

Objective Video Quality Tests oriented to SDTV System

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Overview

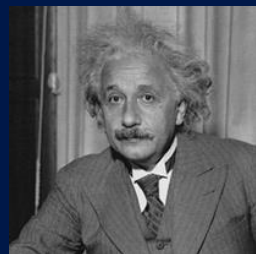
- ❖ Introduction to Video Quality
 - Measurement Methods: Subjective vs Objective
 - Types of Objective Methods: FR, RR and NR
 - Basic and perceptual metrics used on measurements
- ❖ Test Description
- ❖ Results

Introduction to Video Quality (I)

TDT Advantages for Users

- Uniform reception quality for all DTV programs (ATV channels).
- Access to new useful services: EPG, Data broadcasting, PVR, Time Shift, Interactive applications.
- Reception of radio stations.
- Increase of DTV programs (ATV channels).
- Better sound and **video quality**.

Introduction to Video Quality (II)



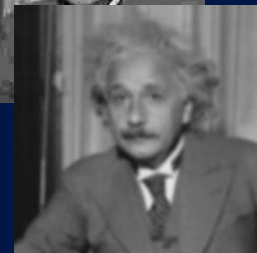
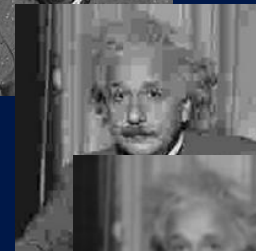
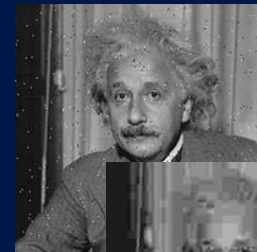
Original
Image



Transmission Degradation

Information Loss (coding)

Delay, error, packet loss (IP network)



Distorted
Image

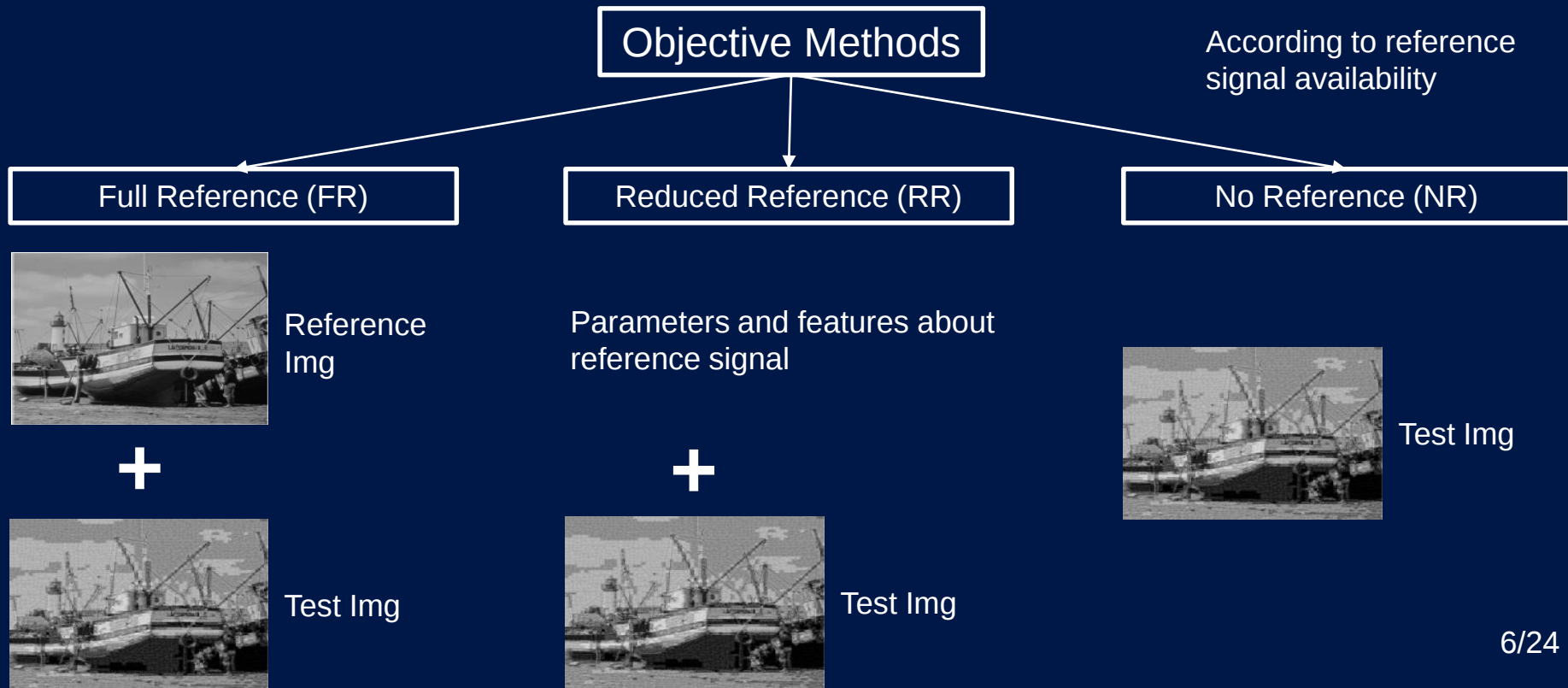
Introduction to Video Quality (III)



