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New Algorithms to Solve Non-Linear Least Square Problems

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Non-linearity often leads to slow or unstable convergence in iterative solvers for nonlinear least-squares problems. In this work, we introduce a family of accelerated algorithms that leverage a periodically restarted variant of the Generalized Minimum Residual (GMRES) method to address these challenges. The restarting strategy keeps the computational cost under control and makes the method more reliable when dealing with nonlinear problems.

To further improve efficiency, our approach integrates sketching and subspace-projection mechanisms, enabling substantial reductions in computational cost while maintaining high solution accuracy. We derive an explicit perturbation bound that quantifies how inaccuracies in the reduced subspace influence the stability of the computed solution.

Extensive numerical experiments confirm that the resulting algorithms deliver accurate reconstructions with markedly improved computational performance compared to classical gradient-based techniques.

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