Regularized solution of large scale underdetermined nonlinear least-squares problems

Federica Pes[1], Lothar Reichel[2], and Giuseppe Rodriguez[1]

[1] Department of Mathematics and Computer Science, University of Cagliari
via Ospedale 72, 09124 Cagliari, Italy
federica.pes@unica.it,rodriguez@unica.it
[2] Department of Mathematical Sciences, Kent State University
Kent, 44242, OH, USA
reichel@math.kent.edu

Abstract

We will describe a regularized Newton-type method for the computation of the minimal-norm solution to underdetermined nonlinear least-squares problems, recently proposed in [1, 2]. The iterative algorithm is obtained by adding a correction vector to the Gauss–Newton iteration, and depends on two relaxation parameters which are automatically estimated. We will discuss a modified algorithm for the solution of medium and large scale problems, which projects each linearized step in a suitable Krylov space. Numerical experiments concerning imaging science will be presented to illustrate the performance of the method.

Keywords: Nonlinear least-squares problem, Minimal-norm solution, Gauss–Newton method.

References

1. Pes, F., Rodriguez, G.: The minimal-norm Gauss–Newton method and some of its regularized variants, Electron. Trans. Numer. Anal. 53 (2020) 459–480.
2. Pes, F., Rodriguez, G.: A doubly relaxed minimal-norm Gauss–Newton method for underdetermined nonlinear least-squares problems. Appl. Numer. Math. 171 (2022) 233–248.