Digital Video Signal Processing - Web course

COURSE OUTLINE

The course is intended for Senior Undergraduate Students in the branch of ECE, with a prior background in digital signaprocessing.

COURSE DETAIL

Module No.	Topic/s	No.of Lectures
1	**Video Formation, Perception and Representation** a. **Video Capture and Display** • Principles of Color Video. • Video Cameras. • Video Display. • Composite versus Component Models. • Gamma Conection. b. ***Analog Video Raster*** • Progressive vs Interlaced scans. • Characterisation of Video Raster. • Spatial and Temporal resolution, Signal Bandwidth. • Multiplixing of Luminance, Chrominance and Audio. c. ***Digital Video*** • Notation. • ITU-R.BT.601 Digital Video Format. • Other Digital Video Formats and Applications. • Digital Video Quality Measure.	5
2	**Fourier Analysis of Video Signals and Frequency Response of the Human Visual System.** a. **Multidimensional Continuous-Space Signals and Systems.** b. **Multidimensional discrete-Space Signals and Systems.**	5

NPTEL

http://nptel.iitm.ac.in

Electronics & Communication Engineering

Coordinators:

Prof. Sumana Gupta
Department of Electronics and Communication EngineeringIIT Kanpur

	c. **Frequency Domain Characterization of Video Signals.** • Spatial and Temporal Frequencies. • Temporal Frequencies Caused by Linear Motion. d. **Frequency Response of the Human Visual System** • Temporal Frequency Response and Flicker Perception. • Spatial Frequency Response. • Spatiotemporal Frequency Response. • Smooth Pursuit Eye Movement.		
3	**Video Sampling** a. **Basics of the Lattice Theory.** b. **Sampling of Video Signals Over Lattices** • Required Sampling Rates. • Sampling Video in Two Dimensions: Progressive versus Interlaced Scans. • Sampling a Raster Scan: BT.601 Format Revisited. • Sampling Video in Three Dimensions. • Spatial and Temporal Aliasing. c. **Filtering Operations in Cameras and Display Devices** • Camera Apertures. • Display Apertures.	5	
4	**Video Sampling Rate Conversion** a. **Conversion of Signals Sampled on Different Lattices** • Up-Conversion. • Down-Conversion. • Conversion between Arbitrary Lattices. • Filter Implementation and Design, and other Interpolation Approaches. b. **Sampling Rate Conversion of Video Signals** • Deinterlacing. • Conversion between PAL and NTSC Signals. • Motion-Adaptive Interpolation.	5	

5	**Video Modeling** a. **Camera Model** • Pinhole Model. • CAHV Model. • Camera Motions. b. **Object Model** • Shape Model. • Motion Model. c. **Scene Model**. d. **Two-Dimensional Motion Models** • Definition and Notation. • Two-Dimensional Motion Models Corresponding to Typical Camera Motions. • Two-Dimensional Motion Corresponding to Three-Dimensional Rigid Motion. • Approximation of Projective Mapping.	5	
6	**Two-Dimensional Motion Estimation** a. **Optical Flow** • Two-Dimensional Motion versus Optical Flow. • Optical Flow Equation and Ambiguity in Motion Estimation. b. **General Methodologies** • Motion Representation. • Motion Estimation Criteria. • Optimization Methods. c. **Pixel-Based Motion Estimation** • Regularization Using the Motion Smoothness Constraints. • Using a Multipoint Neighborhood. • Pel-Recursive Methods. d. **Block-Matching Algorithm** • The Exhaustive Block-Matching Algorithm. • Fractional Accuracy Search. • Fast Algorithm. • Imposing Motion Smoothness Constraints. • Phase Correlation Method. • Binary Feature Matching.	5	

	e. **Multiresolution Motion Estimation** • General Formulation. • Hierarchical Block Matching Algorithm. f. **Application of Motion Estimation in Video Coding.**		
7	**Waveform-Based Video Coding** a. **Block-Based Transform Coding**. • Overview. • One-Dimensional Unitary Transform. • Two-Dimensional Unitary Transform. • The Discrete Cosine Transform. • Bit Allocation and Transform Coding Gain. • Optimal Transform Design and the KLT. • DCT-Based Image Coders and the JPEG Standard. • Vector Transform Coding. b. **Predictive Coding** • Overview. • Optimal Predictor Design and Predictive Coding Gain. • Spatial-Domain linear Prediction. • Motion-Compensated Temporal Prediction. c. **Video Coding Using Temporal Prediction and Transform Coding** • Block-Based Hybrid Video Coding. • Overlapped Block Motion Compensation. • Coding Parameter Selection. • Rate Control. • Loop Filtering.	5	
8	**Video Compression Standards** a. **Video Telephony with H.261 and H.263** • H.261 Overview. • H.263 Highlights. • Comparison. b. **Digital TV with MPEG-2** • Systems. • Audio.	5	

	- Video. - Profiles. c. **Coding of Audiovisual Objects with PMEG-4** - MPEG-4 Profiles. - MPEG-4 Features. - MPEG-4 Object Based Orientation.	
	Total	40

References:

1. "Multimedia Communication Technology", J.R.Ohm, Springer Publication.
2. "Video Coding for Mobile Communications" David Bull et al, Academic Press.
3. "Handbook on Image and Video Processing", A.I.Bovik, Academic Press.
4. "Digital Video", Tekalp, Prentice Hall.