The remarkable effectiveness of a new class of extrapolation techniques for accelerating monotone algorithms in statistical modeling

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Maximum likelihood estimation (MLE) plays a central role in statistical inference. Expectation maximization (EM) algorithm is a very popular computational approach for MLE. A more general approach to MLE is the minorize-maximize (MM) algorithm. The EM algorithm may be viewed as a special case of the MM algorithm. A major reason for the popularity of MM algorithms is that they are monotone, i.e. they always head uphill in terms of the likleihood function. MM algorithm is locally linearly convergent. MM algorithms are globally convergent under rather weak regularity conditions. However, in many applications the linear rate of convergence is painfully slow. We recently developed a new classes of iterative scheme called the squared iterative methods (SQUAREM), to accelerate the convergence of MM (Varadhan and Roland 2008). By viewing SQUAREM as continuations of MM, we showed that fast and globally-convergent schemes can be obtained. SQUAREM is especially attractive in high-dimensional problems, when compared to numerical accelerators such as quasi-Newton and conjugate gradient methods, due to its simplicity and minimal storage requirements. We present several examples of the remarkable effectiveness of SQUAREM for accelerating the MM algorithm in high-dimensional problems(multi-dimensional scaling, genetic admixture, PET imaging, and movie ratings). We also discuss some approaches for handling parameter constraints including projection onto feasible region and backtracking of steplength.

References

[1] R. Varadhan, C. Roland *Scandinavian Journal of Statistics*, 35 (2008), pp. 335–353.