SoftCast-based Linear video coding (LVC)

SoftCast [1]: Linear joint source-channel video coder

- 3D-DCT, power allocation, analog modulation, LMMSE estimation
- Received quality improves gracefully with channel quality.

\[ y = \hat{y} + F v \]

\[ v = v_L + v_I \]

\[ v_I \text{ is a sparse impulse noise vector} \]

\[ F \sim \mathcal{CN}(0,\sigma_I^2) \]

\[ y \sim \mathcal{CN}(\mu,\sigma^2) \]

Optimal subchannel provisioning (OSP)

Assuming \( f_i \sim \mathcal{CN}(0,\sigma_i^2) \), a phenomenological model for

\[ \log_{10}(\sigma^2_f) = \mu_0 (r_{\text{dB}} \text{INR}_{\text{dB}}) + \mu_1 (r_{\text{dB}} \text{INR}_{\text{dB}})^2 \text{log}_{10}(\eta_i) \]

where \( \mu_0 = \mu_0 + \mu_1 (1-r_{\text{dB}}) + \mu_2 (1-r_{\text{dB}})^2 \) \( r_{\text{dB}} \) INR \( \text{dB} \)

IMPULSE MITIGATION FOR LINEAR VIDEO CODING SCHEMES

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ABSTRACT: The problem of impulse noise mitigation is considered when videos encoded using a SoftCast-based Linear Video Coding (LVC) scheme are transmitted using an OFDM scheme over a wideband channel prone to impulse noise. A Fast Bayesian Matching Pursuit algorithm is employed for impulse noise mitigation. This approach requires the provisioning of some OFDM subchannels to estimate the impulse noise locations and amplitudes. Provisioned subchannels cannot be used to transmit data and lead to a decrease of the nominal decoded video quality at receivers in absence of impulse noise. Using a phenomenological model (PM) of the residual noise variance after impulse correction, an algorithm is proposed to evaluate the optimal number of subchannels to provision for impulse noise mitigation. Simulation results show that the PM can accurately predict the number of subchannels to provision and that impulse noise mitigation can significantly improve the decoded video quality compared to a situation where all subchannels are used for data transmission.

Results

First frame of Racehorses when SNR=15dB, INR=10dB and \( p_I=0.01 \).

\[ \text{LVC-NIC: PSNR 30.83dB} \]

\[ \text{LVC-OSP: PSNR 38.64dB} \]

Impact of mismatched \( p_I \)

Impact proportion of provisioned subchannels \( r_d = q/n_{\text{SC}} \)

First 5 GoPs of BQSquare, with different impulse noise probability \( p_I \) and \( r_d \).

\[ r_d = 0.25 \]

\[ r_d = 0.5 \]

\[ r_d \text{ has to be optimized. Optimal value depends on } p_I \text{ and } \sigma^2_I \]

Conclusions

SoftCast-based LVC with impulse noise mitigation scheme is proposed. Phenomenological model proposed to estimate variance of impulse noise residual after impulse mitigation. Used to optimize subchannel provisioning. Approach robust to mismatched impulse noise characteristics.

Bibliography


