

ECMC2T6A: TRANSFORM TECHNIQUES

UNIT 1: Review of Transforms

Introduction, Need for transform, Image transform, Fourier Transform, 2D Discrete Fourier Transform, Properties of 2D- DFT, Importance of Phase, Walsh transform, Hadamard Transform, Haar Transform, Slant Transform, Discrete Cosine Transform, Karhunen-Loeve Transform, Singular value Decomposition, Radon Transform, and Comparison of Different Image transforms.

UNIT II: Fourier Analysis

Fourier series, Examples, Fourier Transform, Properties of Fourier Transform, Examples of Fourier transform, sampling theorem, Partial sum and Gibbs phenomenon, Fourier analysis of Discrete time Signals, Discrete Fourier Transform Time – Frequency Analysis: Window function, Short Time Fourier Transform, Discrete Short Time Fourier Transform, Discrete Gabor Representation, Continuous wavelet transform, Discrete wavelet transform, wavelet series, Interpretations of the Time-Frequency plot, Wigner-Ville Distribution, Quadratic Superposition principle, Ambiguity function

UNIT III: Multiresolution Analysis

Multiresolution analysis, Orthogonal, Biorthogonal and semiorthogonal decomposition, Two scale relations, Decomposition relation, Spline functions, Mapping a function into MRA space

UNIT IV: Construction of Wavelets

Necessary ingredients for wavelet construction, construction of semiorthogonal spline wavelets, Construction of orthonormal wavelets, Orthonormal scaling functions, Construction of Biorthogonal wavelets

UNIT V: Discrete wavelet transform and filter bank algorithms

Decimation and Interpolation, Signal representation in the approximation subspace, wavelet decomposition algorithm, reconstruction algorithm, change of bases, Signal reconstruction in semiorthogonal subspaces, Two channel perfect reconstruction filter bank, Polyphase representation of filter banks, comments on DWT and PR filter banks

UNIT VI: Digital Signal processing Applications

Wavelet packets, Wavelet packet algorithms, Thresholding-Hard thresholding, Soft thresholding, Percentage thresholding, Implementation, Interference suppression, Faulty bearing signature identification- Pattern Recognition of Acoustic Signals, Wavelets, Wavelet packets, and FFT features. Two Dimensional wavelets and wavelet packets, Wavelet and Wavelet packet algorithms for two dimensional signals, Image compression, Microcalcification cluster Detection

UNIT VII: Lifting Scheme

Wavelet transform using polyphase matrix factorization, Geometrical foundations of lifting scheme, lifting scheme in the Z-domain, Mathematical preliminaries for polyphase factorization

UNIT VIII: Beyond wavelets: The Ridgelets and curvelets. Why ridgelets and curvelets?, The ridgelet transform, The digital curvelet transform second generation curvelets

Text Books

1. S. Jayaraman, S. Esakkirajan and T. Veerakumar, “Digital image processing” Mc Graw Hill publishers, 2009 ISBN (13) 978-0-07-014479-8 (1st chapter)
2. Jaideva C.Goswami and Andrew K.Chan, “ Fundamentals of Wavelets” Wiley publishers, 2006 ISBN 81-265-1032-3 (Chapters 2 to 6)
3. K.P.Soman and K.I Ramachandran, “ Insight into Wavelets – from theory to practice” PHI, Second edition,2008 ((ISBN 978-81-203-2902-7) (Chapter 7 & 8)

Reference Book

1. P.P.Vaidyanathan, “Multirate systems and Filter Banks” Pearson education, 2008, ISBN 978-81-7758-942-9
