Center for Computational Mathematics Seminar

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On solving an unconstrained quadratic program by the method of conjugate gradients and quasi-Newton methods

Abstract:
Solving an unconstrained quadratic program means solving a linear equation where the matrix is symmetric and positive definite. This is a fundamental subproblem in nonlinear optimization. We discuss the behavior of the method of conjugate gradients and quasi-Newton methods on a quadratic problem. We show that by interpreting the method of conjugate gradients as a particular exact line search quasi-Newton method, necessary and sufficient conditions can be given for an exact line search quasi-Newton method to generate a search direction which is parallel to that of the method of conjugate gradients. The analysis gives a condition on the quasi-Newton matrix at a particular iterate, the projection is inherited from the method of conjugate gradients. We also analyze update matrices and show that there is a family of symmetric rank-one update matrices that preserve positive definiteness of the quasi-Newton matrix. This is in contrast to the classical symmetric-rank-one update where there is no freedom in choosing the matrix, and positive definiteness cannot be preserved.

Tuesday, March 7, 2017
11:00 AM
AP&M 2402