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 signal processing.

COURSE DETAIL

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<tr>
<th>Module No.</th>
<th>Topic/s</th>
<th>No.of Lectures</th>
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<td>1</td>
<td><strong>Video Formation, Perception and Representation</strong></td>
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<td></td>
<td>a. <strong>Video Capture and Display</strong></td>
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<td></td>
<td>• Principles of Color Video.</td>
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<td>• Video Cameras.</td>
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<td>• Video Display.</td>
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<td>• Composite versus Component Models.</td>
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<td>• Gamma Connection.</td>
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<td>b. <strong>Analog Video Raster</strong></td>
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<td>• Progressive vs Interlaced scans.</td>
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<td>• Characterisation of Video Raster.</td>
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<td>• Spatial and Temporal resolution, Signal Bandwidth.</td>
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<td>• Multiplexing of Luminance, Chrominance and Audio.</td>
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<td>c. <strong>Digital Video</strong></td>
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<td>• Notation.</td>
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<td>• ITU-R.BT.601 Digital Video Format.</td>
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<td>• Other Digital Video Formats and Applications.</td>
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<td>• Digital Video Quality Measure.</td>
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<td>2</td>
<td><strong>Fourier Analysis of Video Signals and Frequency Response of the Human Visual System.</strong></td>
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<td>a. <strong>Multidimensional Continuous-Space Signals and Systems.</strong></td>
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<td>b. <strong>Multidimensional discrete-Space Signals and Systems.</strong></td>
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<td>3</td>
<td>Video Sampling</td>
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<td>b. Sampling of Video Signals Over Lattices</td>
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<td>c. Filtering Operations in Cameras and Display Devices</td>
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<th>Video Sampling Rate Conversion</th>
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<td>a. Conversion of Signals Sampled on Different Lattices</td>
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<td>b. Sampling Rate Conversion of Video Signals</td>
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### 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.

### 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.
### 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.

### 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.
- Video.
- Profiles.

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

| Total | 40 |

**References:**