



# PRINCIPLES OF SIGNAL ESTIMATION FOR MIMO, OFDM WIRELESS COMMUNICATION

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**TYPE OF COURSE** : Rerun | Both | UG/PG

**COURSE DURATION** : 12 weeks (20 Jul' 20 - 9 Oct' 20)

**EXAM DATE** : 17 Oct 2020

**PRE-REQUISITES** : Basic knowledge of - Probability, random variables - Digital modulation, BPSK, QPSK etc

**INTENDED AUDIENCE** : NULL

**INDUSTRIES APPLICABLE TO** : Most companies in wireless communications area should find this useful. Examples are Qualcomm, Broadcom, Intel etc.

## **COURSE OUTLINE :**

The field of wireless communications has witnessed revolutionary technology developments in the last decade. While previously there existed only 2G GSM based communication systems which supported a data rate of around 10 Kbps, several radical wireless technologies have been developed in the last 10 years to enable broadband wireless access with rates in excess of 100 Mbps. These have subsequently led to the development of 3G and 4G wireless technologies such as HSDPA (High Speed Downlink Packet Access), LTE (Long Term Evolution) and WiMAX (Worldwide Interoperability for Microwave Access). This has been made possible through breakthrough wireless technologies such as Code Division for Multiple Access (CDMA), Orthogonal Frequency Division Multiplexing (OFDM), Multiple Input Multiple Output (MIMO). These techniques form the basis of understanding the world of 3G/4G wireless communication systems. This course will present an elaborate introduction to the principles and performance of these fundamental 3G/ 4G wireless technologies

## **ABOUT INSTRUCTOR :**

Prof. Aditya K. Jagannatham (<http://home.iitk.ac.in/~adityaj/index.html>) 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 &#39;07 to May &#39;09 he was employed as a senior wireless systems engineer at Qualcomm Inc., San Diego, California, where he worked on developing 3G UMTS/WCDMA/HSDPA mobile chipsets as part of the Qualcomm CDMA technologies division. His research interests are in the area of next-generation wireless communications and networking, sensor and ad-hoc networks, digital video processing for wireless systems, wireless 3G/4G cellular standards and CDMA/OFDM/MIMO wireless technologies. 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 for pursuing graduate studies at the University of California San Diego and in 2009 he received the Upendra Patel Achievement Award for his efforts towards developing HSDPA/HSUPA/HSPA+ WCDMA technologies at Qualcomm. Since 2009 he has been a faculty member in the Electrical Engineering department at IIT Kanpur, where he is currently an Associate Professor, and is also associated with the BSNL-IITK Telecom Center of Excellence (BITCOE). At IIT Kanpur he has been awarded the P.K. Kelkar Young Faculty Research Fellowship (June 2012 to May 2015) for excellence in research. His popular video lectures for the NPTEL (National Programme on Technology Enhanced Learning) course on Advanced 3G and 4G Wireless

## **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