MULTIRATE DSP

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TYPE OF COURSE : Rerun | Elective | UG/PG
COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22)
EXAM DATE : 23 Apr' 2022

PRE-REQUISITES : Basic course in Digital Signal Processing

INTENDED AUDIENCE : B.E. / B.Tech/ M.E./ M.Tech/ Ph.D. students who have completed basic course in Digital Signal Processing, Students planning to do projects / research in DSP, Industry practitioners working with DSP, audio and video products

INDUSTRIES APPLICABLE TO : Texas Instruments, Qualcomm, Broadcomm, Jasmine Infotech, Samsung, Sasken, Intel, Motorola, Ittiam,Redpine Companies developing products based on DSP

COURSE OUTLINE :

The key features of this course includes the following topics. An in-depth understanding of sampling, reconstruction, sampling rate conversion using multirate building blocks. Applications of multirate DSP - Filter design, Filterbanks, Transmultiplexer, Delta-Sigma A/D. Mathematical framework for Perfect Reconstruction Filter banks. Achieving capacity in wireless channels, motivation for Multicarrier modulation, Redundancy via zero padding and cyclic prefix. Mathematical framework for OFDM and its extensions. Introduction to Wavelets and Multichannel filter banks. Matlab-based computer exercises to gain understanding of multirate DSP concepts and applications.

ABOUT INSTRUCTOR :

Prof. R. David Koilpillai received the B.Tech degree in Electrical Engineering from the Indian Institute of Technology Madras and the M.S. and Ph.D. degrees in Electrical Engineering from the California Institute of Technology, Pasadena, CA. In June 2002, David joined the EE faculty of IIT Madras. He is currently the Qualcomm Institute Chair Professor in EE and Dean (Planning).

COURSE PLAN :

Week 1: Introduction• Overview of Sampling and Reconstruction • Review Discrete-Time Systems, digital filters

Week 2: Oversampling techniques, DT processing of continuous time signals

Week 3: Fundamentals of Multi-rate Systems• Basic building blocks – Up sampling, down sampling, aliasing Mathematical framework for sampling rate change

Week 4: Sampling rate change and filtering, fractional sampling rate change

Week 5: Interconnection of multirate DSP blocks, Multiplexer and Demultiplexer functionality, Polyphase decomposition, Noble Identities, efficient implementation of sampling rate conversion

Week 6: Applications of Multirate DSP - DFT-based Filterbanks, Interpolated FIR filter design, Cascaded-Integrator-Comb (CIC) filters, Transmultiplexer, Filterbank interpretation of Spectral analysis using DFT

Week 7: Two channel maximally decimated filter bank, Signal impairments - Aliasing, Magnitude distortion, Phase distortion, Aliasing cancellation

Week 8: Allpass filters, properties, application in two channel filterbanks, Half-band filters, Power complementary filter pairs, Mth band filters, two channel perfection reconstruction filterbanks.

Week 9: Capacity of wireless channels, Waterfilling method, motivation for Multicarrier modulation

Week 10: Block transceivers with redundancy, Zero-padding, cyclic prefix, OFDM, extensions of OFDM incuding Filterbank Multicarrier (FBMC)

Week 11: Application of Multirate DSP – Delta Sigma A/D conversion

Week 12: Introduction to wavelets and M-channel perfect reconstruction filterbanks.