

The aim of this work is to analyse some acceleration techniques for first-order methods for nonlinear constrained optimization and discuss their performances in the context of biomedical imaging problems.

The proposed strategies exploit recent ideas based on suitable choices of the step length parameters and on the introduction of a variable metric induced by scaling matrices in the definition of the gradient projection step; such strategies efficiently contribute in speeding up the convergence rate of the methods without adding significant computational costs.

Thanks to their light computational burden with a limited storage requirement, first-order methods represent an effective tool for solving large-scale optimization problems. This feature appears promising for the employment of such methods into problems that have to be solved in a short time without strict requirements on the accuracy demand.

The experimental framework for the evaluation of the proposed acceleration strategies consists in two problems arising in biomedical domain applications. The first one concerns the fibre orientation distribution recovery in the white matter of the brain from diffusion Magnetic Resonance Imaging data and it exploits recent innovative approaches for sparse minimization problems. The second collection of experiments is conducted on a 3D image reconstruction problem in X-rays Computed Tomography from a limited number of acquisition data, taking advantage of sparsity feature of the sought solution.

Extensive numerical experience in presence of different types of noise and data shows the efficiency of the acceleration processes specifically designed for the gradient projection schemes.