

Low-rank Optimization Through the Lens of Geometry



Invited Speaker

Bin Gao

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Biography

Bin Gao is an associate professor at the Academy of Mathematics and Systems Science, Chinese Academy of Sciences. He received the Bachelor degree (2014) in mathematics at Sichuan University and the PhD (2019) in applied mathematics at the University of Chinese Academy of Sciences. From 2019 to 2022, he was a post-doctoral fellow at UCLouvain (2019-2021) and University of Münster (2021-2022). His research interests include numerical methods for optimization on manifolds and their applications. He is also interested in tensor computation, machine learning, and parallel/distributed optimization stemming from various research and engineering areas.

Abstract

Imposing additional constraints on low-rank optimization has garnered growing interest recently. However, the geometry of coupled constraints restricts the well-developed low-rank structure and makes the problem nonsmooth. In this paper, we propose a space-decoupling framework for optimization problems on bounded-rank matrices with orthogonally invariant constraints. The "space-decoupling" is reflected in several ways. Firstly, we show that the tangent cone of coupled constraints is the intersection of the tangent cones of each constraint. Secondly, we decouple the intertwined bounded-rank and orthogonally invariant constraints into two spaces, resulting in optimization on a smooth manifold. Thirdly, we claim that implementing Riemannian algorithms is painless as long as the geometry of additional constraint is known a priori. In the end, we unveil the equivalence between the original problem and the reformulated problem. The numerical experiments validate the effectiveness and efficiency of the proposed framework.