PIXEL DOMAIN REFERENCELESS VISUAL DEGRADATION DETECTION AND ERROR CONCEALMENT FOR MOBILE VIDEO

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Vantrix Industrial Research Chair in Video Optimization

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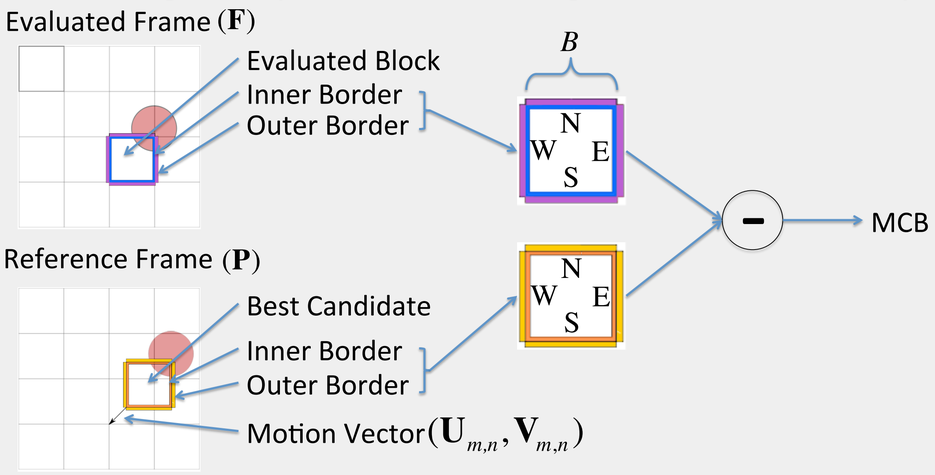
1. INTRODUCTION

In mobile video applications, where unreliable networks are commonplace, corrupted video packets can have a profound impact on the quality of the user experience. Error resilient mechanisms like retransmission and redundant frames may impose an unacceptable burden on mobile networks. In these cases a decoder-based error resilience approach, that selectively reuses content from broken packets, can help improve the end-user's experience without adding load to the network.

2. MOTION-COMPENSATED BLOCKINESS

This selective reuse is guided by a novel concept that combines motion estimation and a measure of blocking artefacts at block edges to predict visual degradation caused by the decoding of erroneous packets.

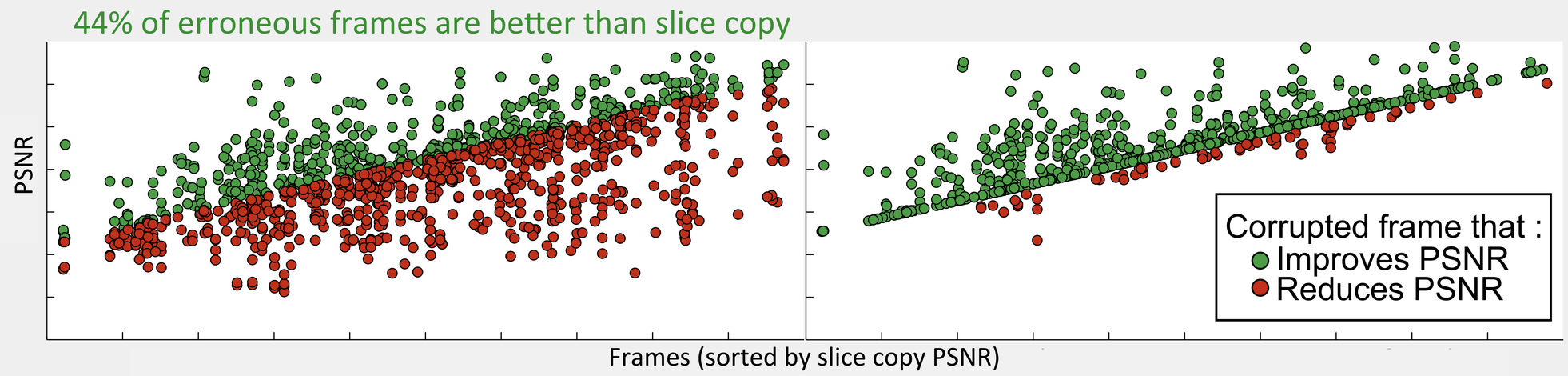


- The sum of the MCB for all borders of a block is measured by $\mathrm{SMCB}(\mathbf{F},\mathbf{P},m,n) = \sum_{d\in\{\mathrm{N,E,S,W}\}} \mathrm{MCB}_d(\mathbf{F},\mathbf{P},m,n)$.
- The MCB is
$$\mathrm{MCB}_d(\mathbf{F},\mathbf{P},m,n) = \sum_{l=0}^{B-1} \left| b_{d,l}(\mathbf{F},mB,nB) - b_{d,l}(\mathbf{P},mB+\mathbf{U}_{m,n},nB+\mathbf{V}_{m,n}) \right|.$$
- The blockiness (*inner vs. outer border difference*) measures are
$$\mathrm{b}_{\mathrm{N},l}(\mathbf{I},x,y) = \mathbf{I}_{x+l,y} - \mathbf{I}_{x+l,y-1}, \quad \mathrm{b}_{\mathrm{S},l}(\mathbf{I},x,y) = \mathbf{I}_{x+l,y+B} - \mathbf{I}_{x+l,y-B-1},$$
$$\mathrm{b}_{\mathrm{E},l}(\mathbf{I},x,y) = \mathbf{I}_{x+B,y+l} - \mathbf{I}_{x+B-1,y+l}, \quad \mathrm{b}_{\mathrm{W},l}(\mathbf{I},x,y) = \mathbf{I}_{x,y+l} - \mathbf{I}_{x-1,y+l}.$$