- Based on the perception of humans.
- Quality measured by the MOS (Mean Opinion Score)
- Most accurate method to measure video quality
- Can not be used for monitoring real time applications
- Expensive
- Not repeatable

- Based on automatic procedures and mathematical algorithms
- Quality measured by several metrics
- Try to estimate and predict video quality approximating to subjective assessments
- Can be used for monitoring real time applications
- Expensive or inexpensive
- Repeatable

Introduction to Video Quality (IV)



Introduction to Video Quality (V)

Metrics used to measure FR Objective Quality of Processed Digital Video

Basic Metrics: Based on calculating the pixel by pixel difference between original and test images

- Mean Square Error (MSE)
- Peak Signal to Noise Ratio (PSNR)
- MSAD
- DELTA

Perceptual Metrics: Perception characteristics of Human Visual System (HVS) are taken into account

- Structural Similarity (SSIM)
- New Quality Index (NQM)
- Video Quality Metric (VQM)

Introduction to Video Quality (VI)

Basic Metrics

MSE: Average squared difference between original and test image

PSNR: Ratio between maximum possible value of reference image and the value of distorting noise that affects the quality of its representation

Introduction to Video Quality (VII)

Basic Metrics

MSAD

$$d(X, Y) = \frac{\sum_{i=1}^m \sum_{j=1}^n |X_{i,j} - Y_{i,j}|}{mn}$$

Mean absolute difference of color components



DELTA

$$d(X, Y) = \frac{\sum_{i=1}^m \sum_{j=1}^n (X_{i,j} - Y_{i,j})}{mn}$$

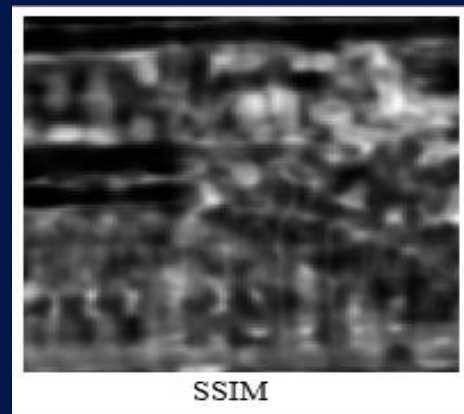
Mean difference of color components



Introduction to Video Quality (VIII)

Perceptual Metrics

SSIM: Based on measuring three components (luminance, contrast and structural similarities) and combining them into a result value named SSIM index.



Introduction to Video Quality (IX)

Perceptual Metrics

NQI: Defines picture distortion as a combination of three factors: difference in mutual characteristics, luminance and contrast.

VQM: Based on DCT and spatial-temporal properties of human visual perception.

