Low Complex Blind Video Quality Predictor Based on Support Vector Machines

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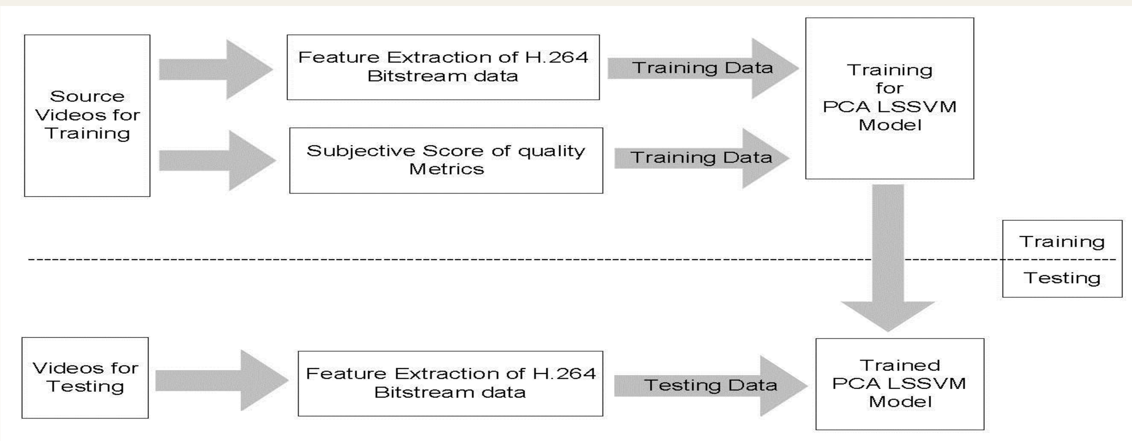
Abstract

- Objective Video Quality Assessment plays an important role in visual processing systems and specially in mobile communication field, some of video applications boosted the interest in need of robust methods for No-Reference(NR) Objective Video Quality Assessment where the handiness of reference video is not available.
- Our challenge lies in formulating and melding effective features into one model based on human visualizing characteristics. Our research work explores the tradeoffs between quality prediction and complexity of system.
- we implemented support vector regression algorithm as NR-based Video Quality Metric(VQM) for quality estimation with simplified input features. The features are obtained from extraction of H.264 Bit stream data at decoder side of network.
- Our metric has predicted with good correlation for all deployed metrics and the obtained results demonstrates robustness of our approach.

Proposed Approach

We proposed an idea, when an encoded video is transmitted through a channel or network, coding results in the bit stream data at decoder side consists of motion vector parameters, coded residual coefficients, header information. Our interest lies in estimating video quality without using any reference or distorted video but features extracted from H.264bitream.

- Building the proposed Quality Predictor using Data analysis
- Proposed model is regressed with extracted bitstream features and coresponding target values of various quality metrics.
- Based on training experiences our metric predicts residuals for unknown sequences
- The performance of model is measured between true and predicted values for selected quality metrics

