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Fakultät für Mathematik

Vortrag

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Donnerstag, 2. Oktober 2014, 14:00-15:30, SR 10,
Oskar-Morgenstern-Platz1, 1090 Wien
Titel: "Affine covariant versus affine contravariant Gauss-Newton methods"

Abstract:
Two versions of Gauss-Newton methods for the numeral solution of nonlinear least squares problems (NLSPs) are described synoptically in terms of both affine invariance structure and adaptive algorithms. To begin with, the two affine invariance classes are exemplified at Newton methods for nonlinear systems of equations.

Affine covariant Gauss-Newton methods, also called error oriented GN methods, are in common use and quite successful for NLSPs in differential equations. The are constructed on the conceptual background of a local and global Gauss-Newton path. These methods converge locally only for a class of "adequate" NLSPs wherein the so-called incompatibility factor must be less than 1 in a sufficiently large neighborhood of the solution. A convenient numerical estimation of the incompatibility factor is possible. In order to achieve some kind of global convergence, an adaptive trust region strategy has been constructed. The treatment of rank-deficient cases yields additional insight of the nature of the inverse problem at hand. An illustrative example from systems biology will be given.

Affine contravariant GN methods, also called residual based GN methods, can also be consistently derived. These methods converge locally only for ``small residual'' problems, which are algebraically equivalent to the geometrically derived convergence condition of P.-A. Wedin. A convenient numerical estimation of this small residual factor is available. As above, in order to achieve some kind of global convergence, an adaptive trust region strategy can be derived, which is, however, different from the one for the affine covariant case. Finally, a possible extension to mollifier methods for inverse Radon problems due to Louis/Maas will be sketched. Here, a contravariant approach may possibly be preferable.