MATHEMATICAL METHODS AND TECHNIQUES IN SIGNAL PROCESSING

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TYPE OF COURSE : Rerun | Elective | PG
COURSE DURATION : 12 weeks (18 Jan' 21 - 09 Apr' 21)
EXAM DATE : 25 Apr 2021

PRE-REQUISITES : UG in Digital Signal Processing, familiarity with probability and linear algebra

INTENDED AUDIENCE : Post graduates and senior UGs with a strong background in basic DSP.

INDUSTRIES APPLICABLE TO : Any company using DSP techniques in their work, such as, TI, Analog Devices, Broadcom and many more.

Rajeev Motwani and Prabhakar Raghavan,Randomized Algorithms

COURSE OUTLINE :

Review of basic signals, systems and signal space: Review of 1-D signals and systems, review of random signals, multi-dimensional signals, review of vector spaces, inner product spaces, orthogonal projections and related concepts.Sampling theorems (a peek into Shannon and compressive sampling), Basics of multi-rate signal processing: sampling, decimation and interpolation, sampling rate conversion (integer and rational sampling rates), oversampled processing (A/D and D/A conversion), and introduction to filter banks.Signal representation: Transform theory and methods (FT and variations, KLT), other transform methods including convergence issues. Wavelets: Characterization of wavelets, wavelet transform, multi-resolution analysis.

ABOUT INSTRUCTOR :

Prof. Shayan Garani Srinivasa received his Ph.D. in Electrical and Computer Engineering from Georgia Institute of Technology - Atlanta, M.S. from the University of Florida - Gainesville and B.E. from Mysore University. Dr. Srinivasa has held senior engineering positions within Broadcom Corporation, ST Microelectronics and Western Digital. Prior to joining IISc, Dr. Srinivasa was leading various research activities, managing and directing research and external university research programs within Western Digital. He was the chairman for signal processing for the IDEMA-ASTC and a co-chair for the overall technological committee. He is the author of a book, several journal and conference publications, holds U.S patents in the area of data storage.

COURSE PLAN :

Week 1**:** Review of vector spaces, inner product spaces, orthogonal projections, state variable representation

Week 2**:** Review of probability and random processes

Week 3**:** Signal geometry and applications

Week 4**:** Sampling theorems multirate signal processing decimation and expansion

Week 5**:** Sampling rate conversion and efficient architectures, design of high decimation and interpolation filters, Multistage designs.

Week 6**:** Introduction to 2 channel QMF filter bank, M-channel filter banks, overcoming aliasing, amplitude and phase distortions.

Week 7**:** Subband coding and Filter Designs: Applications to Signal Compression

Week 8**:** Introduction to multiresolution analysis and wavelets, wavelet properties

Week 9**:** Wavelet decomposition and reconstruction, applications to denoising

Week 10**:** Derivation of the KL Transform, properties and applications.

Week 11**:** Topics on matrix calculus and constrained optimization relevant to KL Transform derivations.

Week 12**:** Fourier expansion, properties, various notions of convergence and applications.