PRINCIPLES OF SIGNAL ESTIMATION FOR MIMO/ OFDM WIRELESS COMMUNICATION

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PRE-REQUISITES : BE/ME/MS /PhD can be allowed, Basic knowledge of, Probability, random variables, Linear Algebra, DSP

INTENDED AUDIENCE : Can be both core or elective. Core course for students in Signal Processing and Communications stream. Both UG/ PG can be allowed.

INDUSTRY SUPPORT : Most companies in wireless communications area should find this useful. Examples are Qualcomm, Broadcom, Intel etc.

COURSE OUTLINE :

Signal estimation theory provides a wide variety of tools and techniques which form the basis for several key applications in modern wireless communications and signal processing. Various signal processing procedures in communication systems such as channel estimation, equalization, synchronization etc, which are also employed in MIMO-OFDM based 3G/ 4G wireless systems, are based on fundamental concepts in estimation theory. Further, recent research developments in areas such as wireless sensor networks also employ several tools from estimation theory towards distributed parameter estimation etc. Therefore, principles of estimation are naturally of a significant interest in research and industry. A clear grasp of the basic principles of estimation can significantly enhance understanding by providing deeper insights into various techniques in signal processing and communication. Beginning with a brief overview of the basic concepts of maximum likelihood (ML) and Least Squares Estimation (LS), this course will comprehensively cover several applications of estimation theory in wireless communications such as channel estimation, equalization, MIMO, OFDM. Further, we will also cover Bayesian Estimation, MMSE, LMMSE principles.

ABOUT INSTRUCTOR :

Prof. Aditya K. Jagannatham received his Bachelors degree from the Indian Institute of Technology, Bombay and M.S. and Ph.D. degrees from the University of California, San Diego, U.S.A. From April '07 to May'09 he was employed as a senior wireless systems engineer at Qualcomm Inc., San Diego, California, where he was a part of the Qualcomm CDMA technologies (QCT) division. His research interests are in the area of next-generation wireless cellular and WiFi networks, with special emphasis on various 5G technologies such as massive MIMO, mmWave MIMO, FBMC, NOMA, Full Duplex and others. He has contributed to the 802.11n high throughput wireless LAN standard and has published extensively in leading international journals and conferences. He was awarded the CAL(IT)2 fellowship at the University of California San Diego and the Upendra Patel Achievement Award at Qualcomm.

COURSE PLAN :

Week 1- Basics of Estimation, Maximum Likelihood (ML)
Week 2- Application: Wireless Sensor Network, Reliability of Estimation
Week 3- Application: Wireless Fading Channel Estimation, Cramer-Rao Bound for Estimation
Week 4- Vector Parameter Estimation, Properties of Estimate; Applications: Multi-antenna Wireless Channel Estimation
Week 5- Application: MIMO Wireless Channel Estimation, Error Covariance of Estimation, Equalization for Frequency Selective Channels
Week 6- Application: OFDM Estimation, Sequential Estimation
Week 7- Minimum Mean-Squared Error (MMSE) Estimate, Gaussian Parameter
Week 8- Application: Wireless Sensor Network, Wireless Fading Channel Estimation
Week 9- Application: MMSE Estimation for Multi-Antenna Channel
Week 10- Application: MMSE for MIMO Channel Estimation, Properties of Estimate
Week 11- Application: MMSE for Equalization of Wireless Channel
Week 12- Application: MMSE for OFDM Channel Estimation