A Newton-MR Algorithm With Complexity Guarantees for Nonconvex Optimization

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We consider variants of Newton-MR algorithm for solving unconstrained, smooth, but non-convex optimization problems. Unlike the overwhelming majority of Newton-type methods, which rely on conjugate gradient algorithm as the primary workhorse for their respective sub-problems, Newton-MR employs minimum residual (MINRES) method. Recently, it has been established that MINRES has inherent ability to detect non-positive curvature directions as soon as they arise and certain useful monotonicity properties will be satisfied before such detection. We leverage these recent results and show that our algorithms come with desirable properties including competitive first and second-order worst-case complexities. Numerical examples demonstrate the performance of our proposed algorithms.

Joint work with Yang Liu (Oxford University).