Purpose

Estimate the quality degradation of a video transmitted simultaneously on three SDTV programs using objective FR metrics.

Test Description

Air DTV Signal



Transport
Stream
Analyzer



Recorded TS file

MPEG-2 Demux
Software

Demultiplexing software
developed in LACETEL,
in 2014



Cubavisión



InfantilCHab



CVI

Reference Video



Test Video

Cubavisión

Test 1

EVQE

Metrics



Elecard Video Quality Estimator

Reference Video

CVI

Test Video

Cubavisión

Test 2

EVQE

Metrics

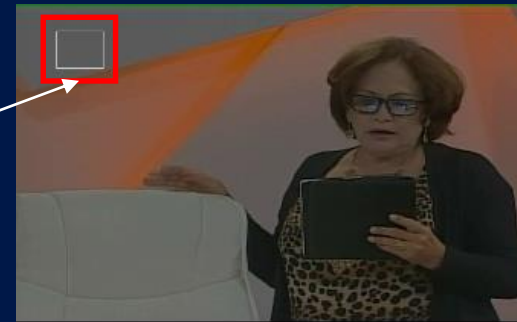
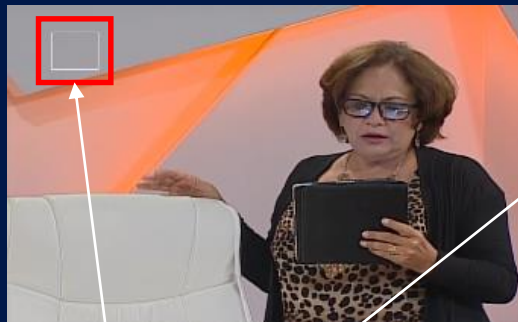
InfantilCHab

