ABSTRACT

Work in the last decade on matrix completion has shown it is possible to leverage linear structure to interpolate missing values in a low-rank matrix. However, the assumption that the data is low-rank is not always met in practice, and it is of great interest to extend matrix completion theory and algorithms to other low-complexity nonlinear structures. In this talk I will describe the problem of completing a matrix whose columns belong to an algebraic variety, i.e., the set of solutions to a system of polynomial equations. In this case the original matrix is possibly high-rank, but it becomes low-rank after mapping each column to a higher dimensional space of monomial features. Many well-studied extensions of linear models, including affine subspaces and their union, plus a rich class of nonlinear quadratic and higher degree curves and surfaces, are captured in a variety model. I will describe an efficient matrix completion algorithm that minimizes a convex or non-convex surrogate of the rank of the matrix of monomial features. Our algorithm uses the well-known “kernel trick” to avoid working directly with the high-dimensional monomial matrix. The proposed algorithm is able to recover synthetically generated data up to predicted sampling complexity bounds and outperforms standard low-rank matrix completion and subspace clustering techniques in experiments with real motion capture data. This is joint work with Greg Ongie, Robert Nowak, and Laura Balzano.

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