Digitising the 2:1 Shannon Mappings for Transport over Heterogeneous Networks

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We have earlier presented a joint source-channel coding (JSCC) method for 2:1 bandwidth reduction [1], a method we have called Shannon mappings. There, two samples from a Gaussian iid source of bandwidth $B$ are transmitted over an AWGN channel of bandwidth $B$, using discrete-time and continuous-amplitude channel symbols. Now we want to extend this scheme to include a digital transport network between the point of the received JSCC symbols and the ultimate destination. Since the JSCC symbols are continuous-amplitude, some form of digitising or transcoding is necessary before transmission on the digital network. Instead of decoding the JSCC symbols and subsequently applying a digital source coder, we propose using a uniform scalar quantization directly on the received channel symbols. The quantizer can be either be applied at the receiver side, maintaining the scheme from [1], or it can be applied at the transmitter with jointly optimised JSCC and quantization. In the latter case, we give a model for the total distortion and solve this numerically with Matlab’s optimisation toolbox. However, the resulting parameters are proportional to the parameters for the unquantized system [1], so this approach is no more complex than the receiver-side quantizer. Another interesting observation is that the optimisation leads to an equal amount of mapping and quantization noise. Both approaches can be entropy coded and protected with forward error-correcting codes before further transmission. We compare the performance of these two approaches with a 2D entropy-constrained vector quantizer (2D-ECVQ) applied to the decoded JSCC symbols. We see that applying the quantizer at the transmitter side and jointly optimise mapping and quantization is always better than both the 2D-ECVQ and the receiver-side quantizer. Finally, we note that with the quantizer rate equal to the channel capacity, the proposed system is only 2.8 dB away from the theoretical optimum, this without any coding at all.

References


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