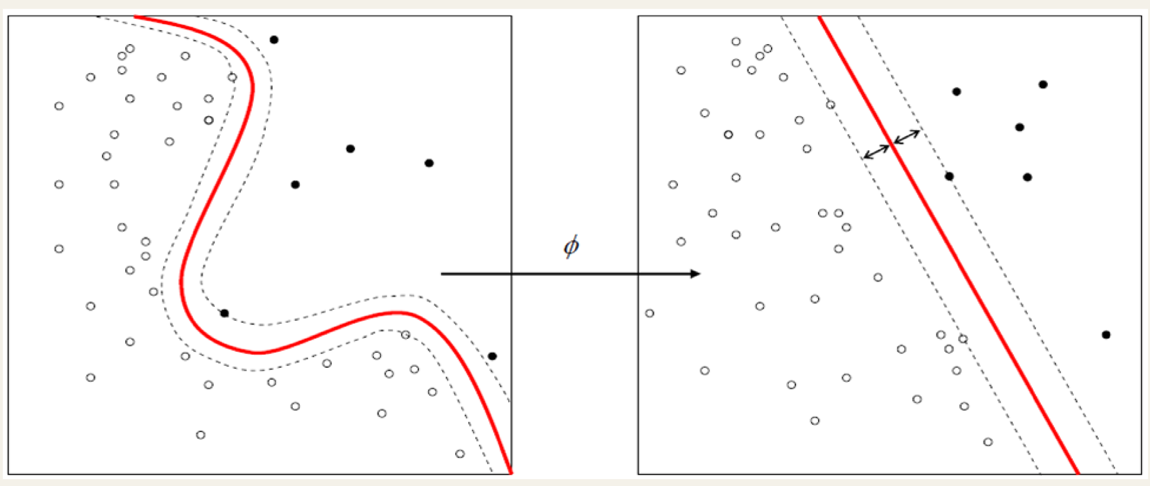


Generation of Video Sequences

- All Video sequences were encoded with JM Reference software version 16.1 based on H.264/AVC Standards generated by JVT using baseline profile.
- We selected Six Videos Sequences based on motion content and spatial/temporal complexity.

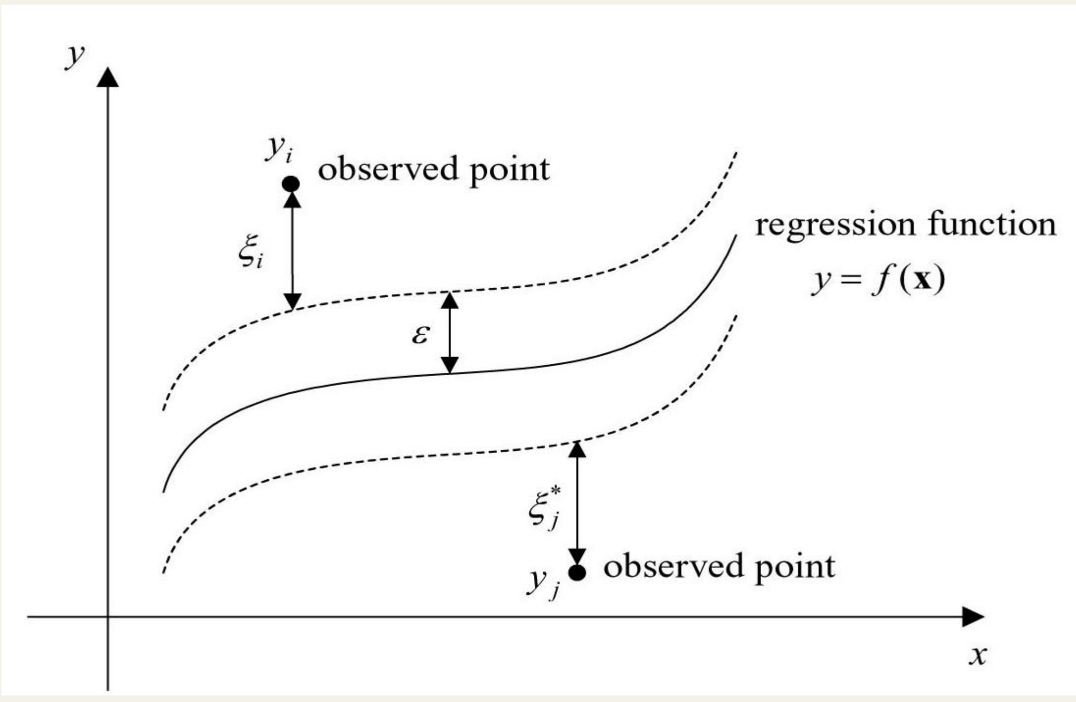
Kernel Based Learning concept

- Generally, kernel based learning methods are classified into supervised and unsupervised learning algorithms. Kernel method solves any problem by mapping the input data set into high dimensional kernel space via linear or nonlinear mapping which is also referred as kernel trick.
- This algorithms are used for regression, classification and other jobs. In recent years, few powerful kernel based machines were proposed and support vector machines is one among them.
- we adopted both supervised learning and unsupervised learning methods in our thesis work.



