

Ongoing work on MCWAL

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Abstract

This informal document reflects the ongoing work and thinking on a algorithm for constrained nonlinear least squares. The current algorithm (rapper) name is MCWAL for Moindres Carrés With Augmented Lagrangian.

1 Introduction

We consider least squares problems subject to both nonlinear and linear constraints of the form

$$\begin{aligned} \min_{x \in \mathbb{R}^n} \quad & \frac{1}{2} \|r(x)\|^2 \\ \text{s.t.} \quad & c(x) = 0 \\ & Ax = b \\ & \ell \leq x \leq u, \end{aligned} \tag{1}$$

where $r: \mathbb{R}^n \rightarrow \mathbb{R}^d$ and $c: \mathbb{R}^n \rightarrow \mathbb{R}^t$ are assumed to be nonlinear, potentially non convex, continuously differentiable functions, $\|\cdot\|$ denotes the euclidean norm, A is a $m \times n$ ($m \leq n$), $b \in \mathbb{R}^m$ and ℓ and u are vectors in \mathbb{R}^n . For the latter and without loss of generality, components can be set to $\pm\infty$ for unbounded parameters. In the context of least squares problems, components r_i of the function r are often denoted as the residuals.

We will also refer to the linear constraints using the set notation

$$X = \{x \in \mathbb{R}^n \mid Ax = b, \ell \leq x \leq u\}. \tag{2}$$

References

- [1] P. Borie, A. Marcotte, F. Bastin, and S. Dellacherie. Enlsip.jl: A Julia optimization package to solve constrained nonlinear least-squares problems. *Journal of Open Source Software*, 9 (97):6226, 2024. doi: 10.21105/joss.06226.