Video Quality Assessment

Learning Progress Report

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Learning Goals and Topics

- Understand models of non-reference VQA and their mathematical basis
  - BRISQUE

What is BRISQUE?

- Full name: Blind/Referenceless Image Spatial Quality Evaluator
- Type: No-Reference Image Quality Assessment (NR-IQA)
- Goal: Evaluate image distortion (e.g., blur, noise, compression) without the original image
- Application: Image processing, visual quality analysis, UGC quality rating

Overall Pipeline

1. Convert the input image to grayscale
2. Compute MSCN (Mean Subtracted Contrast Normalized) coefficients
3. Fit Generalized Gaussian Distribution (GGD) and Asymmetric Generalized Gaussian Distribution (AGGD)
4. Extract 28-dimensional feature vector
5. Use a pre-trained SVR model to predict the quality score

MSCN Formula

$$\hat{I}(i,j) = \frac{I(i,j) - \mu(i,j)}{\sigma(i,j) + C}$$

- $\mu(i,j)$: Local mean around pixel (i, j), computed via Gaussian filter
- $\sigma(i,j)$: Local standard deviation
- C: Small constant to avoid division by zero (typically 1.0)

Purpose: Normalize local luminance and contrast to make distortions more detectable

GGD Fitting Formula

GGD is used to fit the MSCN distribution:

$$f(x;\alpha,\beta) = \frac{\beta}{2\alpha\Gamma(1/\beta)} \exp\left(-\left(\frac{|x|}{\alpha}\right)^{\beta}\right)$$

- α: Scale parameter (related to standard deviation)
- β: Shape parameter (controls sharpness of distribution)
- β = 2 → becomes a Gaussian distribution

AGGD Fitting Formula

AGGD fits directional pairwise products of MSCN:

$$f(x) = \begin{cases} \frac{\beta}{(\lambda_l+\lambda_r)\Gamma(1/\beta)} \exp\left(-\left(\frac{-x}{\lambda_l}\right)^{\beta}\right), & x < 0 \\ \\ \frac{\beta}{(\lambda_l+\lambda_r)\Gamma(1/\beta)} \exp\left(-\left(\frac{x}{\lambda_r}\right)^{\beta}\right), & x \geq 0 \end{cases}$$

- λ_l, λ_r: Scale (std) for negative and positive sides
- β: Shape parameter

Why It Works

- Natural images exhibit stable local statistics (MSCN distribution)
- Distortion alters these statistics (distribution becomes asymmetric or heavy-tailed)
- BRISQUE captures these shifts as a proxy for visual degradation

BRISQUE Feature Dimensions

Source	Count
GGD (MSCN itself)	2
AGGD × 4 directions	3 × 4 = 12
2 scales (original + downsampled)	2
Total	**28 features**

SVR Prediction

- Trained using human-rated scores (e.g., MOS or DMOS)
- Input: 28-dimensional BRISQUE feature vector
- Output: Predicted quality score (lower is better)

Summary

- BRISQUE is a statistical, reference-free IQA method
- Uses GGD and AGGD to model local distortions
- No need for a reference image
- Practical for UGC and real-world visual quality assessment

Thank You