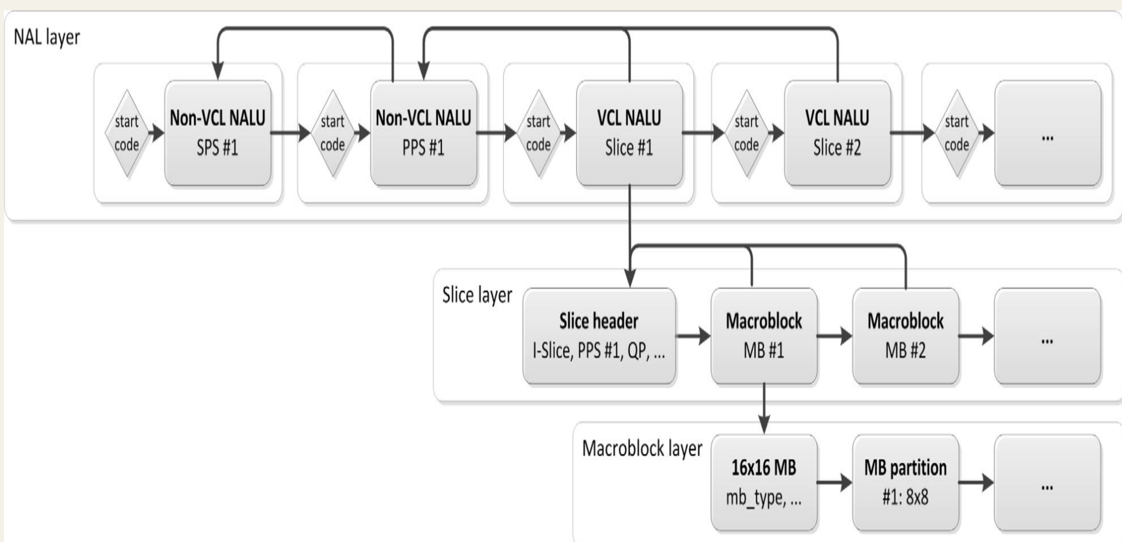
Support Vector Machines

- Support Vector Machines Algorithm is a supervised learning method, where a non-linear function is transformed to linear function and regression or classification analysis is performed in high dimensional Kernel induced space.
- The capacity of the model is controlled by parameters that do not depend on dimensionality of feature space.
- In support vector regression, a loss function is introduced that ignores errors situated within the zone of the true value while regressing and predicts the residuals for unknown data.



Features Extraction of H.264 Bitsteam Data

- Feature Extraction of 120 videos has been processed using JM Reference software Version16.1.
- The properties of encoded videos are acquired from bit stream data of H.264/AVC which has been generated as a trace file while encoding process.
- Rather than using completely decoded frame, our interest lies in reversing the entropy encoding of bit stream and by analyzing three successive NAL, Slice and Macro Block Layer the features were extracted.



Dimensionality Reduction

- Generally when we are dealing with high dimensional data, addition of more features will effect the model performance and increase complexity of system.
- Dimensionality reduction is suitable in visualizing data, noticing a compact representation and minimizes computational processing.
- Especially in machine learning, any model required large number of features for training so that they are numerous samples with each permutation of values.
- We employed Principle Component Analysis for dimensionality reduction.

