

# Adaptive Image Quantization Based on Learning Classifier Systems

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(Extended Abstract)

The performance of a quantizer depends primarily on the selection of a codebook. Most of the quantization techniques used in the past are based on a static codebook which stays unchanged for the entire input. As already demonstrated successfully in lossless data compression, adaptation can be very beneficial in the compression of typically changing input data. Adaptive quantization has been difficult to accomplish because of its lossy nature.

In this extended abstract, we present a model for distribution-free adaptive image quantization based on learning classifier systems which have been used successfully in machine learning. A basic learning classifier system is a special type of message-processing, rule-based system that produces output according to its input environment. Probabilistic learning mechanisms are used to dynamically direct the behavior of the system to adapt to its environment. The adaptiveness of a learning classifier system seems very appropriate for the quantization problem.

A learning classifier system based adaptive quantizer consists of the input data, a codebook, and the output. The quantizer operates similarly to a static quantizer by repeatedly taking an input item, searching for the codeword, and producing the output. The output result is then used by the learning algorithms to modify the codebook to adapt to the changing input environment. The key is the ability to identify the useful codebook entries from the not so useful ones and the use of a *discovery algorithm* to create potentially useful new codebook entries. The idea is based on the genetic algorithm in which it is assumed that if a code word is useful to the system, its parts may also be useful. By combining parts from different useful codewords, we may expect to discover new useful ones.

One of the difficulties in static quantization is when none of the codebook entries matches satisfactorily with the input. In a learning classifier system, a specifically triggered cover algorithm is used to resolve such novel situations. When an input can not be matched, a new codebook entry is constructed to match the input. Such an algorithm allows us not only to deal with the changing environment, but also to control the quality of the quantized output.

The adaptive quantizers presented can be applied to both scalar quantization and vector quantization. Experimental results for each case in image quantization are very promising.