Chap 6. Conclusions and Future Works

\section{Conclusions}

\label{e:conclusion}

In this final chapter, conclusions from all previous chapters are made. Besides, in order to complete a more general purpose wireless video transmission system, some suggestions for the future research directions are introduced as well. These suggestions are expected to be able to provide the next steps along the path toward a practical and widely applicable system.

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\section{Conclusions}

\label{ee:conclusion}

%The objective of this thesis has been to elaborate the main concept of the proposed UEP scheme designed for uncompressed video transmission system based on MRF ISCD, including its motivation, problems formulation, derivation details and final structures. In Chapter \ref{i:intro}, the background of wireless uncompressed video transmission is introduced and the concept of UEP scheme is brought out additionally. That is, the purpose of the proposed UEP scheme in this thesis is to improve the quality of a wireless uncompressed video transmission system through delivering different transmission energy to each bit-plane.

%In Chapter \ref{chapter:opt-prob}, the optimization problem for purpose of the proposed UEP scheme is formulated. However, a distortion estimator in encoder is required according to the proposed formula. Thus, the distortion estimator for basic decoder utilizing only the current channel information and channel code information acquired in advance is derived in the same chapter. Then, the simulation results show that the proposed UEP scheme performs better than EEP scheme with an average 14 dB gain in terms of PSNR. As a result, Chapter \ref{chapter:estimation} further updates the distortion estimator to adapt to MRF based ISCD which is introduced in Chapter \ref{b:intro}. Based on the result of the derivation, simulations are compared with the performance of EEP scheme.

In this thesis, we have proposed an UEP scheme designed for uncompressed video transmission system based on 3D-MRF iterative joint source-channel decoder (ISCD). Improving the quality of a wireless uncompressed video transmission system through delivering different transmission energy to each bit-plane is the main purpose of our proposed UEP scheme. Firstly, by our proposed distortion estimation for ISCD decoded video in Chapter \ref{chapter:estimation}, the encoder can predict the expected decoded visual quality with only the redundancy information described in Markov random field (MRF) model, current channel information fromchannel estimation, as well as the channel code information acquired in advance. Once the encoder can predict the distortion of the decoded video in receiver, the encoder can thus determine the transmission energy allocation for different bit-planes in order to obtain the optimized decoding quality according to the UEP concept introduced in Chapter \ref{chapter:opt-prob}. As a result, the inference of the UEP scheme based on the proposed distortion estimation is then solved by the Lagrange multiplier method and proposed in Chapter \ref{chapter:optimization}. Finally, the iterative solver for the proposed UEP scheme is constructed and it helps the encoder decide the transmission energy distribution among bit-planes.

Based on the simulation results, the proposed UEP scheme increases the efficiency of the transmission energy usage and enhances the decoded quality in the meanwhile. Besides, The numerical results have also shown that our proposed UEP scheme can significantly enhance the decoded video quality in terms of PSNR in comparison with the conventional EEP scheme. Several video sequences are used as the test sequence to verify the performance of our proposed UEP scheme. Additionally, in this simulation result, it is observed that the proposed UEP scheme also can improve the ability of the noise tolerance for uncompressed video streaming since the PSNR drops and rapid varying in EEP scheme are all mitigated in the proposed UEP scheme. In summary, our proposed UEP scheme can successfully enhance the quality and the energy efficiency in the wireless uncompressed video transmission system through the optimized transmission energy allocation.

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\section{Future Works}

\label{ee:future\_works}

% future work

In the end of this thesis, there are several suggestions for the next steps of UEP scheme and this system. First of all, it is noticed that the accuracy of the distortion estimator for the temporal ISCD is actually a little more imprecise than that of the estimator for the spatial ISCD. It might caused by the iterative process in ISCD structure, that results in information propagation through the video. Nevertheless, the solution in currently proposed UEP scheme cannot adapt to this process well. In hence, the first work is to provide an updated structure to handle the iterative process in temporal ISCD. Second, the simulation environment in this thesis only utilizes one channel codec, BPSK modulation and AWGN channel for the sake of simplification. To confirm that the proposed UEP scheme outperforms than other UEP schemes more generally, more simulation environment arrangements should be tested and be compared with other common UEP schemes.

The above two future research directions are for the integrity of the proposed UEP scheme in this thesis. Then, the following two suggestions are for the next steps of the proposed wireless uncompressed video transmission system using ISCD and corresponding UEP scheme to become a more general applicable video transmission system. The first direction is the popular 4K resolution that equals 4 HD frames playing at the same time. Since the transmitted sequence is under such a large resolution, such system is expected to execute frame partition for higher process speed. Therefore, the solutions for 4K resolution or the frame partition algorithm are the next research directions. Additionally, for an ISCD decoder, it is better to consider one compression algorithm which can execute SISO compression as well as SISO decompression. As long as such source code is substituted for the original MRF based SISO source decoder, not only the strength of the ISCD structure can be retained, but also the transmission data rate can dramatically decrease to a much more relaxed level. The whole proposed future works is to make this wireless video system a more general purpose and more applicable system in another day.