

# Image Quality and Formats

## Detailed Syllabus

Dr. Dendi Sathya Veera Reddy

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### 1 Digital Image & Video Fundamentals

- **Pixels and Sampling**
  - Definition of a pixel, Spatial resolution (DPI, PPI), Temporal resolution (frame rate)
- **Image Resolution**
  - SD, HD, Full HD, 4K, 8K
  - Impact on quality and storage
- **Color Representation**
  - RGB color model (24-bit, 8-bit channels)
  - Grayscale and binary images
- **Frame Rate (FPS)**
  - Common standards: 24, 30, 60 fps
  - Impact on motion perception
- **Interlacing vs. Progressive Scan**
  - Concepts, use in broadcast

### 2 Color Formats

- RGB vs. YUV/YCbCr: visual perception and compression efficiency
- Chroma Subsampling: 4:4:4, 4:2:2, 4:2:0
- Use cases in broadcasting and compression

### 3 Color Space Conversions

- RGB, Lab, HSV and YCbCr

- Matrix transformation formulas
- Applications in compression, HDR, rendering

## 4 Image Quality Parameters

- **MTF**: Spatial frequency response
- **SNR**: Noise quantification
- **MSE**: Mean Squared Error
- **Dynamic Range**: Log scale, HDR
- **Distortions and Artifacts**: Blur, aliasing, noise, moiré

## 5 Video Quality

- Frame rate and motion perception
- Motion blur and capture methods
- Synchronization of audio and video

## 6 Lighting Impact on Image Quality

- Natural vs. artificial light sources
- Color temperature (Kelvin scale)
- Low-light challenges: noise, blur, color shift

## 7 Basics of NIR Signals

- Principles of NIR capture, sensor characteristics, and applications

## 8 Visualization Modes (NIR Integration)

- White Light Mode: RGB image
- Green Overlay Mode: RGB + NIR signal added in green channel
- Color Mode: RGB + NIR signal added in green channel (different rendering)
- Contrast Mode: Pure NIR grayscale image

## 9 Subjective Quality Metrics

- **MOS (Mean Opinion Score) and DMOS (Difference in Mean Opinion Score)**: ITU protocols

- ACR, DSCQS, SAMVIQ methods
- Crowdsourcing quality assessments

## 10 Objective Quality Metrics

- **PSNR**: Formula, interpretation
- **SSIM, MS-SSIM**: Structure-based metrics
- **VMAF**: Fusion metric from Netflix
- **NSS**: Natural Scene Statistics
- **BRISQUE, NIQE**: No-reference image quality metrics

## 11 Tools for Quality Assessment

- **Open Source IQA Tools**: Python + OpenCV + SKImage
- **Open-Source Alternatives to Imatest**: ImageJ + Plugins (Fiji distribution)
- Python: Quality metric implementation

## 12 NIR Signal Separation Challenges

- Feasibility of separating NIR from each visualization mode
- Modes where separation is possible and limitations
- Methodologies:
  - Spectral channel analysis
  - Blind source separation (PCA, ICA)
  - Image differencing & filtering techniques

## 13 Compression & Advanced Topics

- **JPEG**: DCT, quantization, progressive modes
- **Video Compression**: H.264/H.265, motion estimation, GOP
- **HDR Imaging**: Exposure fusion, tone mapping
- **Computational Photography**: Super-resolution, Low light enhancement, Denoising
- **AI-based Quality Assessment**: CNN and Transformer-based IQA models, LIVE/TID datasets

## About the Trainer

Dr. Dendi Sathya Veera Reddy is a seasoned expert in **Digital Image and Video Quality Assessment**, with deep expertise in **computer vision**, **deep learning**, and **multimedia processing**. He holds a **Ph.D. from IIT Hyderabad** and an **M.Tech from IIT Kharagpur**, two of India's premier technical institutions.

He has previously worked with leading R&D organizations such as **Qualcomm India** and **Samsung Research**, where he contributed to the development and evaluation of cutting-edge imaging and video processing technologies.

With extensive academic and industry experience, Dr. Sathya has mentored **hundreds of students and professionals** in advanced imaging technologies and AI-powered vision systems. His contributions span across **image-video quality benchmarking**, and **AI-based assessment frameworks**.

He is currently serving as an **Adjunct Faculty at IIIT Dharwad**, an *Institute of National Importance*, where he continues to guide innovation in the areas of visual computing and intelligent systems.

**Phone:** +91-8332061735

**LinkedIn:** [linkedin.com/in/dsvreddy](https://www.linkedin.com/in/dsvreddy)