Deng KangKang - CV

CONTACT INFORMATION
School of Mathematics and Computer Science
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RESEARCH INTERESTS
Canonical correlation analysis
Nonsmoth problems on manifold; Riemannian optimization
Sparse representation classification
probabilistic Boolean network

EDUCATION
Fuzhou University, Fuzhou, Fujian, China
Doctor of Philosophy (Ph. d program in advance) **September 2015 -- present**

- Expected graduation date: June 2020
- Advisor: Professor Peng Zheng

Fujian Normal University, Fuzhou, Fujian, China
Bachelor's degree **September 2011 -- June 2015**

PROJECTS
稀疏典型相关分析的快速算法及其在基因表达数据分析中的应用 (国家自然科学基金项目 -11571074)

超大规模约束优化问题算法及其应用天元数学交流项目 (国家自然科学基金项目 -11726505)

高维数据驱动稀疏低秩优化问题有效算法的研究及其应用 (国家自然科学基金项目 - 11871153)

REFEREED PUBLICATIONS
Deng, K., Peng, Z., & Chen, J. (2019). Sparse probabilistic Boolean network problems: A partial proximal-type operator splitting method. Journal of Industrial & Management Optimization, 15(4), 1881-1896.

Jiang, B., Peng, Z., & **Deng, K.** (2019). Two New Customized Proximal Point Algorithms Without Relaxation for Linearly Constrained Convex Optimization. Bulletin of the Iranian Mathematical Society, 1-28.

Deng, K., & Peng, Z. (2019). An Inexact Augmented Lagrangian Method for Nonsmooth Optimization on Riemannian Manifold. arXiv preprint arXiv:1911.09900.

Peng, Z, & **Deng, K.**. (2020+). An Riemannian Homotopy Smoothing Method for Nonsmooth Composite Problems on Manifold. **Manuscript.**

Peng, Z, & **Deng, K.**. (2020+). Adaptive Sparse Canonical Correlation Analysis with Trace Lasso Regularization. **Manuscript.**

Deng, K., Peng, Z., & Zhu, W. (2019). A Novel Discriminative Projection and Representation-based Classification Framework for Face Recognition. **Submitted to** SIAM Journal on Imaging Sciences.

Peng, Z., & **Deng, K.** (2019). A Semi-supervised Progressive Sparse Representation-based Classification for Face Recognition with Insufficient Samples. **Submitted to** IEEE Signal Processing Letters.

PROGRAMMING
Python, Matlab.

HOBBIES
I love the outdoors and playing sport.

Summary of Past Research

My main research achievements to date have been associated with gaining a broader understanding into the manifold constraint optimization problems. As an generalization from Euclidean space to Riemannian manifold, the Riemannian optimization method has been widely used to solve the manifold constraint problems. Regardless of the applications, the Riemannian optimization focus on solving smooth problems on manifold. My primary research to date has focused on nonsmooth problems with manifold constraint.

To handle general composite problem on manifold, in which the objective function is the sum of a differentiable component and a nonsmooth convex function, we proposed a manifold inexact augmented Lagrangian method (MIALM). For this purpose, the problem under considered is first reformulated to a separable form. Then, we get a smoothing iteration subproblem on Riemannian manifold by utilizing the Moreau envelope. Theoretically, under suitable assumptions, the convergence to critical point of the proposed method is established.

In addition, to improve the convergence rate of gradient-based methods for nonsmooth problem on manifold, we proposed a Riemannian homotopy smoothing (RHOPS) framework. Our approach relies on a novel combination of smoothing and homotopy techniques applied to nonsmooth problem on Riemannian manifolds. The RHOPS framework gradually decreases the smoothing parameter during the iteration until it yields a sufficiently good approximation of the original function. Then, we give the convergence rate results of our framework under some mild assumptions.

As a application of nonsmooth problem, we consider the sparse canonical correlation analysis (SCCA) model. First we give the definition of trace Lasso in matrix case, which is generalization of trace Lasso in vector case, and proposed a novel adaptive SCCA model by incorporating trace Lasso regularization into sparse CCA model. To solve the nonsmooth and nonconvex model, we proposed an inexact augmented Lagrangian framework. Note that our framework can be used to solve general composite problem on manifold: $\min_{x\in\mathcal{M}_1, y\in\mathcal{M}_2} \{f(x,y)+g(x)+h(y)\}$. In addition, we proved the convergence of the sequence generated by our method to a critical point.

Future Research Plan

In the future, we will start further research mainly from the following aspects.

Riemannian stochastic methods:
The Riemannian stochastic methods, which are used to solve the smooth finite sum problem in Riemannian manifold, have been widely studied. However, it is unknown that traditional stochastic methods in Euclidean space generalized to Riemannian manifold when the objective function contains nonsmooth component. Consider the nonsmooth composite problems in form of finite sum: $\min_{x\in\mathcal{M}}\{\sum_{i=1}^{n} f_i(x)+g(x)\}$. I plan on extend our previous methods MIALM and HOPS to solve such problems.

Second-order Riemannian optimization method for nonsmooth problem:
In recent year, semi-smooth Newton methods are utilized to solve sparse optimization problem in Euclidean space. Another goal in my first year would be to extend such methods to Riemannian manifold. Such generalization will provide a novel perspective for solving sparse problem on manifolds, in which sparsity will be contribute to accelerate computations.

Other Interests:
I also interested in sparse optimization problem in Euclidean space. In particular, I would focus

on using second-order method to solve high dimensional sparse optimization problem:$\min_x\{f(x)+h(x)\}$. Previous searches have focused on second-order method, such as semismooth Newton augmented Lagrangian method. Our target is further relax its condition for object function. We expect the strongly convex condition on smooth term f can be removed.