The Hong Kong University of Science and Technology

Department of Mathematics

PhD THESIS EXAMINATION

Second-Order Algorithms for Sparse Signal Recovery from Intensity-Only Measurements

By

Ms. Ruixue WEN

ABSTRACT

We study the sparse phase retrieval problem, which reconstructs the sparse signal from its intensity-only measurements. Existing algorithms for sparse phase retrieval problem are mostly gradient-type methods and enjoy linear convergence property with high probability provided $m \geq \mathcal{O}(s^2 \log n)$, where n and s are the dimension and the sparsity level of the target signal. In this thesis, we develop two second-order algorithms for sparse phase retrieval problem. When the sparsity level is given as a prior knowledge, the Newton Hard Thresholding Pursuit (NHTP) algorithm is proposed and theoretical analysis suggests NHTP merits a quadratic convergence after at most $\mathcal{O}(\log(\|\boldsymbol{x}^{\#}\|/x^{\#}_{min}))$ iterations with high probability provided $m \geq \mathcal{O}(s^2 \log n)$. Numerical simulations also comfirm its efficiency in terms of the sample complexity and running time. The second work considers the case when the sparsity level is unknown and an l^0-regularized objective function is employed. The primal dual active set method with continuation (PDASC) algorithm is developed for the optimization problem. The update rule for PDASC can be interpreted as a Newton's method. A novel initialization method without knowing the sparsity level is also presented. Numerical experiments on synthetic data and natural images illustrate its efficiency in terms of sample complexity and accuracy compared with other state-of-the-art approaches.

Date : **10 August 2022, Wednesday**

Time : **09:00 a.m.**

Venue : **Online via ZOOM**
ID: 976 3149 0179 **(Passcode: hkust)**
https://hkust.zoom.us/j/97631490179

***Thesis Examination Committee*:**

Chairman	**:**	**Prof. Richard Hau Yue SO, IEDA/HKUST**
Thesis Supervisor	**:**	**Prof. Jianfeng CAI, MATH/HKUST**
Member	**:**	**Prof. Can YANG, MATH/HKUST**
Member	**:**	**Prof. Dong XIA, MATH/HKUST**
Member	**:**	**Prof. Ding PAN, PHYS /HKUST**
External Examiner	**:**	**Prof. Tieyong ZENG, Department of Mathematics/The Chinese University of Hong Kong**

(Open to all faculty and students)

The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).