

Spectral constraints in nonlinear programming

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The robust solution of large-scale nonlinear programming (NLP) is still a challenging task today, notably when it comes to guarantee the iterates remains feasible with relation to a set of nonlinear constraints (potentially nonconvex). It is well-known that one can guarantee feasibility by using a subtle arrangement of line-search or trust-region techniques, but feasibility may be difficult to maintain if the problem is highly nonconvex. In this work, we propose to maintain feasibility by exploiting spectral information about the Jacobian of the nonlinear constraints. Using a smooth approximation of the min operator, one can constrain the minimum eigenvalue to be greater than a given threshold. As a result, we can force the algorithm to remain feasible with some controllable margin. We reuse the results of Lewis and Sendov [1] to evaluate the first- and second-order derivatives of the spectral constraints, allowing us to cast the model as a generic nonlinear problem. We present numerical results on the popular optimal power flow problem (OPF) [2, 3], where we use the newly introduced spectral constraints to guarantee we satisfy strictly the physical constraints of the problem. We show the method is numerically tractable.

References

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