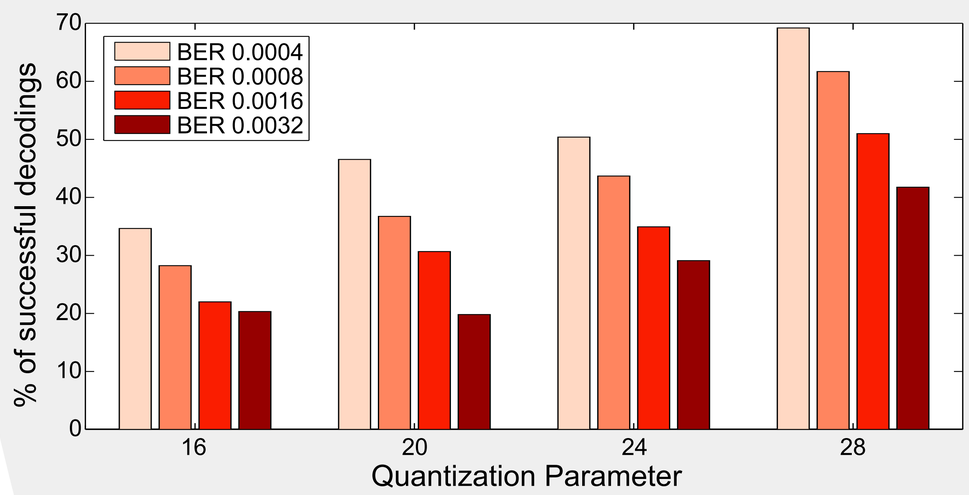
3. EXPERIMENTAL RESULTS

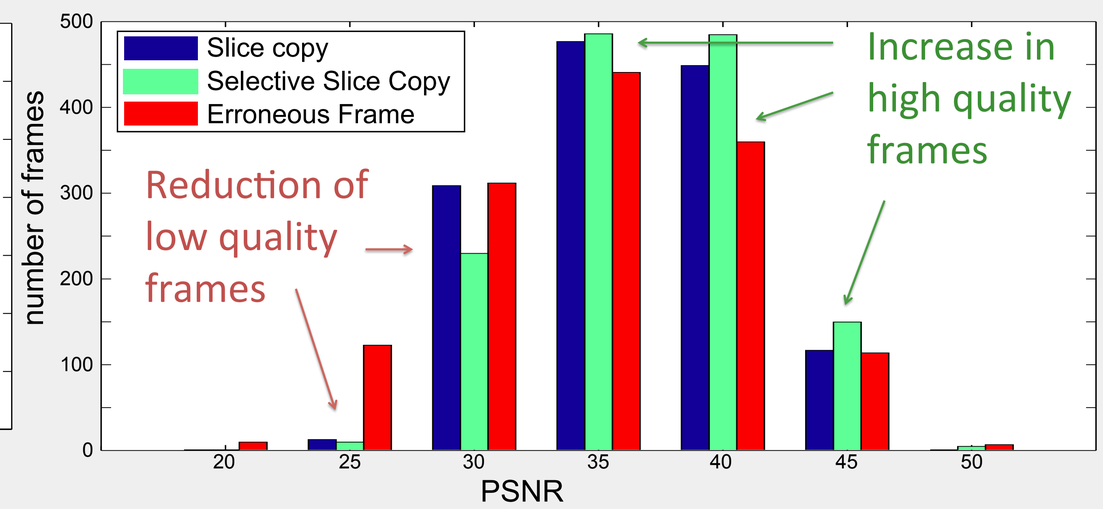
We tested against 17 H.264 coded QCIF sequences with quantization parameters from 16 to 28 and exposed to bit error rates of 0.0004 to 0.0032. Comparing the measured SMCB for frame copy and the erroneous frame, the H.264/AVC JM reference software decoder can select the best option in 81% to 86% and 88% to 91% of the test cases.

Before and After Selective Slice Concealment



Results show that the probability of successfully decoding a broken sequence varies from 20% to 70%. The proposed method leads to an average gain of 0.65 dB to 0.86 dB.





4. CONCLUSION

We propose a low-complexity decoder-based method that allows on the fly analysis of erroneous slices in order to decide whether to use them vs. slice copy so as to improve the visual quality without further burden to the network.

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