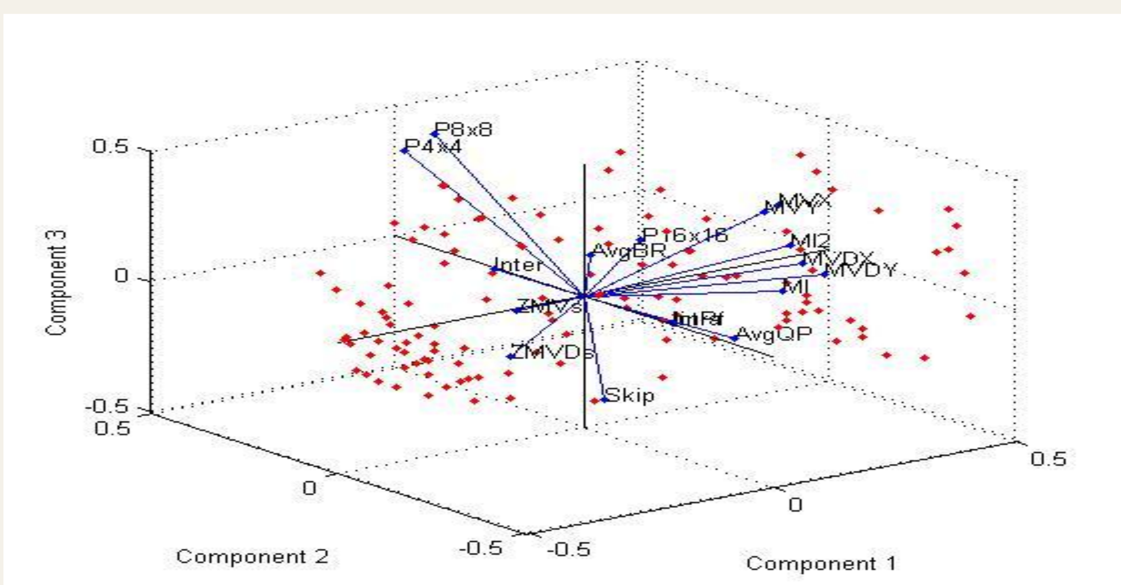
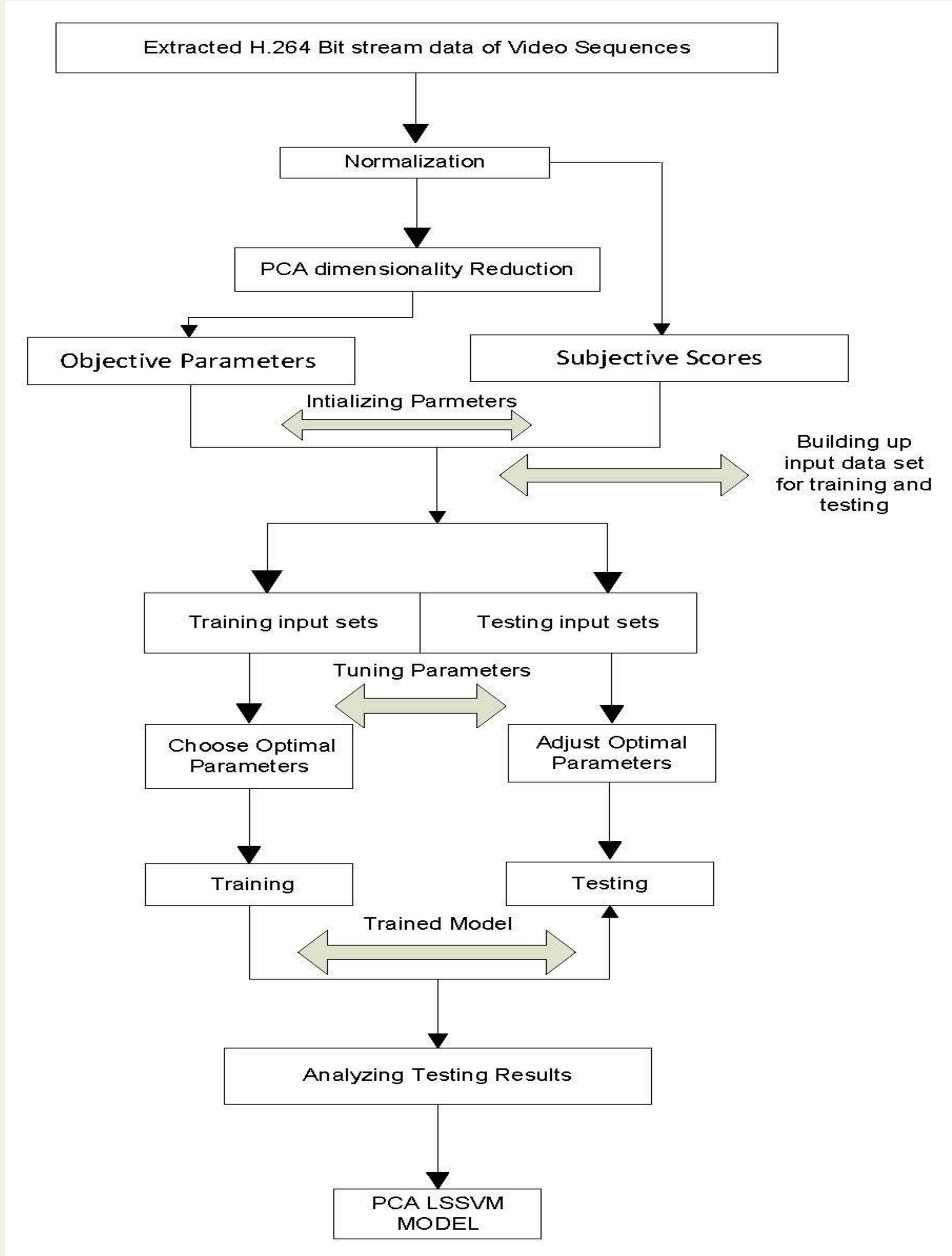


