Internship offer: Anderson acceleration for sparse matrix factorization problems

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Contact: Mathurin Massias (mathurin.massias@gmail.com), Rémi Gribonval

Location: INRIA, ENS de Lyon, 46 allée d'Italie 69007 Lyon

In many machine learning and signal processing applications, decomposing a matrix into a product of sparse matrices allows to use it with reduced memory and computation requirements. In Le Magoarou and Gribonval [2016], FAUST, a multi-layer approach to sparse factorization was proposed, with successful applications in high dimensional problems such as dictionary learning for image[1]. FAUST relies on a non convex optimization problem, solved with a proximal alternated minimization algorithm procedure [Bolte et al., 2014]. Speeding up this algorithm would allow for applications to even larger problems and increase the practical impact of FAUST.

In Bertrand and Massias [2021], it was proposed to use Anderson acceleration to improve the convergence speed of coordinate descent for sparse convex problems. Like inertial acceleration, Anderson acceleration results in theoretical accelerated rates, but it also yields spectacular performance improvements[2], making it a state-of-the-art solver for a variety of machine learning problems.

The goal of the internship is to apply Anderson acceleration (AA) to the optimization procedure used in FAUST. The intern will establish the theoretical conditions for applications of AA (such as support identification Klopfenstein et al. [2020]) and provide a convergence analysis. Improvements over more refined algorithms for FAUST [Le et al., 2021] are also in the range of possible developments. This theoretical analysis will be supported by an efficient numerical implement of the proposed algorithm in Python, together with a rigorous benchmark to assess the numerical gains.

[1] https://faust.inria.fr/
[2] https://mathurinm.github.io/andersoncd

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