gives you a complete understanding of the complex standardization environment of 3G networks and the design and development of 3G systems It

describes how third generation system applications impact radio access system design and compares and contrasts major wideband CDMA standards WCDMA WCDMA TDD and cdma2000 Includes 190 illustrations and 75 equations   *Multiuser Detection in Wireless Communications* Ryuji Kohno,1998   **Improved Multiuser Detection in Code-division Multiple Access Communications** Jie Luo,2002   <u>Mobile and Wireless Communications Networks</u> Cambyse Guy Omidyar,Khaldoun Al Agha,2003 This book covers all areas concerning mobility and wireless communications Presented papers deal with cellular networks 2G 3G and 4G wireless networks IEEE802 11 Bluetooth and sensor networks security quality of service and applications Accepted papers represent a good selection of research in wireless communications They offer an overview and also sharp visions of industrial and scientific work The proceedings have been selected for coverage in Index to Scientific Technical Proceedings ISTP CDROM version ISI Proceedings   **Near-far Resistant Multiuser Detection in Asynchronous WCDMA Systems** Eric Dohrman,2002   *An Application of the Chase Algorithm to Multiuser Detection* Feng Liu,2007 With various added services in future wireless communication systems the demand for fast and highly reliable data transmissions is continuously increasing Multiple access interference MAI in direct sequence code division multiple access DS CDMA and constrained capacity in single input single output SISO are the major obstacles to achieve this purpose For overcoming these limitations the use of multiuser detection MUD and multiple input multiple output MIMO is necessary In the area of error control coding the Chase algorithm which takes advantage of the different reliabilities of the received symbols and focuses on correcting the error in the weakest symbols can achieve a near maximum likelihood ML performance and with significant complexity reduction In this thesis we discuss the application of the Chase algorithm in multiuser detectors for the SISO CDMA and MIMO CDMA systems In the SISO CDMA systems we develop a parallel interference cancellation PIC scheme using the Chase algorithm after the matched filters MFs This scheme is called Chase PIC Instead of optimizing the weight of each user as most of PIC detectors do this detector provides a new optimizing approach right after the MFs Based on the analysis of the complexity and performance over the flat and frequency selective Rayleigh fading channels we also propose a new Chase based multistage PIC that uses the normalized least mean square NLMS algorithm at the earlier stages and the Chase algorithm at the later stages This proposed scheme can achieve a better performance than NLMS PIC but with less complexity In the MIMO CDMA systems we proposed a new Chase based multiuser detector over the flat Rayleigh fading channels This detector focuses on correcting the error of the weakest detected symbol in the layered space time multiuser detector LAST MUD Compared to another Chase based detector B Chase the proposed scheme has less complexity but with the tendency of achieving better performance at high signal to noise ratio SNR   **Multiuser Detection in DSSS Systems** Shahzadi Mahnoor,2014-05-28 Direct sequence code division multiple access DS CDMA is a popular wireless technology in DS CDMA communications all of the users signal overlap in time and frequency and cause mutual interference The capacity of Direct Sequence Code Division Multiple Access DS CDMA is limited by Multiple Access

Interference MAI instead of thermal noise Commercial CDMA systems such as the ones based on IS 95 standard regard MAI as additive noise and employ matched filter detectors This technique limits the number of users that can be supported in DS CDMA system to less than 10% of the spreading gain Moreover the bit error rates for individual users degrade rapidly with an increase in number of users The conventional DS CDMA detector follows single user detection strategy in which each user is detected separately without regard for the other users A better strategy is multi user detection where information about multiple users is used to improve detection of each individual user A number of important multiuser detectors have been proposed here The content of the book is in following sequence **New Multiuser Detection Schemes for Direct-sequence Code-division Multiple Access Systems** Xiaofeng Wang,2001 In this dissertation three multiuser detectors are developed for different application scenarios in direct sequence code division multiple access systems The first detector is an overlapping widow decorrelating detector aimed at asynchronous reverse links In companion with the design of this detector a study on the decay property of the ideal decorrelating impulse response is presented resulting in a quantitative description of the decay rate as a function of the Cholesky factors of the cross correlation matrix of user signature signals This result can serve as a guide for determining window length of decorrelating or minimum mean squared error multiuser detection in asynchronous multiuser systems Based on this result a signal adapted window length determination algorithm is developed for the proposed detector Several supporting utilities for efficient implementation of the proposed detector are also described The second detector is a linear multiuser detector that is also aimed at the reverse links Particularly it is desirable for cases where the number of users is small and thus significant performance gain over the existing linear multiuser detectors is possible Unlike in the decorrelating and MMSE detectors minimizing the bit error rate is taken as the optimization objective in the proposed detector To avoid undesired local minima of the highly nonlinear BER cost function a set of convex constraints is proposed for the optimization problem It is shown that this constrained optimization problem has a unique solution once the decorrelating detector exists It is also shown that the proposed detector achieves the best performance among linear detectors for most realistic situations In addition a Newton barrier method is developed for efficiently calculating the coefficient vector of the proposed detector i e the solution of the constrained optimization problem The third detector is an adaptive detector that is aimed at the forward link where information about interfering users is often unavailable The proposed detector consists of a bank of blind adaptive filters one for each resolvable path followed by a channel estimator and a coherent diversity combiner To allow blind adaptation the impulse response of each filter is decomposed into two orthogonal parts one part is fixed as the decorrelating coefficient vector for the path in the absence of interfering users and the other is free to be adapted according to the mean squared error criterion Assuming perfect adaptation the performance of the proposed detector is shown to be between those of the decorrelating detector and the minimum mean squared error detector Other studies conducted include the effects of fading on the

performance of the proposed detector and the behavior of the proposed blind adaptation algorithm   <u>Soft-input Soft-output Multiuser Detection for Coded Wireless Multiuser Systems</u> Wei Zhang,2005   **Intelligent Structure and Vibration Control** Shaobo Zhong,Yi Min Cheng,Xi Long Qu,2011-02-02 Selected peer reviewed papers from the International Conference on Intelligent Structure and Vibration Control ISVC 2011 January 14 16 2011 Chongqing China   **Multiuser detection in code-division multiple-access communications** Mahesh Kumar Varanasi,1990   **The Use of Antenna Arrays in the Detection of Code Division Multiple Access Signals** Tyler Alan Brown,1995   *Multiuser Detection in Fading Channels Using the EM Algorithm* Andrew W. Eckford,1999 Channels shared by multiple users such as in DS CDMA frequently suffer from Multiple Access Interference MAI which may be mitigated through the use of multiuser detection In previous work the EM algorithm was used in an interference cancellation multiuser detection scheme which used soft decisions However this method along with most currently available multiuser detection algorithms assumed accurate knowledge of users transmitted amplitudes which is impractical for use in a fading channel In this work the role of soft decisions in the EM algorithm and multiuser detection is carefully examined with emphasis on the new idea of turbo detection Adaptations of the EM based multiuser detector for Rayleigh and Rician fading channels are also presented both with and without knowledge of carrier phase Simulation results for all these methods are also presented demonstrating that the proposed algorithms improve somewhat on existing algorithms over wide ranges of SNR   *Multiuser Detection for CDMA Communications* ,2004

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