Figure 1 illustates the features which are characterized by a vector, the contribution of each feature towards three principle components are indicated by distance and direction of vector

Quality Metrics

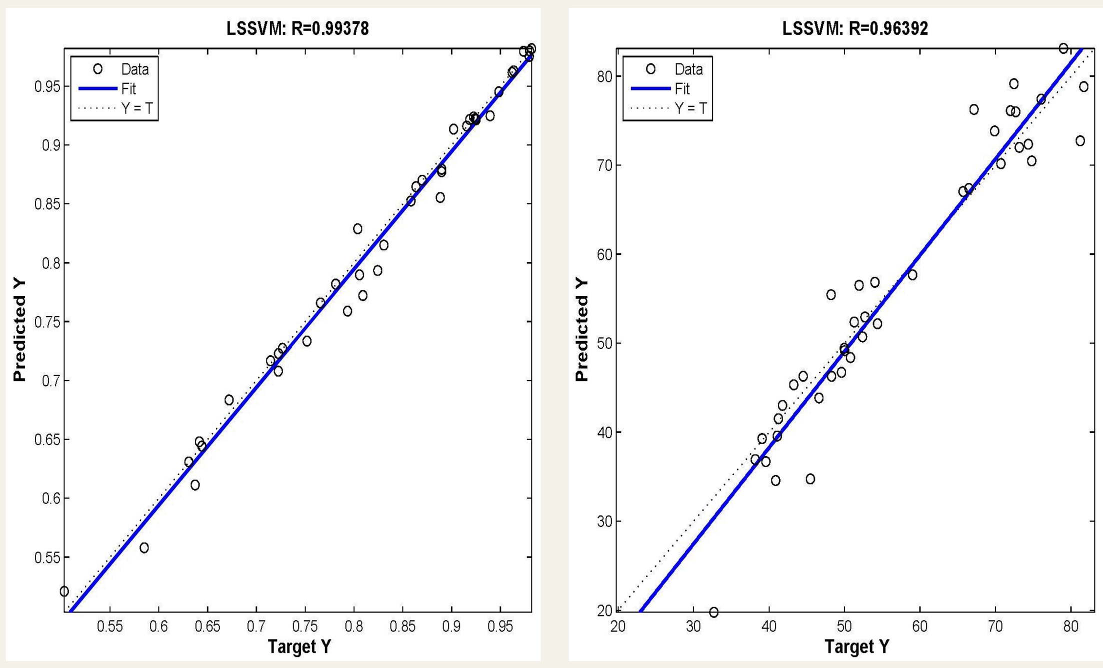
- We performed quality test by SSIM, PEVQ and PSNR Quality metrics for generated video sequences.
- We also conducted subjective experiments for all 120 videos based on ITU-BT.500 recommendation.

Framework of Proposed Scheme



Results

- Performance of Objective Quality prediction Model is evaluated by the aspects Based on According to Video Quality Experts Group phase II test.
- They are prediction accuracy and consistency these attributes are evaluated by Pearson Correlation Coefficient(PCC) and Outlier ratio(OR).
- The below plots illustrate correlation coefficient for predicted values or residuals after regressing with true values Y of SSIM and MOS(Subjective Score).



Statistical Analysis

	MOS		PEVQ		SSIM		PSNR	
Stats	LSSVM	PCA LSSVM	LSSVM	PCA LSSVM	LSSVM	PCA LSSVM	LSSVM	PCA LSSVM
PCC	0.96	0.94	0.98	0.97	0.99	0.98	0.94	0.93
OR	0.47	0.37	0.45	0.45	0.42	0.35	0.42	0.52

Conclusions

- We conclude that prediction accuracy of proposed model has good correlation for all deployed metrics, obtained results demonstrates robustness of our approach.
- In our research work, proposed metric obtained good correlation with Subjective scores which concludes that proposed metric truly understands HVS characteristics and can be employed for real time use. Since, subjective scores are considered as true or standard values of video quality.