Results

Cubavisión

CVI

InfantilCHab



Reference

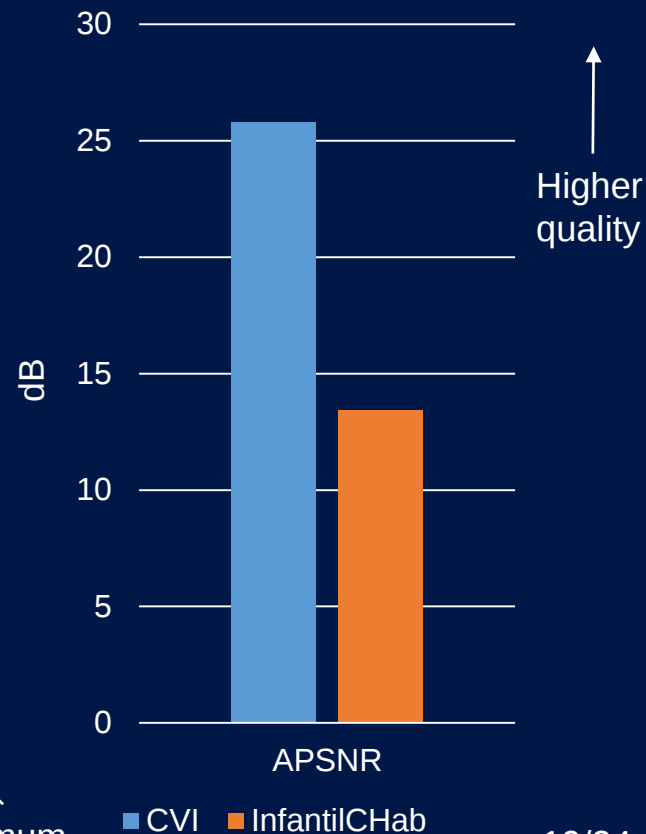
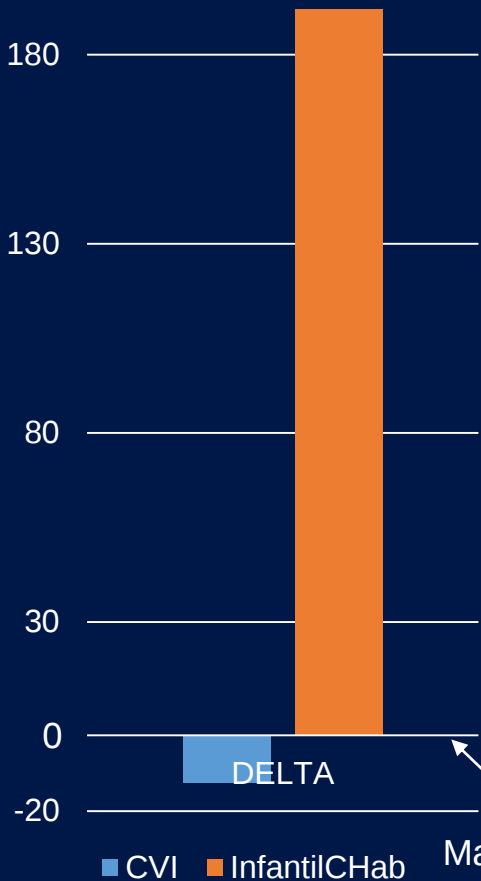
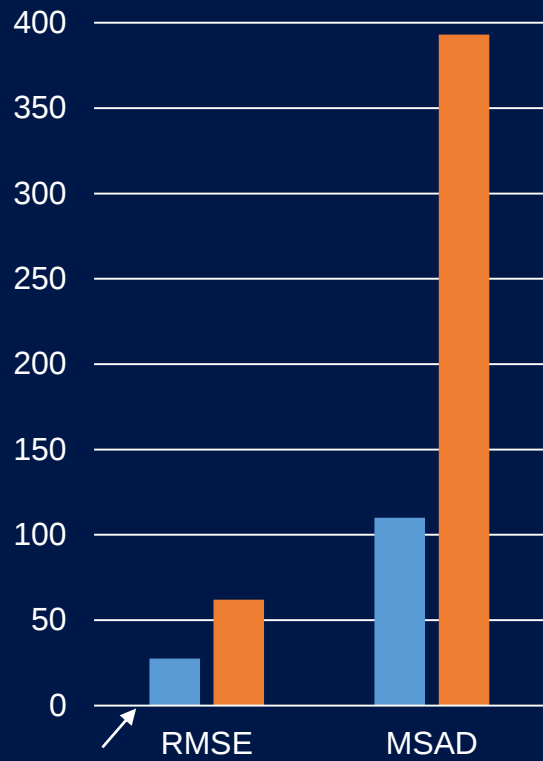
Cropping area

