

# Accepted Manuscript

The Complexity of Primal-Dual Fixed Point Methods for Ridge Regression

Ademir Alves Ribeiro, Peter Richtárik

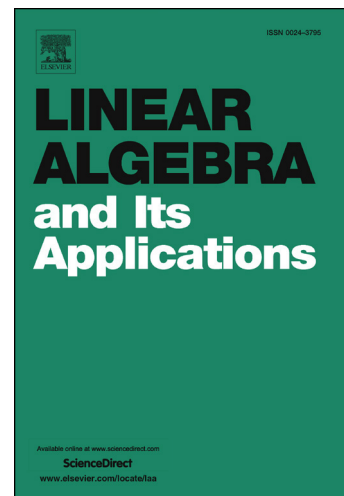
PII: S0024-3795(18)30343-4  
DOI: <https://doi.org/10.1016/j.laa.2018.07.017>  
Reference: LAA 14659

To appear in: *Linear Algebra and its Applications*

Received date: 31 August 2017  
Accepted date: 13 July 2018

Please cite this article in press as: A.A. Ribeiro, P. Richtárik, The Complexity of Primal-Dual Fixed Point Methods for Ridge Regression, *Linear Algebra Appl.* (2018), <https://doi.org/10.1016/j.laa.2018.07.017>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



# The Complexity of Primal-Dual Fixed Point Methods for Ridge Regression<sup>☆</sup>

Ademir Alves Ribeiro<sup>a,1,\*</sup>, Peter Richtárik<sup>b,2</sup>

<sup>a</sup>*Department of Mathematics, Federal University of Paraná, CP 19081, 81531-980,  
Curitiba, PR, Brazil*

<sup>b</sup>*School of Mathematics, University of Edinburgh, United Kingdom*

---

## Abstract

We study the ridge regression ( $L_2$  regularized least squares) problem and its dual, which is also a ridge regression problem. We observe that the optimality conditions describing the primal and dual optimal solutions can be formulated in several different but equivalent ways. The optimality conditions we identify form a linear system involving a structured matrix depending on a single relaxation parameter which we introduce for regularization purposes. This leads to the idea of studying and comparing, in theory and practice, the performance of the fixed point method applied to these reformulations. We compute the optimal relaxation parameters and uncover interesting connections between the complexity bounds of the variants of the fixed point scheme we consider. These connections follow from a close link between the spectral properties of the associated matrices. For instance, some reformulations involve purely imaginary eigenvalues; some involve real eigenvalues and others have all eigenvalues on the complex circle. We show that the deterministic Quartz method—which is a special case of the randomized dual coordinate ascent method with arbitrary sampling recently developed by Qu, Richtárik and Zhang—can be cast in our framework, and achieves the best rate in theory and in numerical experiments among the fixed point methods we study. Remarkably, the method achieves an accelerated convergence rate. Numerical experiments indicate that our main algorithm is competitive with the conjugate gradient method.

*Keywords:* Unconstrained minimization, primal-dual methods, ridge regression, fixed-point methods.

*2000 MSC:* 65K05, 49M37, 90C30

---

<sup>☆</sup>The results of this paper were obtained between October 2014 and March 2015, during AR's affiliation with the University of Edinburgh.

\*Corresponding Author

*Email addresses:* [ademir.ribeiro@ufpr.br](mailto:ademir.ribeiro@ufpr.br) (Ademir Alves Ribeiro),  
[peter.richtarik@ed.ac.uk](mailto:peter.richtarik@ed.ac.uk) (Peter Richtárik)

<sup>1</sup>Supported by CNPq, Brazil, Grants 201085/2014-3 and 309437/2016-4.

<sup>2</sup>Supported by the EPSRC Grant EP/K02325X/1, “Accelerated Coordinate Descent Methods for Big Data Optimization”.

Download English Version:

<https://daneshyari.com/en/article/8897698>

Download Persian Version:

<https://daneshyari.com/article/8897698>

[Daneshyari.com](https://daneshyari.com)