ON EFFICIENTLY COMBINING LIMITED–MEMORY AND TRUST–REGION TECHNIQUES

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Limited memory quasi-Newton methods and trust-region methods represent two efficient approaches used for solving unconstrained optimization problems. A straightforward combination of them deteriorates the efficiency of the former approach, especially in the case of large-scale problems. For this reason, the limited memory methods are usually combined with a line search. We show how to efficiently combine limited memory and trust-region techniques. One of our approaches is based on the eigenvalue decomposition of the limited memory quasi-Newton approximation of the Hessian matrix. The decomposition allows for finding a nearly-exact solution to the trust-region subproblem defined by the Euclidean norm with an insignificant computational overhead compared with the cost of computing the quasi-Newton direction in line-search limited memory methods. The other approach is based on two new eigenvalue-based norms. The advantage of the new norms is that the trust-region subproblem is separable and each of the smaller subproblems is easy to solve. We show that our eigenvalue-based limited-memory trust-region methods are globally convergent. Moreover, we propose improved versions of the existing limited-memory trust-region algorithms. We presented results of numerical experiments demonstrating the efficiency of our approach which is competitive with line-search versions of the L-BFGS method.