Robust Principal Component Pursuit via Alternating Minimization on Matrix Manifolds

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Robust principal component pursuit (RPCP) refers to a decomposition of a data matrix into a low-rank component and a sparse component. In this work, instead of invoking a convex-relaxation model based on the nuclear norm and the ℓ^1-norm as is typically done in this context, RPCP is solved by considering a least-squares problem subject to explicit rank and cardinality constraints. An alternating minimization scheme is employed to solve the resulting constrained minimization problem. In particular, the low-rank matrix subproblem is resolved by a tailored Riemannian optimization technique, which favorably avoids singular value decompositions in full dimension. For the overall method, a corresponding q-linear convergence theory is established. In the numerical experiments, we demonstrate efficiency of the newly proposed approach in comparison with the convex-relaxation based augmented Lagrangian method, and some recent applications in dynamic MRI as well.