“Design of Efficient Algorithms for Image Compression with Application to Medical Images

Ph.D. dissertation

Alexandre Krivoulets

Abstract

This thesis covers different topics on design of image compression algorithms. The main focus in this work is development of efficient entropy coding algorithms, development of optimisation techniques for context modelling (with respect to the minimum code length) and application of the methods in the design of an algorithm for compression of medical images.

Specifically, we study entropy coding methods based on a technique of binary decomposition of source symbols. We show that the binarization allows to fit a parametric distribution mo0del to a source coding algorithm, e.g., arithmetic coding, reducing the number of coding parameters to that of the distribution model.

Context modelling is an essential part of an image coding algorithm, which basically defines its compression performance. In the thesis, we describe a unified approach to this problem based on statistics learning methods and the minimum description length principle. In particular, we present a design of optimised models using context quantization and initialisation techniques. The optimisation allows to find a model, which yields the minimum code length for some set of training data samples.

Entropy coding and context modelling methods are applied for developing a compression algorithm intended for medical images. The algorithm allows for progressive near-lossless coding and is based on lossy plus refinement layered approach. We show that this method results in a better compression performance and image quality for large distortion values compared with the recently adopted standard JPEG-LS for lossless and near-lossless image compression. We also investigate a possibility of image reconstruction with the minimum mean squared error criterion.