Master's Thesis

An explicit exchange method for primal-dual sparse optimization

Guidance

Professor Nobuo Yamashita

Yuji Tokuda

Department of Applied Mathematics and Physics

Graduate School of Informatics

Kyoto University

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Abstract

Recently we need to analyze big data with huge features in many areas such as image processing and speed processing. One of the purposes of big data analysis is to model a function representing the real world with less data samples and less features. We call such functions sparse models. Sparse optimization is an optimization model whose solution becomes a sparse model. One of the well-known sparse optimizations is the $\ell 1$-regularized optimize problem, which enables us to obtain a function of less features. On the other hand, the support vector machine (SVM) can provide a classification function with less data. Note that less data means that a solution of the dual SVM is sparse. These optimization problems can be solved efficiently by exploiting the sparsity of feature or datum. However, it is difficult to solve sparse optimization problems when the numbers of both data and features are quite huge.

In this paper, we first propose a generalized primal-dual sparse optimization model, which can construct a desired sparse model with both primal and dual sparsity, that is, with less features and data. Then, we propose a new method for solving the model, which exploits both primal and dual sparsity. The proposed method is based on the explicit exchange method. The subproblems solved in each iteration of the explicit exchange method consist of less data. Thus, we can exploit the dual sparsity. We then apply the dual augmented Lagrangian method to solve the subproblem since the method can exploit the primal sparsity. We show its global convergence under suitable assumptions. Finally, we conduct some numerical experiments. The numerical results show that the proposed method solves the primal-dual optimization model effectively.