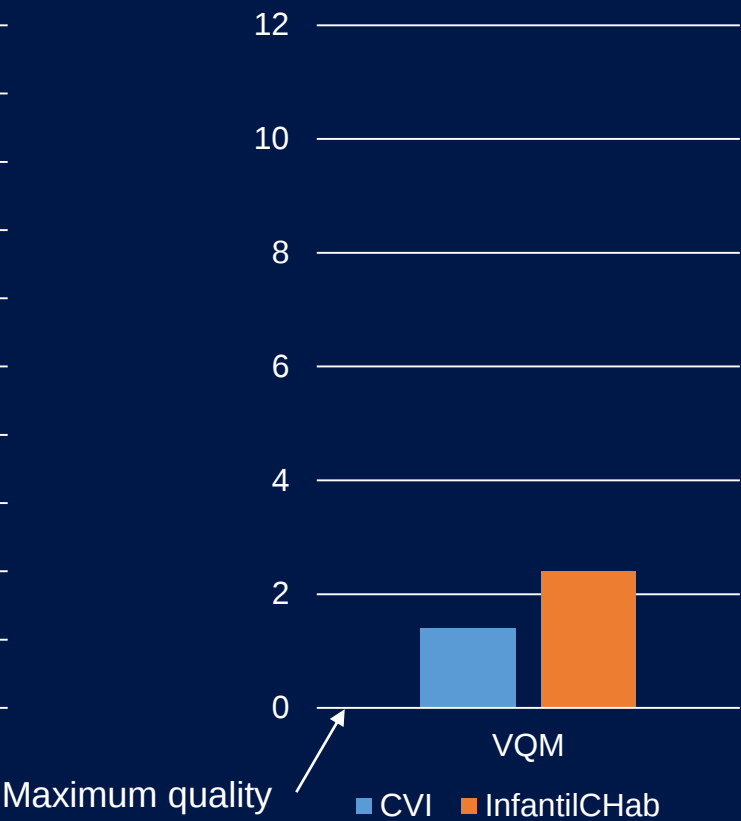
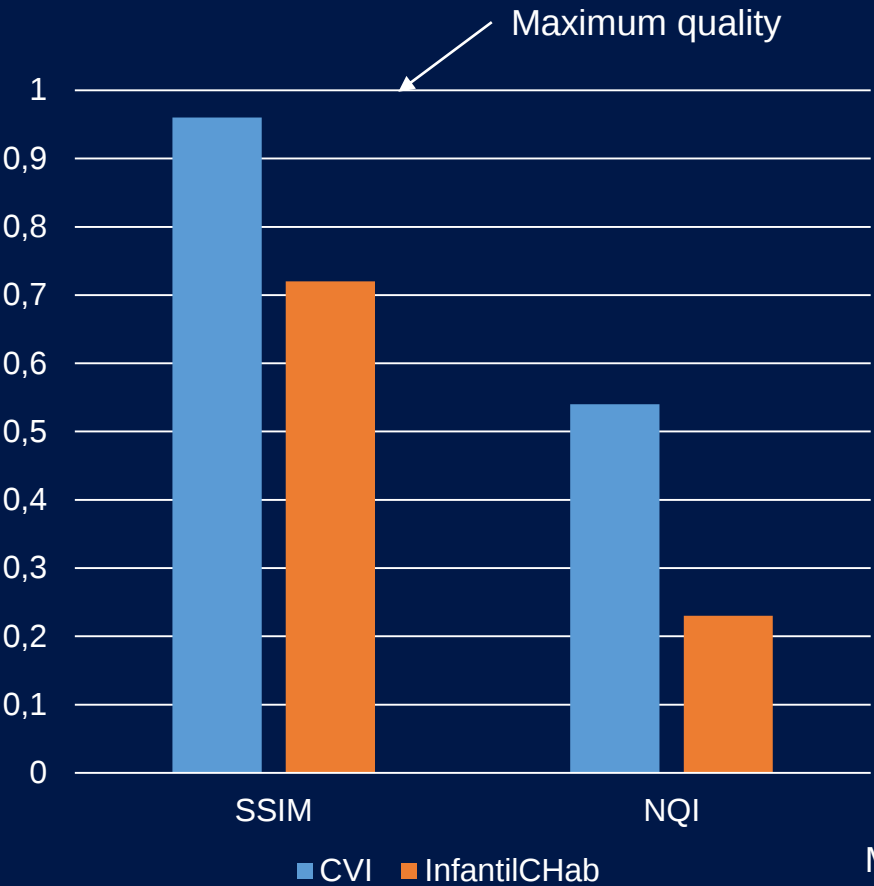
RMSE = 27.43
 APSNR = 25.8 dB
 MSAD = 109.98
 DELTA = -12.58

SSIM = 0.96
 NQI = 0.54
 VQM = 1.40

RMSE = 61.91
 APSNR = 13.41 dB
 MSAD = 393.20
 DELTA = 192.10

SSIM = 0.72
 NQI = 0.23
 VQM = 5.81







Cubavisión/CVI Difference



Cubavisión/InfantilCHab Difference

More defined areas correspond to greater difference

Conclusions

- All the objective metrics calculated prove that the same video has different quality on the three DTV programs under test.
- The video transmitted on “InfantilCHab” DTV program has lower quality than the one transmitted on “CVI” DTV program.

Recommendations

- Study the current video processing/transmission system to determine the origin of these degradations.
- Perform subjective tests in order to obtain a more accurate assessment of quality for these video sequences.
- Study and perform other objective quality tests using more advanced metrics.

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