Title: Weighted Multilevel Monte Carlo

Abstract: The Multilevel Monte Carlo (MLMC) method has become an essential tool for Monte Carlo simulations in cases where it is only possible to generate approximate samples, and where reducing the bias in those samples requires increasing computational effort. The approach works by exploiting a telescoping sum of differences between samples generated at different levels of resolution.

We propose the use of weighted differences, with the weights playing a similar role to the role they play when reducing the variance using control variates. We demonstrate that this can reduce the total work significantly, particularly when the coarsest resolution level is low. We also show that similar generalisations are available for the multi-index case, where there are multiple directions available for increasing the computational effort and reducing the bias, and demonstrate their effectiveness on example problems such as high dimensional integration and SPDEs.

This is joint work with my former student, Yu Li.