LASSO with Inertial Projective Splitting

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1 Overview

This repository contains a Python implementation and comparative analysis of two optimization algorithms:

- Inertial Projective Splitting (IR-PS)
- Projective Splitting (PS)

for solving the LASSO problem using real-world data.

We solve the LASSO optimization problem:

$$\min_x \ \frac{1}{2}\|Ax - b\|^2 + \nu\|x\|_1,$$

which promotes sparsity in the solution and is frequently used in signal processing and machine learning.

The methods implemented are based on the paper

- M. Machado, "An inertial projective splitting method for the sum of two maximal monotone operators", Computational and Applied Mathematics (2025).

We compare the IR-PS and PS across various values of the parameter α, measuring execution time, number of iterations, and convergence behavior.

2 Structure

The package contains 3 functions:

- BreastCancer_lassoPS.py
- InertialProjSpl_LASSO.py

- exact_solution.py

We use the ‘wdbc.data‘ file (Breast Cancer Wisconsin Diagnostic) with 30 features, from https://archive.ics.uci.edu/datasets

Install the required Python packages with:

pip install -r requirements.txt

Run the main script to evaluate performance over a range of random α values:

python BreastCancer_lassoPS.py

3 The script

- Loads and normalizes the Breast Cancer dataset
- Runs IR-PS and PS for 10 random values of $\alpha \in [-1, 1]$
- Stores a full table of performance metrics in performance.csv
- Displays bar charts of execution time and number of iterations

The script generates:

- A table with convergence behavior data ($F(z_k)$, relative error, residuals)
- Bar charts comparing time and iterations across α