square_root_PMM: a MATLAB software for solving square-root regression problems

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The software was first released on XX 01 2021. The software is designed to solve the following square-root regression problems

$$\min_{\beta \in \mathcal{R}^n} \Big\{ g(\beta) := \|X\beta - b\| + \lambda p(\beta) - q(\beta) \Big\}, \tag{1}$$

where the first part of the regularization function $p : \mathcal{R}^n \to \mathcal{R}_+$ is a norm function whose proximal mapping is strongly semismooth and the second part $q : \mathcal{R}^n \to \mathcal{R}$ is a convex smooth function (the dependence of q on λ has been dropped here). For more details, one may see [1].

• **square_root_PMM.zip**

Please read. Welcome to square_root_PMM!

∘ Firstly, unpack the software:
unzip square_root_PMM.zip

∘ Run Matlab in the directory square_root_PMM

∘ In the Matlab command window, type:
>> startup

∘ After that, to see whether you have installed square_root_PMM correctly, set the current folder with the directory square_root_PMM\runexpt and type:
>> square_root_demo

∘ By now, square_root_PMM is ready for you to use.

• The following example shows how to call the main function to solve problems
>> [obj,beta,runhist_I,runhist_II] = square_root_PMM (X, b, m, n,lambda,OPTIONS,regular-type);

One may input the data according to specific real problems.

Input arguments.

- X, b: the design matrix and the response vector.

- m, n: the sample size and the number of attributes.

- OPTIONS: a structure array of parameters.
- lambda: the regularization parameter.
- regular-type: a string represents the type of regularizer, such as ‘l1’, ‘scad’, ‘mcp’.

Output arguments. The argument beta is a solution to (1) and obj is the corresponding objective value. The arguments runhist_I and runhist_II are structure arrays which record various performance measures of the solver for Step 1 and Step 2, respectively.

References

[1] Peipei Tang, Chengjing Wang, Defeng Sun, and Kim-Chuan Toh, *A Sparse Semismooth Newton Based Proximal Majorization-Minimization Algorithm for Nonconvex Square-Root-Loss Regression Problems*, Journal of Machine Learning Research 21(226):1–38, 2020.