Approximate norm descent methods for constrained nonlinear systems of equations

Benedetta Morini [1]

[1] *Dipartimento di Ingegneria Industriale, Università degli Studi di Firenze* `benedetta.morini@unifi.it`

Solving nonlinear systems of equations is an ubiquitous task in applied mathematics and has generated considerable interest for a long time. In this talk, we focus on an important variant of this task: that of solving a nonlinear system subject to convex constraints. Most of the methods proposed in the literature require the calculation of the derivatives of the nonlinear mapping and are Newton-based. However, such methods may become computationally expensive for medium and large scale problems due to the evaluation cost of the Jacobian of the nonlinear mapping, unless this matrix has structure which can be exploited.

We propose a new framework where a Quasi-Newton step is embedded into a non-monotone line search strategy that rules the step acceptance. The main features of the scheme are the flexibility in the computation of the trial step and the derivative-free linesearch. Possible search directions comprise the nonlinear mapping at the current iterate and Quasi-Newton directions, including the Newton step as a limit case. We provide a theoretical analysis of the proposed algorithm and discuss several conditions ensuring convergence to a solution of the constrained nonlinear system. Finally, we illustrate its numerical behaviour also in comparison with existing approaches. This talk is based on results presented in [1], [2].

References

[1] B. Morini, M. Porcelli, Ph. L. Toint, *Approximate norm descent methods for constrained nonlinear systems*, Mathematics of Computation, 87 (2018) pp. 1327–1351.

[2] L. Marini, B. Morini, M. Porcelli, *Quasi-Newton methods for constrained nonlinear systems: complexity analysis and applications*, Computational Optimization and Applications, to appear.