

# **A Novel Image Quality Assessment Metric using SVD**

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# INTRODUCTION



# INTRODUCTION

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- Image Quality Assessment (IQA)
- Traditional IQA Models -
  - Mean Square Error ( MSE )
  - Peak Signal to Noise Ratio (PSNR)
- IQA models are categorized as -
  - Full Reference (FR) IQA model
  - Reduced Reference (RR) IQA model
  - No Reference (NR) IQA model

# PROPOSED MODEL

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- FR-IQA Model
- Approaches for FR-IQA model
  - Bottom-Up Approach
  - Top-Down Approach
- Frameworks for Top-Down approach
  - Structural Similarity Index (SSIM)
  - Non-Shift Edge based Ratio (NSER)
  - Information Fidelity Criteria (IFC)
  - Visual Information Fidelity (VIF)

# TOP DOWN APPROACH

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To extract Structural Information, following methods are used -

- Discrete Cosine Transform (DCT)
- Wavelet Transform (WT)
- Singular Value decomposition (SVD)



# METHODOLOGY



How SVD was traditionally  
used in IQA models?

# How SVD is used in proposed methodology?

- Computation of Basis Vector using SVD
- Image Quality Assessment



# COMPUTATION OF BASIS VECTOR USING SVD

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- SVD can be applied in two ways-
  - Globally
  - Locally
- In Prior method, SVD is applied on complete image.
- In Proposed method, SVD is applied on sub-images.
  - Images are decomposed into  $m \times m$  sub-images
  - Mean Subtraction is performed on each local sub-image.
  - Each mean subtracted images are then combined and results into new sub-image.  
( $m \times n$  dimension, where  $n = 2m$ )

# CONT.

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- SVD is applied on the new sub image-

$$X = U \times S \times V^T$$

$$X = U \times P$$

Where,

$$\left\{ \begin{array}{l} X - i^{\text{th}} \text{ new sub-image} \\ U - m \times m \text{ unitary matrix} \\ S - m \times n \text{ diagonal matrix} \\ V - n \times n \text{ unitary matrix} \\ P - m \times n \text{ projection matrix} \end{array} \right\}$$

# IMAGE QUALITY ASSESSMENT

- Matrix P decomposed into PR and PD matrix

- $ds(j) = \sqrt[3]{\sum P_{rj}^3} - \sqrt[3]{\sum P_{dj}^3}$

Where,

$$\left\{ \begin{array}{l} ds(j) - \text{quality score of } j^{\text{th}} \text{ sample vector} \\ P_{rj} - j^{\text{th}} \text{ projection coefficient vector of PR} \\ P_{dj} - j^{\text{th}} \text{ projection coefficient vector of PD} \end{array} \right\}$$

- $dl(i) = \sqrt{(\sum_{j=1}^m (ds(j) - mds)^2)/m}$

$$mds = (\sum_j^m ds(j))/m$$

Where,

$$\{ dl(i) - \text{quality score of } i^{\text{th}} \text{ local sub- image} \}$$

- $score = (\sum_i^n dl(i))/n$



# IMPLEMENTATION





# CONCLUSION



- A new methodology based upon SVD for FR-IQA has been proposed.
- Both reference and distorted images have been used to compute the singular values and basis vectors.
- Projection coefficient vectors of both reference and distorted images are used to compute the final score.
- The results show that proposed methodology is comparable with other IQA models.



# THANK YOU!

