Fast Index Assignment for balanced N-Description Scalar Quantization

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This work addresses the design of *any* number of *balanced* descriptions with multiple description scalar quantizers (MDSQ), using fast index assignment methods. Such systems proceed in two steps: scalar quantization and index assignment, that maps the quantized value to a N-tuple of quantization indices, to be sent over N channels. We address the specific balanced scenario, where all descriptions have equal rates and where any subset of k out of N descriptions induce the same distortion. We propose two simple index assignment schemes for uniform sources, that are able to generate any number $N \geq 2$ of such balanced descriptions, at any coding rate. The case of Gaussian distributions is also addressed using companding.

The proposed index assignment methods initially assume a scalar quantization that generates N uniform quantizers with step-size 2δ. On the one hand, the *step split* scheme simply divides *i*-th bin of *i*-th quantizer into two bins of size δ. On the other hand, the *merge and split* scheme merges two 2δ bins and then splits the new bin into one of size δ and another of size 3δ. In both cases, receiving all descriptions results in a uniform quantization of the source, with step size δ. Finally, the structure is periodically repeated to increase the bit rate. For the special case where N=3, we also propose an alternative scheme that only further adds bins of size 3δ to increase the coding rate, and interestingly induces a reduced redundancy compared to simple repetition of the previous structures.

The proposed scheme has the advantages of low complexity, and the possibility of being extended easily to any number of descriptions. Unlike existing schemes, it can produce balanced descriptions even at low rate, at the price however of a slightly higher side distortion. For Gaussian sources, a slight imbalance in distortion can be observed at low rate, while the coding rates stay equal for each description. The behavior of the proposed index assignment at high rate is in the same time similar to state-of-the-art schemes [1], [2].

Finally, due to its flexibility, the proposed scheme offers the possibility to adapt to loss probability, and rate constraints, in playing with both the number of descriptions, and the rate of each of them, to minimize the average distortion. Efficient coding strategies can thus be derived, without the cliff-effect penalty induced in UEP-based solutions.

For more details, and extended version of this work, please visit http://lts4www.epfl.ch.

REFERENCES

[1] C. Tian and S.S. Hemami,. "Sequential design of multiple description scalar quantizers". In *Proceedings of the Data Compression Conference, pp. 32 - 41, March 2004.*

[2] V.A. Vaishampayan,. "Design of multiple description scalar quantizers". *IEEE Trans. Inform. Theory* , Vol. 39(3):pp. 821–834, May 1993.

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