# Wavelet-based image data compression

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This work concentrates on problems of image data compression. Our research deals with the optimisation of tools capable of forming natural and medical image representations. The presented ideas refer to fundamental compression theses and important practical (realisation) notes. Both the construction of a whole compression scheme and the more detailed design of selected components are considered. Moreover, the formulated definition of the new wavelet-based image coding paradigm shows a useful pattern for current still-image compression applications. This paradigm is in response to the present challenges facing the disciplines of both theoretical and practical data compression. These challenges encompass the reality of overcrowded networks and insufficient data storage capacity, and also have such facets as obtaining accurate models of naturally occurring sources of image data and "optimal representations" of such models with the help of rapid algorithms. Te wavelet coder seems to be able to fulfil all of these demands. The depicted advantages of the wavelet decomposition and coder scheme and the practical benefits due to its implementation are determined using the essence of former and present optimisation efforts in the field of image data compression.

The complex process of wavelet coder optimisation is considered. The fundamentals of state-of-the-art coders are analysed, compared and synthesised. The common element of using conditional data models is proposed for a whole compression scheme optimisation. Local data characteristics, correlated conditional data modelling, context selection and quantization are applied in the processes of integer wavelet transform design, adaptive scalar quantization and binary encoding of wavelet coefficients. Such models assure a more extended range of optimisation capability than the complex models of a whole compression scheme based on necessarily established simplifications such a memoryless assumptions.

The important points of interests of the image compression discipline that make heavy demands are the medical applications. The key problem of lossy compression is preserving diagnostic accuracy. To find a satisfactory solution, the diagnostic accuracy definition, a measure of reconstructed image fidelity and the incorporation of diagnostic accuracy measures into the compression design process are required. A new definition of diagnostic accuracy and a procedure of subjective tests providing an estimate of the diagnostic content pattern for a set of test images is proposed. The vector measure of diagnostic accuracy is optimised on the basis of such a pattern. Wavelet compression procedures, mostly quantization, were optimised in the sense of better preserving diagnostic accuracy.

Another described concept is a hybrid system of medical image compression proposed as a useful archiving and transmission tool for hospital information systems. The system contains complex methods of lossless and lossy compression like scanning and prediction followed by statistical modelling of intermediate data representation and entropy coding. Furthermore, wavelet coders able to create flexible image representation are included. Scalable data streams for progressive transmission and effective representation for data storing, fast and effective image database preview, indexing and retrieval could be formed in the presented system.

Generally, a composition of the concepts, performance analysis, theory and experimental results given here prove the great potential and usefulness of optimised wavelet coders. The presented wider dimension of the optimisation process is related to extended and unified models for the design of a compression scheme, and the method of diagnostic accuracy estimation (in clinical tests). The synthesized opinion of radiologists could be treated as representative of application-dependent subjective (semantic) verification of the reconstructed information. The importance, topicality, and occasional appearance of limited efficiency of the current state-of-the-art techniques are determined. A suggested further direction of development is combining the approximation theory and harmonic analysis with the revised information theory (by including the semantic meaning of the interpreted information).