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Variance reduction in Monte-Carlo via Empirical Variance Minimization

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Monte Carlo integration typically has an error variance of the form σ^2/n, where n is a sample size. We can make the variance smaller by using a larger value of n, but the cost of the corresponding estimate also grows with n. Therefore it is important to find a way to reduce σ instead of increasing the sample size n. To this end, one can try to construct a new Monte Carlo problem with the same expectation as our the original one but with a lower variance σ. We are going to discuss an approach which is based on minimization of the empirical variance over a suitable class of zero mean control functionals. We present the corresponding convergence analysis and a simulation study showing numerical efficiency of the proposed approach.